Nederlandse Astronomen Conferentie 2023

Report of Contributions

https://indico.astron.nl/e/309

Contribution ID: **8** Type: **Poster**

Construction of the Extremely Large Telescope and its instrument suite

Wednesday, 17 May 2023 13:15 (1 minute)

This presentation shows the status of the construction of the Extremely Large Telescope. It addresses both the infrastructure (telescope and building), as well as the instrument suite.

Images and graphics show the assembly status of the Dome and Main Structure on site in Chile, and the development of the mirrors and optomechanical control systems. Key figures are presented. Contracts involving companies and institutes in The Netherlands are highlighted.

The development of the instrument suite is addressed. Several instruments have made the transition from design to manufacturing: HARMONI, MICADO, METIS. Other instruments just started Phase B: concept development / preliminary design: ANDES, MOSAIC. Key capabilities and performances are highlighted.

Primary author: NAVARRO, Ramon (NOVA)

Presenter: NAVARRO, Ramon (NOVA)

Session Classification: Poster Prizes & closing

Contribution ID: **9** Type: **Contributed talk**

Mining archival data from wide-field astronomical surveys in search of hazardous near-Earth objects

Wednesday, 17 May 2023 12:45 (15 minutes)

The serendipitous appearances of Near-Earth Objects (NEOs) in a subset of the millions of archival exposures of optical and near-infrared astronomical imaging surveys can improve our knowledge of the orbits and compositions of NEOs. We show how the data processing and data mining of such imaging archives can be exploited to identify new and known NEOs, leading to a re-assessment of the impact probability of hazardous NEOs for the latter. We describe our automatic pipelines that precovers NEO appearances making use of the Astronomical Wide-field Imaging System for Europe (AstroWise). AstroWise is an information system that contains a 10 Terabyte-scale database for data mining that is connected to a Petabyte scale imaging storage archive from various telescopes. As a pilot study, we performed a systematic search for the ESA risk-list NEOs appearances in a decade of archival observations of the OmegaCAM optical wide-field imager at ESO's VLT Survey Telescope. The observatory has been used for several multi-year large surveys (including the Kilo-degree Survey, VST-ATLAS, Fornax Deep Survey and VPHAS+) plus many smaller programs. None of these surveys and programs is dedicated to the detection and surveillance of NEOs. Our current NEO precovery pipeline detects 196 NEO appearances. The NEO precovery can be expanded to other archives of wide-field imaging instruments/surveys thanks to the homogenized metadata interface offered by AstroWise to such archives.

Primary author: SAIFOLLAHI, Teymoor (Kapteyn Astronomical Institute)

Presenter: SAIFOLLAHI, Teymoor (Kapteyn Astronomical Institute)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **10** Type: **Poster**

Observation of warm-hot intergalactic medium in OVII and OVIII absorption against diffuse extended sources with Athena and LEM

Wednesday, 17 May 2023 13:15 (1 minute)

The physical properties of the faint and extremely tenuous plasma in the filaments of the cosmic web remain one of the biggest unknowns in our story of large-scale structure evolution. The most common techniques how to observe this medium are either in emission, or in absorption against very bright, point-like sources. In this talk I focus on the warm-hot intergalactic medium and present yet another technique, which can be explored for now only in theory and with simulations, but it might serve as a complementary tool to explore the properties of the cosmic web with upcoming future X-ray missions. I will present how the cosmic web filaments, simulated with the cosmological hydrodynamical simulations Hydrangea, look like in OVII and OVIII absorption against diffuse extended sources, in particular relaxed, nearby, massive cool core galaxy clusters. I simulate the observations with Athena X-IFU and LEM, while taking into account the absorption from our Galaxy, and report on the significance of the detection of WHIM in OVII and OVIII. I discuss the lower limit on the column densities that can still be observed with these instruments and provide a guide of where to look for WHIM on the sky.

Primary author: STOFANOVA, Lydia (Leiden Observatory, SRON)

Presenter: STOFANOVA, Lydia (Leiden Observatory, SRON)

Session Classification: Poster Prizes & closing

Contribution ID: **11** Type: **Poster**

XRISM: the new X-ray observatory with unprecedented resolution

Wednesday, 17 May 2023 13:15 (1 minute)

A new era of high-resolution X-ray spectroscopy is upcoming. This spring, the JAXA/NASA (with SRON/UniGe/ESA participation) XRISM mission will be launched.
As already revealed by the short-lived Hitomi mission, the new vision on an energy band never explored before at high resolution, will bring transformational results.
In particular, the X-ray calorimeter, Resolve, will bring new insight on accretion and ejection in supermassive black holes, cluster of galaxy gas dynamics and supernova remnant ejecta, not to mention the many other possible science cases on stars, the interstellar medium, galaxies… In this talk, I will illustrate the capabilities of XRISM and the opportunity it will bring to the whole scientific community.

Primary author: COSTANTINI, Elisa (SRON Netherlands Institute for Space Research)

Presenter: COSTANTINI, Elisa (SRON Netherlands Institute for Space Research)

Session Classification: Poster Prizes & closing

Contribution ID: **12** Type: **Contributed talk**

WEAVE: First light and current status

Tuesday, 16 May 2023 14:00 (15 minutes)

WEAVE is the next-generation wide-field survey facility for the William Herschel Telescope (WHT). WEAVE will provide the instrument required for full scientific exploitation of the Gaia, LOFAR, and APERTIF surveys in the Northern Hemisphere. WEAVE is a multi-object and multi-integral-field-unit (IFU) facility utilizing a large, new 2-degree-diameter prime focus corrector at the WHT with a pick-and-place fibre positioner system hosting nearly 1000 multi-object fibres or 20 mini-IFUs for each observation, or a single wide-field IFU. The fibres are fed into a dual-beam spectrograph located in the GHRIL enclosure on the WHT's Nasmyth platform. The spectrograph records nearly 1000 spectra simultaneously at a resolution of R~5000 over an instantaneous wavelength range of 366-959 nm or at a resolution of R~20000 over two more-limited wavelength ranges. WEAVE has been on sky since late 2022. The WEAVE Survey will provide complete phase-space coordinates of roughly 3 million stars in the northern sky selected with ESO's Gaia satellite, chemical analysis of more than 1 million stars from Gaia, half a million massive stars in the Galactic Plane, distances and properties of galaxies selected from the low-frequency radio-wave surveys being conducted with LOFAR, "three-dimensional" spectroscopy of galaxies selected from surveys using the new Apertif focal plane array at WSRT, and deep surveys of galaxy clusters and moderate-redshift galaxies. In this talk I will discuss the design, construction, and (on-going) commissioning of WEAVE and the impressive "first-light"data we've already collected with it.

Primary author: TRAGER, Scott (Kapteyn Astronomical Institute, University of Groningen)

Presenter: TRAGER, Scott (Kapteyn Astronomical Institute, University of Groningen)

Session Classification: Plenary Session

Track Classification: Instrumentation

Contribution ID: **14** Type: **Contributed talk**

The early dynamical evolution of massive clusters and the production of runaway O stars

Monday, 15 May 2023 16:45 (15 minutes)

Young massive clusters provide an ideal place to study the outcome of the star-formation process and the early dynamics of star clusters. With Gaia (E)DR3, we have studied the young massive clusters NGC 6611 in the Eagle Nebula (M16) and NGC 6618 in the Omega Nebula (M17). We determine membership and age of the cluster and search for stars that may have originated in the cluster. For NGC 6611, we identify two stellar populations: the younger population has an age = 1.3 ± 0.2 Myr, while the older population has an age = 7.5 ± 0.4 Myr and is more spatially extended than the younger population. NGC 6618 is heavily extincted (A_V ~ 5 to 15 mag) and is likely younger than 1 Myr.

We find that both NGC 6611 and NGC 6618 have ejected a significant fraction (~ 33%) of their original O star members within the first Myr through dynamical interactions. These O runaways can be traced back to the centre of their parent cluster, with kinematic ages consistent with the isochrone age of the cluster. This provides evidence that the kinematic ages of dynamically ejected runaways can be used as an indicator for the age of a cluster.

These results indicate that dynamical interactions play an important role in the early evolution of young massive clusters. On their way, the stellar winds, ionising radiation and supernovae of these O-type runaways will have a strong impact on the ambient medium, affecting the evolution of our Milky Way.

Primary author: STOOP, Mitchel (Anton Pannekoek Institute)

Co-authors: KAPER, Lex (Anton Pannekoek Institute); DE KOTER, Alex (Anton Pannekoek Institute); DERKINK, Annelotte (Anton Pannekoek Institute); GUO, Difeng (Anton Pannekoek Insitute); ROGERS, Ciaran (Leiden Observatory); RIEDER, Steven (Geneva Observatory, University of Geneva); LAMERS, Henny (Anton Pannekoek Institute)

Presenter: STOOP, Mitchel (Anton Pannekoek Institute)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **17** Type: **Poster**

Understanding accretion onto neutron stars with near-infrared and X-ray observations

Wednesday, 17 May 2023 13:01 (1 minute)

X-ray binaries, which are neutron stars or black holes accreting gas from a companion star, emit radiation across the electromagnetic spectrum. Whereas it is well established where their X-ray and radio emission originates, it is much less clear where their infrared emission comes from: is it coming from the cooler outer part of the disk, the companion star, a jet, or a hot flow? During my thesis, l analyzed near-infrared images obtained for many different neutron star low-mass X-ray binaries with the 6.5-m Magellan telescope located in Las Campanas Observatory in Chile to measure the near-infrared flux. By comparing the obtained near-infrared luminosities with earlier obtained X-ray luminosities, I investigate what the dominant near-infrared emission processes are and whether this changes depending on how fast the neutron star is accreting. Since different emission processes predict different correlations between the X-ray and near-infrared bands, such studies can contribute to our understanding of the dominating emission processes. I compare my results for this large sample of neutron stars with the X-ray and near-infrared properties of accreting black holes to see what the differences and similarities are. This will be an important contribution to our general understanding of accretion onto neutron stars and black holes and the outflows they produce.

Primary author: REITSMA, Iris (API)

Presenter: REITSMA, Iris (API)

Session Classification: Poster Prizes & closing

Contribution ID: **18** Type: **Contributed talk**

Discovery and Investigation into the Type-2 High-redshift QSO Population

Wednesday, 17 May 2023 11:30 (15 minutes)

Understanding how supermassive black holes and their host galaxies co-evolve in the universe is an unsolved problem. In a classical "unified"model for active galactic nuclei (AGN), observers can detect unobscured (Type-1) AGNs,with broad emission lines and continuum, or obscured (Type-2) AGNs, with only narrow emission lines. Type-2 AGNs have been readily identified at low redshift (z<1). However, only handfuls of bonafide Type-2 QSOs are known at redshifts z~2 with bolometric luminosities that are comparable to the typical luminosity of Type-1 QSOs. The lack of luminous Type-2 QSOs at high redshift constitutes an unsolved problem. We select high-redshift Type-2 candidates using the optical survey (SDSS, Legacy Survey) and mid-infrared survey (WISE) . The basic selection is requiring the targets bright and well-detected in WISE but non-detection in optical. We selected more than 300 new Type-2 candidates and conducted the spectroscopic confirmation. We have got GEMINI/GNIRS spectra for 24 candidates and Keck/LRIS spectra for 35 candidates. We have identified 19 new z > 2 Type-2 AGNs. Many quasars are confirmed through Lya-nebula and sometimes this is the only convincing feature we see. The photometry evolution with redshift and the SED fitting of these objects help us better understand the property of high-z Type-2 AGN. We also quantify the radio properties of these quasars by matching them to LOFAR, FIRST, and NVSS and are exploring how radio measurements might inform future selection algorithms. This project will guide us on how to find high-z Type-2 ANG and understand the obscured fraction at high-z.

Primary authors: WANG, Ben (Leiden University); Prof. HENNAWI, Joseph (Leiden University)

Presenter: WANG, Ben (Leiden University)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **19** Type: **Contributed talk**

JWST/MIRI Catches Many Obscured AGNs at High Redshifts

Tuesday, 16 May 2023 15:45 (15 minutes)

Mid-infrared observations are potentially powerful in identifying heavily obscured AGNs which have weak emission in other wavelengths. MIRI onboard JWST offers an excellent chance to perform such studies. We take advantage of the MIRI imaging data from the CEERS survey to investigate the AGN population in the distant universe. We estimate the source properties of MIRI-selected objects utilizing spectral energy distribution (SED) modelling, and classify them into star-forming galaxy (SF), SF-AGN mixed object, and AGN. We derive the median SEDs for all three source types, respectively, and publicly release them. The median AGN SED is similar to the typical SEDs of Hot DOGs and Seyfert 2s, indicating that they are intrinsically the same type of objects, i.e., actively accreting but obscured supermassive black holes (BHs). Based on our SED-fit results, we estimate the BH accretion density (BHAD; i.e., total BH growth rate per comoving volume) as a function of redshift. The resulting BHAD agrees with the X-ray measurements at z < ~3, but becomes significantly higher than them toward higher redshift (~0.5-1 dex at z=4-5). This difference indicates MIRI is able to identify many heavily obscured AGNs in the early universe.

Primary author: YANG, Guang (Kapteyn Astronomical Institute)

Presenter: YANG, Guang (Kapteyn Astronomical Institute)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **20** Type: **Poster**

The evolutionary pathways of massive hierarchical triple stars

Massive stars are the progenitors to a vast variety of observed highly energetic transients. Many of these transients are presumably the product of interaction between two or more stellar companions. Until recently, theoretical work has mainly focused on understanding the evolution of single- and binary stars. However, recent observations show that triple (and higher order multiple) star systems are common in the local population of massive stars. Including a third companion adds complexity to the stellar system via three-body dynamical interactions, such as the Von Zeipel-Lidov-Kozai (usually referred to as ZLK or KL) effect. These interactions could potentially alter the evolution of the system and therefore also the predicted rates and properties of astrophysical sources. This implies that complementary studies of triple stars are needed in order to get a more comprehensive picture of the origins of observed transients. In this talk, I will give an overview of the most common evolutionary outcomes of massive triple stars up to their first interaction (e.g. mass transfer). Also, I will compare these results with simulations of isolated binary evolution.

Primary author: KUMMER, Floris (Anton Pannenkoek Institute)

Presenter: KUMMER, Floris (Anton Pannenkoek Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **21** Type: **Poster**

Convergence of high resolution Black Hole accretion simulations of Magnetically Arrested Disks

Wednesday, 17 May 2023 13:15 (1 minute)

Accretion is a fundamental astrophysical process, occurring across all scales of black hole mass. Despite its ubiquitous nature, the accretion process, alongside its connection to jet outflows, poses many fundamental questions. General Relativistic Magneto hydrodynamic (GRMHD) simulations are providing significant insights into the nature of black hole accretion and jet outflows. Following recent efforts in the Event Horizon Telescope (EHT) collaboration to compare numerical solutions between different GRMHD codes, we now aim to perform a convergence study between five simulations conducted using the GPU-accelerated GRMHD code H-AMR, up to a resolution of $5375 \times 2304 \times 2304$ in a logarithmic spherical-polar grid. The objective of this analysis is to assess the influence of numerical resolution on the global characteristics of simulations across a broad range of resolutions. The goal is to determine the level of agreement between simulations, examine the alteration in the disk and jet evolution, and determine the consistency of the overall results across all resolutions considered.

Primary author: SOSAPANTA SALAS, León David (University of Amsterdam)

Co-authors: Dr MUSOKE, Gibwa (University of Amsterdam); Prof. MARKOFF, Sera (University of Amsterdam); Dr PORTH, Oliver (University of Amsterdam)

Presenter: SOSAPANTA SALAS, León David (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **22** Type: **Poster**

4MOST: ESO's new wide-field, high-multiplex, optical spectroscopic survey project

Wednesday, 17 May 2023 13:15 (1 minute)

4MOST is a new high-multiplex, wide-field spectroscopic survey facility under construction for ESO's 4m-VISTA telescope at Paranal, Chile. Its key specifications are: a large field of view of 4.4 square degrees, a high multiplex fibre positioner with 2436 science fibres, of which 1624 fibres go to two low-resolution spectrographs (R = $\lambda/\Delta\lambda$ ~ 6500) and 812 fibres transfer light to the high-resolution spectrograph (R ~ 20,000). All subsystems are finished and full testing in Europe will be completed fall 2023, after which 4MOST will be shipped to Chile. An overview will be given of instrument capabilities, the planned science of the consortium and the selected community programmes, and the unique operational scheme of 4MOST.

Primary author: DE JONG, Roelof (Leibniz-Institut für Astrophysik Potsdam (AIP))

Presenter: DE JONG, Roelof (Leibniz-Institut für Astrophysik Potsdam (AIP))

Session Classification: Poster Prizes & closing

Contribution ID: **23** Type: **Poster**

A panchromatic view of the broad line region of a narrow-line Seyfert 1

Wednesday, 17 May 2023 13:15 (1 minute)

The broad line region of active galactic nuclei, tightly connected to the central engine's activity, is still poorly understood. In this talk, we present an analysis of X-ray, UV and optical spectroscopic observations of the broad emission lines applied for the first time to a narrow-line Seyfert 1 (Juranova et al., to be subm.). For the panchromatic modelling of the broad-line emission, we adopt the 'locally optimally emitting cloud' approach and investigate the possible scenarios resulting in the observed complexity of the data. We compare the results with the broad line regions observed in normal Seyfert 1s and demonstrate the power of this method in placing constraints on the properties of the active galactic nucleus environment. Finally, we show that models with wind-like geometry based on this approach are promising candidates for a more insightful description of the broad line region structure.

Primary author: JURANOVA, Anna (SRON / Anton Pannekoek Institute)

Co-author: COSTANTINI, Elisa (SRON / Anton Pannekoek Institute)

Presenter: JURANOVA, Anna (SRON / Anton Pannekoek Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **24** Type: **Poster**

Recreating post-AGB binaries using MESA

Wednesday, 17 May 2023 13:00 (1 minute)

Primary author: MOLTZER, Casper (Radboud University)

Presenter: MOLTZER, Casper (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **25** Type: **Contributed talk**

Radiation shielding of young protoplanetary disks

Monday, 15 May 2023 15:00 (15 minutes)

Most stars form in stellar clusters that dissolve into the galactic field on timescales of tens to hundreds of millions of years. Planet formation takes place in a protoplanetary disk around young stars, disks that have typical lifetimes of a few millions years. The process of planet formation thus typically takes place in a stellar cluster environment. Understanding the impact of this environment on protoplanetary disks, and subsequently on planet formation, requires multi-scale, multi-physics models. Using the Torch model, we couple the collapse of a giant molecular cloud, the formation of stars, and stellar feedback, with the evolution of protoplanetary disks around the newly formed stars. These disks evolve viscously, and are subject to truncation due to stellar encounters and to external evaporation due to radiation from nearby massive stars. We show that gas in the star forming region shields protoplanetary disks from external photoevaporation for at least 0.5 Myr after the formation of the first massive stars. We also find that truncations due to encounters are less effective than external photoevaporation in casuing disk mass loss, even accounting for shielding, and that shielding allows disks to retain more solid material for planet formation.

Primary author: WILHELM, Martijn (Leiden Observatory)

Presenter: WILHELM, Martijn (Leiden Observatory)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **26** Type: **Contributed talk**

Early galaxy formation and its large-scale effects

Wednesday, 17 May 2023 09:15 (15 minutes)

Galaxy formation in the first billion years mark a time of great upheaval in our cosmic history: the first sources of light in the Universe, these galaxies ended the 'cosmic dark ages' and produced the first photons that could break apart the hydrogen atoms suffusing all of space starting the process of cosmic reionization. At the forefront of astronomical research, the past few years have seen cutting-edge instruments such as JWST and ALMA provide tantalising glimpses of such galaxies chaotically assembling in an infant Universe. I will show how this data has provided an unprecedented opportunity to pin down the reionization state of the Universe, understand the physical properties of early galaxies, shed light on their dusty nature and study the key physics driving their formation and evolution. Time permitting, I will try to give a flavour of how the first billion years can also provide a powerful testbed for Dark Matter models beyond "Cold Dark Matter".

Primary author: DAYAL, Pratika (Kapteyn Institute, Groningen University)

Presenter: DAYAL, Pratika (Kapteyn Institute, Groningen University)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **27** Type: **Contributed talk**

X-ray jitter radiation in Cassiopeia A

Wednesday, 17 May 2023 12:00 (15 minutes)

X-ray emission from young supernova remnants (SNRs) is characterized by non-thermal radiation and is usually interpreted as synchrotron process. This type of emission is detected in regions close to the shock front and it is explained with the the diffusive shock acceleration (DSA) theory, which requires high magnetic turbulence. However, the current spectral models used to fit the data overlook the influence of the turbulence in the shape of the emitted photons' spectrum. A more appropriate emission process, self-consitently including such turbulence effects, is known as jitter radiation. So far, jitter radiation has never been considered as a putative responsible of the non-thermal emission observed in SNRs. In this talk I present preliminary results on multi-instrument X-ray data analysis of the SNR Cassiopeia A (Cas A) adopting non-thermal models having different spectral shapes, including a custom jitter model. The spatially resolved spectral analysis showed that jitter radiation is most likely at work in most of the SNR. The successful detection of jitter radiation gives us new direct diagnostic tools of the physical scale size and of the spectral distribution of the magnetic turbulence across various region of the SNR.

Primary author: GRECO, Emanuele (API - University of Amsterdam)

Co-authors: Dr ELLIEN, Amael; Prof. VINK, Jacco

Presenter: GRECO, Emanuele (API - University of Amsterdam)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **28** Type: **Contributed talk**

First JWST results on the high redshift, low mass end of the galaxy stellar mass function from z=4 to z=8

Wednesday, 17 May 2023 09:00 (15 minutes)

Despite its crucial role in shaping our understanding of galaxy formation and evolution, the low mass end of the high redshift galaxy mass function has so far remained largely unknown. This is specially true for the high redshift universe, where even the deepest surveys have been unable to probe this elusive galaxy population.

To address this challenge, we leverage the powerful near-infrared imaging capabilities of the JWST, and supplement this data with larger area ancillary data from the Hubble Space Telescope (HST) and ground-based observatories.

We use two of the deep fields recently observed by JWST: HUDF and PRIMER-UDS, reaching a depth of ~ 29.5mag for the blue NIRCam bands in HUDF. This strategy allows to mitigate cosmic variance while probing the low mass end of the galaxy mass function down to log10(M/Msun)=8 at redshift z=5 or log10(M/Msun)=8.5 at redshift z=6.

In this talk I will present the outcomes of our study, which will offer a preliminary examination of the low mass end of the galaxy mass function and pave the way for deeper and larger area JWST observations to complement our findings which will come in the future.

Primary author: NAVARRO, Rafael (Kapteyn Astronomical Institute)

Co-author: Dr CAPUTI, Karina I. (Kapteyn Astronomical Institute)

Presenter: NAVARRO, Rafael (Kapteyn Astronomical Institute)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **29** Type: **Poster**

When did the initial mass function become bottom-heavy?

Wednesday, 17 May 2023 13:15 (1 minute)

The characteristic mass that sets the peak of the stellar initial mass function (IMF) is closely linked to the thermodynamic behaviour of interstellar medium (ISM), which controls how gas fragments as it collapses under gravity. As the Universe has grown in metal abundance over cosmic time, this thermodynamic behaviour has evolved from a primordial regime dominated by molecular hydrogen cooling to a modern regime where the dominant process in dense gas is protostellar radiation feedback, transmitted to the gas via dust grains. We study gas thermodynamics in collapsing dusty molecular clouds at a wide range of metallicities, from primordial to super-Solar, in different ISM conditions. We show that the transition in the IMF from the primordial regime to the modern regime begins at metallicity $Z \sim 10^{-4}\,\mathrm{Z}_\odot$, passes through an intermediate stage where metal line cooling is dominant, and then transitions to the modern dust- and feedback-dominated regime at $Z \sim 0.05\,\mathrm{Z}_\odot$. This transition is accompanied by a dramatic change in the characteristic stellar mass, from $\sim 50\,\mathrm{M}_\odot$ at $Z \sim 10^{-6}\,\mathrm{Z}_\odot$ to $\sim 0.3\,\mathrm{M}_\odot$ once radiation feedback begins to dominate, which marks the appearance of the bottom-heavy Milky Way IMF. The exact transition from top- to bottom-heavy IMF occurs at intermediate metallicities. Specifically, this transition is sensitive to the abundances of C and O, which observations of metal-poor stars and dwarf galaxies show is non-Solar-scaled. Our work brings together the stellar and galaxy communities by revealing the impact of the IMF on our understanding of the metal-poor Universe.

Primary author: SHARDA, Piyush (Leiden University)

Presenter: SHARDA, Piyush (Leiden University)

Session Classification: Poster Prizes & closing

Contribution ID: **30** Type: **Contributed talk**

Using metallicity gradients to trace the evolution of galaxies

Tuesday, 16 May 2023 16:00 (15 minutes)

Thanks to integral field unit (IFU) spectroscopy, spatially-resolved metallicities have been measured in thousands of galaxies. This has built up a census of the baryonic cycle in local galaxies, which is crucial to understand how processes local to the interstellar medium (ISM) contribute to global trends in galaxies and influence the dynamics of the circumgalactic medium (CGM). JWST has already begun to push boundaries by obtaining spatially-resolved metallicity measurements for galaxies beyond $z > 3$. To provide physical explanations for the trends revealed by these observations, we develop a new, first-principles model for the evolution of spatially-resolved gas-phase metallicities in galaxies. Crucially, and in contrast with existing models, we include a comprehensive treatment of metal dynamics and galactic winds, both of which are expected to play a bigger role at high redshifts. When normalized by metal diffusion, metallicity gradients are governed by the competition between radial advection, metal production, and accretion of metal-poor gas from the cosmic web. Reproducing the observed mass-metallicity and mass-metallicity gradient relations in the local Universe from the model shows that galaxies transition from the advection-dominated to the accretion-dominated regime as they increase in mass. The shape of metallicity-based galaxy scaling relations is governed by the metal enrichment of galactic winds, and the model predicts winds in low-mass galaxies are more metal enriched as compared to their ISMs. The model also predicts a complex and non-linear dependence of metallicity gradients on the gas velocity dispersion at high redshifts, which can be directly tested by JWST.

Primary author: SHARDA, Piyush (Leiden University)

Presenter: SHARDA, Piyush (Leiden University)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **31** Type: **Poster**

A panchromatic approach to the merger-active galactic nuclei connection

Wednesday, 17 May 2023 13:15 (1 minute)

Collisions and interactions between galaxies are thought to be crucial phases in their evolution and mass assembly process, elevating star formation activity and potentially fueling accretion onto the central supermassive black holes. In this study, we leverage the high spatial resolution and sensitivity of the Hyper Suprime Cam survey and the associated rich multi-wavelength data in the GAMA 09 field to gain new insights into the role of mergers in triggering active galactic nuclei (AGN) up to z~1. We employ a deep learning convolutional neural network algorithm to identify galaxy mergers based on features learned from two different cosmological hydrodynamical simulation suites. We explore data from the X-ray to sub-millimeter regimes to robustly select mid-infrared (MIR) and X-ray AGN and derive a continuous distribution of the AGN fraction (f_{AGN}) for the first time. With this latter approach, we are able to explore how mergers are connected to the importance of AGN. Our findings reveal that mergers exhibit a higher fraction of galaxies with high f_{AGN} compared to non-mergers, accounting for ~40% of AGN-dominated galaxies. Furthermore, our binary classification analysis indicates that MIR AGN are twice as frequent in mergers than non-mergers, while X-ray AGN are only slightly more frequent in mergers. Additionally, the merger fraction in MIR AGN is higher than in MIR non-AGN controls (~40% vs. 25%), while the merger fraction in selected X-ray AGN is comparable to that in X-ray non-AGN controls. Our study sheds new light on the relationship between mergers and AGN evolution up to z~1.

Primary author: LA MARCA, Antonio (SRON - Kapteyn Astronomical Institute)

Co-authors: Dr MARGALEF-BENTABOL, Berta (SRON); Dr WANG, Lingyu (SRON - Kapteyn Astronomical Institute)

Presenter: LA MARCA, Antonio (SRON - Kapteyn Astronomical Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **32** Type: **Poster**

Disturbed and old AGN remnant in a galaxy group discovered by LOFAR

Wednesday, 17 May 2023 13:15 (1 minute)

We present the discovery of an AGN remnant associated with the galaxy group Abell 1318. Using GMRT and APERTIF data, we derive its radiative age and disentangle its complex history, showing that galaxy groups can have (surprisingly) dynamic past.

Primary author: SHULEVSKI, Aleksandar (ASTRON)

Presenter: SHULEVSKI, Aleksandar (ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **33** Type: **Contributed talk**

Feedback on ionised gas over the radio AGN life-cycle

Wednesday, 17 May 2023 11:45 (15 minutes)

Feedback from radio AGN has been observed in the form of jet driven gas outflows, which can affect the host galaxy's evolution. Radio AGN are also known to have a life-cycle of activity. However it is still not completely clear how feedback evolves with the AGN life-cycle. In the first part of my talk, I will discuss our results from a study to investigate this with a sample of uniformly selected 129 radio AGN up to z=0.2 and L(1.4 GHz)=1e26 W/Hz. We used radio spectral shape from 144-3000 MHz (LoTSS, FIRST, VLASS) as a proxy for the evolutionary stage of the AGN, and [OIII] spectra to trace the warm ionised gas kinematics. We found that outflows in young sources (peaked radio spectrum) were more extreme than evolved sources (non-peaked), and are typically short lived. This was true even if we included the [OIII] non-detections and used a stacking analysis, showing this is true on average for the radio AGN population. For candidate restarted AGN, we found tentative evidence for more disturbed gas kinematics, suggesting a link with episodic jet activity. We also found that radio luminosity, optical luminosity, ionisation state and accretion rate did not play a definitive role in driving feedback in our sample.

In the second part, I will discuss new results from an expansion of this study to ~5500 sources, up to z=0.8 and L(1.4 GHz)=1e28 W/Hz. Our findings support the picture from simulations where impact of feedback changes as the radio jets grow.

Primary authors: KUKRETI, Pranav (Kapteyn Astronomical Institute, and ASTRON); MORGANTI, Raffaella (ASTRON)

Presenter: KUKRETI, Pranav (Kapteyn Astronomical Institute, and ASTRON)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **34** Type: **Contributed talk**

The impact of uncertainties in current NICER analyses: the case of PSR J0030+0451

Monday, 15 May 2023 15:45 (15 minutes)

In the last few years, the NICER collaboration has provided mass and radius inferences, via pulse profile modeling, for two pulsars: PSR J0030+0451 and PSR J0740+6620. Given the importance of these results for constraining the equation of state of dense nuclear matter, it is crucial to validate them and test their robustness. We therefore explore the reliability of these results and their sensitivity to analysis settings and random processes, including noise, focusing on the specific case of PSR J0030+0451. In particular our simulations are inspired by the analysis of a revisited version of the NICER data set published in 2019.
We use X-PSI, one of the two main analysis pipelines currently employed by the NICER collaboration for mass and radius inferences.
With synthetic data that mimic the NICER PSR J0030+0451 data set, we evaluate the recovery performances of XP-SI under conditions never tested before, including complex modeling of the thermally emitting neutron star surface. For the test cases explored, our results suggest that X-PSI is capable of recovering the true mass and radius within reasonable credible intervals.
This work also reveals the main vulnerabilities of the analysis: a significant dependence on noise and the presence of multi-modal structure in the likelihood surface.
Noise particularly impacts our sensitivity to the analysis settings and widths of the posterior distributions.
The multi-modal structure in the likelihood suggests that biases could be present if the analysis is unable to exhaustively explore the parameter space.
Convergence testing is one possible solution to these challenges.

Primary author: Dr VINCIGUERRA, Serena (University of Amsterdam)

Co-authors: Prof. WATTS, Anna (University of Amsterdam); Mr CHOUDHURY, Devarshi (University of Amsterdam); Dr RILEY, Thomas (University of Amsterdam); Dr SALMI, Tuomo (University of Amsterdam); Mr KINI, Yves (University of Amsterdam)

Presenter: Dr VINCIGUERRA, Serena (University of Amsterdam)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **35** Type: **Contributed talk**

Revealing the progenitors of Galactic Supernovae

Monday, 15 May 2023 16:15 (15 minutes)

The majority of massive stars are born in binaries, and most unbind upon the first supernova. With the precise proper motion measurements of Gaia, it is possible to trace back the trajectory of stars in the vicinity of young supernova remnants and neutron stars to search for intersecting paths, and hence ejected companions. At present, only a handful of supernova runaway candidates are known, but a large sample would enable direct, statistically significant insight into the binary progenitors of supernovae. We present binary population synthesis predictions for secondary stars ejected by the supernova of their companion, and evaluate the prospects for finding more with Gaia. We demonstrate that the current sample of stars ejected by the supernova of their companion can be increased by a factor of a few with Gaia data release 3, and show that further progress (by an order of magnitude or more) is possible with future Gaia data releases and the deep, NIR imaging capability of JWST, Euclid and more.

Primary author: CHRIMES, Ashley (Radboud University)

Presenter: CHRIMES, Ashley (Radboud University)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **36** Type: **Poster**

Swarm Intelligence-based Extraction and Manifold Crawling Along the Large-Scale Structure

Wednesday, 17 May 2023 13:15 (1 minute)

The spatial distribution of matter on the mega-parsec scale of the Universe forms a complex and highly anisotropic pattern termed the Cosmic Web or the Large-Scale Structure. In the study of the Cosmic Web, several tools and methodologies have been developed to inspect the properties of its different environments i.e. clusters, filaments, walls, and voids. In this work, we show that the previously introduced framework 1-Dimensional Recovery, Extraction, and Analysis of Manifolds (1-DREAM) can analyze cosmological N-body simulation data of the Cosmic Web. 1-DREAM is a toolbox consisting of five Machine Learning algorithms that jointly serve the extraction and modelling of 1-dimensional structures in big data astronomical settings. After explaining the function of the different algorithms, we compare our toolbox with other methods which trace structures of the Cosmic Web. We show that 1-DREAM is able to split the network into its various environments with results comparable to the state-of-the-art methodologies. A comparison with the publicly available code DisPerSE demonstrates the ability of 1-DREAM to recover axes well aligned with the centers of cosmic filaments.

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Presenter: Ms AWAD, Petra (University of Groningen, Kapteyn Astronomical Institute, 9747 AD Groningen, The Netherlands)

Session Classification: Poster Prizes & closing

Contribution ID: **37** Type: **Poster**

Aging with grace: Studying the chemical composition and evolutionary history of short-period X-ray binaries

Wednesday, 17 May 2023 13:15 (1 minute)

Studying the chemical composition of accretion discs in low-mass X-ray binaries (LMXBs) provides vital information about their formation and evolutionary history. This, in turn, touches on a range of key topics, such as the formation and physics of Type-Ia supernovae, the birth masses and growth of compact objects, and the physics of accretion. Ultraviolet spectroscopy is particularly suited to study the composition of the transferred material in the accretion disc, as this waveband contains strong transitions of important elements, such as C, N, O, and He. However, this area has hardly been explored yet for LMXBs. In this talk, I will present my work on studying the UV spectra of several short-period X-ray binaries. I will present the composition and relative element abundances of the discs, as well as properties of the donor star. Finally, I will discuss our initial conclusions on the current evolutionary stages and histories of these binaries.

Primary author: FIJMA, Stefanie

Presenter: FIJMA, Stefanie

Session Classification: Poster Prizes & closing

Contribution ID: **38** Type: **Contributed talk**

The high-energy burst distribution of a hyper-active repeating fast radio burst source

Monday, 15 May 2023 13:40 (15 minutes)

Fast radio bursts (FRBs) are enigmatic millisecond-duration radio flashes with an extragalactic origin. FRBs sources can be divided into two populations: repeating and apparently non-repeating sources. The burst energy distribution from repeating FRB sources is an important diagnostic tool that can be used to better understand the emission process, cosmological applications, and the potential link between repeaters and apparent non-repeaters. The study of this distribution is limited both by the sensitivity of telescopes and on-sky time. The brightest FRBs are the most rare; on-sky time is therefore essential in order to probe the high-energy tail. FRB 20220912A is a newly discovered, hyper-active repeating FRB source, first detected by CHIME/FRB in late 2022. Since its discovery we have observed FRB 20220912A for more than 2200 hours over the span of 5 months using the 25-m class radio telescopes in Westerbork, Stockert and Toruń. Our unique, high-cadence observing campaign yielded the detection of more than 150 high-fluence bursts (>10 Jy ms). We have detected bursts at both 300 MHz and 1.4 GHz, but not simultaneously. This newly observed sample of high-fluence bursts from FRB 20220912A allows us to compare it to the high-energy distribution from our previous high-cadence campaign towards FRB 20201124A, another highly active source. In this presentation, I will discuss the maximum burst energies that FRBs can reach, as well as the potential links between repeaters and apparent non-repeaters.

Primary author: OULD-BOUKATTINE, Omar (ASTRON)

Presenter: OULD-BOUKATTINE, Omar (ASTRON)

Session Classification: Plenary Session

Track Classification: Time Domain

Contribution ID: **39** Type: **Poster**

Density calculations of NGC 3783 warm absorbers using a time-dependent photoionization model

Wednesday, 17 May 2023 13:15 (1 minute)

The distance of the outflowing wind is poorly constrained due to lack of direct imaging observations, which limits our understanding of their kinetic power. One way is that once known the density of the ionized plasma, the distance can be derived from the ionization parameter which measured based on the ionization states. Here, applying a new time-dependent photoionization model, TPHO, in SPEX, we define a new approach, TPHO-delay method, to calculate/predict a detectable density range for warm absorbers of NGC 3783. We also highlight the importance of TPHO model than equilibrium in the delayed state of plasma. Further, we add Be-like ion metastable absorption line method and physical constraints to the map of NGC 3783 warm absorber density, which as a comprehensive estimation/prediction for the future of new observations, such as XRISM. In addition, the counterpart in UV band can be a cross-check to inspect the TPHO-delay method. Finally, we calculate crossing time to consider the effect of the transverse motion of the outflow to the intrinsic luminosity variation.

Primary author: LI, Chen (Leiden University)

Presenter: LI, Chen (Leiden University)

Session Classification: Poster Prizes & closing

Contribution ID: **40** Type: **Poster**

Chemical evolution in the building blocks of the Milky Way

Wednesday, 17 May 2023 13:15 (1 minute)

Galaxy mergers and accretions are a fundamental process in galaxy evolution. In the Milky Way, we can identify signatures of past galaxy accretion events as kinematic substructures, allowing us to characterize the property of each accreted galaxy and, potentially, its impact on the Milky Way's evolution. We here characterize the chemical properties of stars belonging to kinematic substructures over 13 elements based on high-quality spectra and differential abundance analysis, which minimizes systematic uncertainties. With the detailed elemental abundance, we first confirm that each kinematic substructure needs an independent progenitor from differences in chemical abundance. We then show that less prominent progenitors tend to show stronger signatures of chemical enrichments by type Ia supernovae, indicating that their star formations took place over a long time. We will finally present future prospects and requirements to isolate debris of individual accreted galaxies based on kinematics and chemical abundances.

Primary author: MATSUNO, Tadafumi (Kapteyn Astronomical Institute)

Presenter: MATSUNO, Tadafumi (Kapteyn Astronomical Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **41** Type: **Contributed talk**

A LOFAR sample of luminous compact radio sources coincident with nearby dwarf galaxies

Monday, 15 May 2023 16:45 (15 minutes)

The vast majority of extragalactic, compact continuum radio sources are associated with star formation or jets from (super)massive black holes and, as such, are more likely to be found in association with starburst galaxies or early type galaxies. Recently, two new populations of radio sources have been identified: (a) compact and persistent sources (PRS) associated with fast radio bursts (FRBs) in dwarf galaxies and (b) compact sources in dwarf galaxies that could belong to the long-sought population of intermediate-mass black holes. Despite the interesting aspects of these newly found sources, the current sample size is small (a few to dozens), limiting scrutiny of the underlying population. Here, we present a search for compact radio sources coincident with dwarf galaxies. We search the LOFAR Two-meter Sky Survey (LoTSS) – the most sensitive large-area survey for optically thin synchrotron emission to date. Exploiting LoTSS' high spatial resolution (6 arcsec) and high astrometric precision (about 0.2 arcsec), we match its compact sources to the compiled sample of dwarf galaxies in the Census of the Local Universe. We identify 29 over-luminous compact radio sources, evaluate probability of chance alignment, investigate the potential nature of these sources, and evaluate their volumetric density and rate. While optical line-ratio diagnostics on the nebular lines from the host galaxies prefer a star-formation origin over an AGN origin, future high angular resolution radio data is necessary to ascertain the origin of the radio sources. We discuss planned strategies to differentiate them between candidate FRB hosts and intermediate-mass black holes.

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Presenter: VOHL, Dany (Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **42** Type: **Contributed talk**

Towards sustainable astronomy in the Netherlands

Monday, 15 May 2023 13:55 (15 minutes)

The current climate crisis has led to UN and EU regulations to reduce greenhouse gas emissions by 55% in 2030. Astronomers should lead this effort by example, as they are aware of the lack of a Planet B to live on.
In the Netherlands, the RvdA installed a working group to monitor and improve the sustainability of Dutch astronomy, including outreach & communication on this topic. Our kickoff study [1] showed that in 2019, airplane travel dominated the CO2 footprint of astronomy research, with uncertain contributions from observatories and supercomputing. Meeting the goals of the Paris agreement requires flying 2-4x less than before the pandemic.
This talk presents an update of our activities, including an estimate of the LOFAR footprint, a plan to measure the computing footprint, and a survey of effective and acceptable ways to reduce CO2 emission due to airplane travel.

[1] Van der Tak et al 2021, Nature Astronomy 5, 1195

Primary authors: Dr ROWLINSON, Antonia (ASTRON); VAN DER TAK, Floris (SRON / Kapteyn); Prof. NELEMANS, Gijs (Nijmegen); Prof. VINK, Jacco (UvA); Prof. WIJNANDS, Rudy (UvA); Dr SHIPMAN, Russ (SRON); Prof. PORTEGIES ZWART, Simon (Leiden); Dr BLOEMEN, Steven (Nijmegen); Dr IMPELLIZERI, Violette (Leiden)

Presenter: VAN DER TAK, Floris (SRON / Kapteyn)

Session Classification: Plenary Session

Contribution ID: **43** Type: **Poster**

The importance of the way in which resolution elements are selected for supernova feedback in simulations of galaxies

Wednesday, 17 May 2023 13:15 (1 minute)

Supernova (SN) feedback plays a fundamental role in galaxy evolution. However, modelling SN feedback in simulations of galaxy formation remains challenging because the simulations cannot resolve the scales on which SN feedback occurs. Therefore, SN feedback is generally implemented as a subgrid model that has a number of free parameters, which are calibrated such that the simulated galaxies have realistic morphologies and masses. Differences in how the energy from SNe is coupled to the gas have resulted in a variety of SN feedback models used by different groups. However, the importance of the selection of resolution elements in which young stellar particles inject their SN energy has largely been overlooked. In this work, we study five methods of gas-element selection in SN feedback. We consider the mass-weighted method, which was used in the Eagle simulations; the isotropic method, which produces a statistically isotropic distribution of SN energy; the minimum-distance method, in which stellar particles inject SN energy into their closest gas neighbour; and the minimum (maximum) density method, where the gas neighbour with the lowest (highest) density receives the energy. We run a suite of simulations of an isolated Milky Way-mass galaxy and small cosmological volumes. We demonstrate that different neighbour-selection strategies result in significant variations in galaxy star formation rates, morphologies, gas densities, and wind mass loading. We conclude that the way in which the SN energy is distributed among the resolution elements surrounding an SN event is as important as changing the energy by factors of a few.

Primary authors: CHAIKIN, Evgenii (Leiden Observatory); SCHAYE, Joop (Leiden Observatory); SCHALLER, Matthieu (Leiden Observatory); BAHÉ, Yannick (Leiden Observatory); NOBELS, Folkert (Leiden Observatory); PLOECKINGER, Sylvia (University of Vienna)

Presenter: CHAIKIN, Evgenii (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **44** Type: **Poster**

Molecular or atomic? Hydrogen chemistry in atmospheres of gas giants

Wednesday, 17 May 2023 13:15 (1 minute)

Primary author: Ms JANSSEN, Leoni (University of Amsterdam)

Presenter: Ms JANSSEN, Leoni (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **45** Type: **Contributed talk**

Unveiling the baryonic structure and evolution of local star forming discs

Wednesday, 17 May 2023 10:15 (15 minutes)

In the literature, large amount of work has been devoted to the study of the build-up of metals and dust in disc galaxies. However, most of these analyses are based on global galactic properties. Therefore, spatially resolved studies are crucial to provide more detailed information on the evolution processes affecting these star forming galaxies.
In this talk, I will present a spatially resolved study of the relations between stellar, gas, star formation rate (SFR), dust surface densities and chemical abundances in the nearby spiral galaxies M101, NGC628, M33 and NGC300. This selection allow us to probe objects showing diverse characteristics, from the morphology to the stellar mass.
We re-derived stellar, gas, SFR and dust radial profiles within this galaxy sample and explored the obtained relations between the different physical quantities. These quantities are then related with literature data of different chemical abundances (i.e. carbon, nitrogen, oxygen) available for this sample that can tell us about the relative roles played by gas flows and the star formation history in these systems.
To this aim, we also performed a detailed analysis by running state-of-the-art, multi-zone galactic chemical evolution models including dust evolution for the studied galaxies. The models are calibrated by means of a Bayesian analysis to fit the observed stellar, gas and SFR profiles and allowed us to pin down the main events characterising the star formation history as well as to better constrain the highly uncertain processes regulating dust evolution.

Primary author: PALLA, Marco (Ghent University)

Co-authors: Prof. DE LOOZE, Ilse (Ghent University); Prof. RELAÑO, Monica (University of Granada); Mr VAN DER GIESSEN, Stefan (Ghent University)

Presenter: PALLA, Marco (Ghent University)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **46** Type: **Contributed talk**

A Bayesian Approach To The Halo-Galaxy-SMBH Connection Through Cosmic Time

Wednesday, 17 May 2023 10:00 (15 minutes)

We present an empirical galaxy evolution model, investigating the co-evolution of dark matter halos, galaxies, and supermassive black holes using from z= 0 - 10. Our approach connects the evolution of dark matter structure with simple empirical prescriptions for baryonic processes, allowing us to reproduce key observations in the relationship between galaxies and their black holes.
To construct our model, we assumed a physically-motivated direct relationship between galaxy and supermassive black hole properties and their host halo mass. We then used this relationship to derive expressions for the galaxy stellar mass function, galaxy UV luminosity function, active black hole mass function, and quasar bolometric luminosity function. We calibrated our baryonic prescriptions using a fully Bayesian approach, ensuring that our model was consistent with observed population statistics.
Our results show that the model is qualitatively consistent with observations, reproducing the galaxy stellar mass - UV luminosity relation, black hole mass - stellar mass relation, black hole mass - AGN luminosity relation, and their evolution with redshift. We present upper limits on the expected number of sources for z=5 up to z=15 for upcoming surveys by JWST and Euclid. Our study demonstrates that empirical models can complement more computationally expensive approaches, providing a fast, easy, and flexible way to make predictions for observational surveys.

Primary author: BOETTNER, Christopher (Kapteyn Astronomical Institute, University of Groningen)

Co-authors: TREBITSCH, Maxime (Kapteyn Astronomical Institute); DAYAL, Pratika (Kapteyn Institute, Groningen University)

Presenter: BOETTNER, Christopher (Kapteyn Astronomical Institute, University of Groningen)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **47** Type: **Poster**

BASS XXXV. The $M_{\rm BH}$ - $\sigma_\star$ Relation of 105-Month Swift-BAT Type 1 AGNs

Wednesday, 17 May 2023 13:15 (1 minute)

We present two independent measurements of stellar velocity dispersions ($\sigma_\star$) from the Ca H K & Mg I region (388–555 nm) and the Calcium Triplet region (CaT, 835–875 nm) for 173 hard X-ray selected Type 1 AGNs from 105-month Swift-BAT catalog. We construct one of the largest samples of local Type 1 AGNs that have both single-epoch (SE), 'virial' black hole mass ($M_{\rm BH}$) estimates and $\sigma_\star$ measurements obtained from high-resolution data, allowing test various aspects of the usage of such methods for supermassive black hole studies. We report that two independent $\sigma_\star$ measurements are highly consistent with each other, with an average offset of merely 0.002 ± 0.001 dex. Comparing $M_{\rm BH}$ estimates based on broad emission lines and on stellar absorption features (coupled with the $M_{\rm BH}$ - $\sigma_\star$ relation), we find that the former is systematically lower, by ≈ 0.12 dex on average than the latter. Consequently, Eddington ratios estimated through these $M_{\rm BH}$ determinations are similarly biased (but in the opposite way). We argue that the discrepancy is driven by extinction in the broad-line region (BLR). We also find an anti-correlation between the offset from the $M_{\rm BH}$ - $\sigma_\star$ relation and the Eddington ratio. Our sample of Type 1 AGNs shows a shallower $M_{\rm BH}$ - $\sigma_\star$ relation (a power law exponent of ≈ 3.5) compared with that of inactive galaxies, confirming earlier results obtained from smaller samples.

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Co-author: COLLABORATION, BASS

Presenter: CAGLAR, Turgay (Southern Methodist University)

Session Classification: Poster Prizes & closing

Contribution ID: **48** Type: **Poster**

Revealing deeper secrets: Developing a new higher-resolution technique for XMM imaging analysis

Wednesday, 17 May 2023 13:15 (1 minute)

We develop a new technique to resolve small-scale structures in galaxy groups and clusters using XMM-MOS. This study takes advantage of the steep nature of the on-axis XMM PSF which encloses ~60% of the incident photon energy within 10 arcsec. Standard pipeline processing of XMM-MOS data yields images with 4 arcsec binning by default; however, images may be created with 1 arcsec bins to better sample the PSF. Our study demonstrates that this sampling can highlight structures such as cavities better than the default processing. We apply this technique to XMM-MOS observations of multiple objects, all of which have confirmed cavity structures detected in Chandra images. By creating unsharp masked images, we demonstrate that this new technique is most effective if the cavities are located beyond the very core (< 10 arcsec) where the PSF blurring remains the main limitation. Cavities beyond this region are clearly revealed. By measuring the decrease in the azimuthally averaged surface brightness at the position of the detected cavities, we estimate a statistical significance of 2-3 sigma for these features. Many of these features remain undetected however if we apply unsharp masking to the 4 arcsec binned images created by the default XMM-MOS processing.

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Presenter: Mr MAJUMDER, Anwesh (Anton Pannekoek Institute, University of Amsterdam; SRON, Netherlands Institute for Space Research)

Session Classification: Poster Prizes & closing

Contribution ID: **49** Type: **Contributed talk**

Unravelling the gas physical conditions in the starburst galaxy NGC 253

Wednesday, 17 May 2023 09:30 (15 minutes)

Various feedback mechanisms, such as star formation, large-scale outflows, shocks or Active Galactic Nuclei, affect the shape and evolution of galaxies. Starburst galaxies, in particular, show exceptionally higher star-formation rates compared to regular galaxies (e.g. the Milky Way), indicating different physical conditions. Understanding how these physical conditions differ in starburst galaxies is crucial to study their evolution.

Star-formation gathers several physical processes, each associated with a specific gas component (e.g. dense, turbulent, shocked gas). Thanks to powerful millimetre interferometers (e.g. ALMA, NOEMA), it is now possible to disentangle gas components down to scales of Giant Molecular Clouds (i.e. tens of pc) using molecular line emission. NGC 253 is the nearest (d~ 3.5 Mpc) brightest starburst galaxy in both the infrared and millimetre ranges and is thus the best target to study physical conditions in starburst galaxies.

The ALMA Comprehensive High-resolution Extra-galactic Molecular Inventory (ALCHEMI) provides the first unbiased molecular survey (84.2 - 373.2 GHz) towards the Central Molecular Zone (CMZ) of NGC 253, at an unprecedented angular resolution of 1.6" (~27pc) (Martin et al. 2021). In this context, we investigated the CMZ of NGC 253 using sulphur-bearing molecules, known as effective in reconstructing the dynamics of the studied object. We found that these species belong to different categories of gas (e.g. cold vs hot and quiescent vs shocked), and we could extract the various physical conditions associated with the CMZ of NGC 253 and compare them to those found in the Milky Way and other external galaxies.

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Co-author: Prof. VITI, Serena (Leiden Observatory, Leiden University)

Presenter: BOUVIER, Mathilde (Leiden Observatory, Leiden University)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **50** Type: **Contributed talk**

Probing the repetition of fast radio bursts with CHIME and LOFAR

Monday, 15 May 2023 13:10 (15 minutes)

Fast radio bursts (FRBs) are extragalactic radio transients of microsecond to millisecond duration, whose physical origin is largely unknown. Some FRBs are known to repeat, which rules out cataclysmic progenitor models for these sources. Repeating FRBs exhibit significantly different temporal widths and bandwidths as compared to the non-repeating sources. A potential explanation for these differences is that repeaters and non-repeaters have different progenitors. In this talk, I will present a study of a new sample of repeating FRBs discovered with the Canadian Hydrogen Intensity Mapping Experiment telescope (CHIME) in the frequency range of 400-800 MHz. While some repeating sources have anomalously high repetition rates, we find no clear bi-modality between the repetition rates of repeaters and the upper limits on repetition from previously discovered non-repeating sources. This argues against repeaters and non-repeaters belonging to fundamentally different source classes. We further study the frequency dependence of the measured repetition rates by searching archival observations made with the Low Frequency Array (LOFAR) telescope at the location of 45 known repeating sources and 460 apparent non-repeaters. These observations were conducted as part of the LOFAR Tied-Array All-sky Survey (LOTAAS) in the frequency range of 119-151 MHz. I will report on the results of this search and discuss resulting constraints on the frequency dependence of FRB repetition and their implications for the emission mechanism and circum-burst environments of FRBs.

Primary author: CHAWLA, Pragya (University of Amsterdam)

Presenter: CHAWLA, Pragya (University of Amsterdam)

Session Classification: Plenary Session

Track Classification: Time Domain

Contribution ID: **51** Type: **Poster**

Suzaku view of the cluster pair Abell 222/223

Wednesday, 17 May 2023 13:15 (1 minute)

Previous XMM-Newton observations of Abell 222/223 reveal a large-scale filament connecting the clusters, which is further verified by weak-lensing data. This cluster pair is also implied to be pre-merger. Therefore this filament was claimed to represent relatively pristine warm-hot intergalactic gas, before being processed by the cluster's interaction.

We analyzed the Suzaku archival data of the Abell 222/223 cluster pair to investigate the properties in the outskirts and the filament regions. We used Chandra data to reveal the surface brightness profile of clusters and to constrain the Cosmic X-ray Background. For the Suzaku analysis, we carefully modelled the scattered light from the two clusters into the filament region using ray tracing.

Both the Chandra surface brightness profiles and the Suzaku temperature and density profiles suggest that there are no obvious shocks at the clusters'outskirts, in agreement with previous results. Even though consistent within the large error bars of the initial XMM measurement (0.91±0.25 keV), the temperature of the filament measured by Suzaku appears to be higher, around 1.74±0.22 keV. The emission measure of the filament at $0.3Z_{\odot}$ is $1.37\pm0.11 \times 10^{65}\ \mathrm{cm}^{-3}$, perfectly consistent with the XMM measurement ($1.3 \times 10^{65}\ \mathrm{cm}^{-3}$). The higher instrumental background and susceptibility from soft proton contamination in the XMM-Newton data could be responsible for this difference in the temperature measurements. Given the best-fit values from Suzaku, it seems possible that the excess emission is due to a superposition of the cluster outskirts, rather than pristine WHIM as initially claimed.

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Presenter: CHEN, Yanling

Session Classification: Poster Prizes & closing

Contribution ID: **52** Type: **Poster**

Zooming in on the first-known repeating fast radio burst source and its putative hyper-nebula

Wednesday, 17 May 2023 13:15 (1 minute)

Fast radio bursts (FRBs) are enigmatic astrophysical transients; they are brief, intense flashes of radio emission from extragalactic sources. The extreme brightness and millisecond-duration timescales of FRBs indicate that they are likely produced by compact objects with large energy reservoirs, such as accreting black holes or magnetars (ultra-magnetic neutron stars). Although most FRBs appear to be one-off events, a small percentage have been observed to repeat, including FRB 20121102A, the first-known repeating FRB. Using the European Very Long Baseline Interferometry (VLBI) Network (EVN), we have conducted a follow-up study of FRB 20121102A and its associated persistent radio source (PRS), which is a putative hyper-nebula powered by the FRB source. Our observations, which include a half-dozen bursts from FRB 20121102A, have allowed us to better constrain the position of the FRB source and its potential offset from the PRS. By combining data from 2016 and 2022, we have also placed constraints on the proper motion of the FRB source. Furthermore, we have found that the brightness of the PRS has remained constant over a span of >6 years, providing important clues about the nature of FRB 20121102A and its local environment.

Primary author: SNELDERS, Mark (ASTRON)

Presenter: SNELDERS, Mark (ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **53** Type: **Poster**

Towards Bayesian Inference of GRMHD model parameters from VLBI data

Wednesday, 17 May 2023 13:15 (1 minute)

Recent Event Horizon Telescope (EHT) observations of M87*and Sgr A* have proven to be an insightful data set to probe the spacetime and physical conditions in accreting supermassive black hole systems. For this purpose an ad hoc and fixed, pre-computed library of ~60,000 model images for M87*and about 1,800,000 for Sgr A* was used to sample black hole spin, magnetic flux on the horizon, inclination angle, and electron thermodynamics parameter Rhigh.
In this work we introduce the new capability of adaptive parameter estimation of models involving ray-traced images from given GRMHD simulations in a Bayesian scheme. The radiative transfer is done adaptively during the sampling via a Markov chain Monte Carlo (MCMC) algorithm without the need for a fixed model image library. We restrict the discussion here to an analysis with four parameters: accretion rate onto the black hole, electron temperature parameter Rhigh, observer viewing angle, and the position angle of the source on the sky.
We develop a pipeline by incorporating the general relativistic radiative transfer code ipole into the EHT parameter estimation tool THEMIS. The pipeline produces a ray-traced model image from GRMHD data, computes VLBI observables from the image for a specific VLBI array configuration and samples the likelihood surface via an MCMC scheme.
We find that our scheme recovers faithfully parameters from simulated data with known truth values and we illustrate its application to time variable models and datasets with more realistic errors.

Primary author: YFANTIS, Aristomenis (Radboud University)

Presenter: YFANTIS, Aristomenis (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **54** Type: **Contributed talk**

Probing particle acceleration in the famous cluster Abell 2256: from to 16 MHz to gamma rays

Tuesday, 16 May 2023 16:15 (15 minutes)

Merging galaxy clusters often host an impressive collection of diffuse radio sources. These diffuse synchrotron sources can be explained by a non-thermal pool of relativistic electrons accelerated by shocks and turbulence in the intracluster medium. The origin of the pool of relativistic electrons and details of the acceleration mechanisms in clusters are still open questions. Due to the often extremely steep spectral indices of diffuse radio emission, it is best studied at low frequencies. However, the lowest frequency window available to ground-based telescopes (10-30 MHz) has remained largely unexplored, as RFI and calibration problems related to the ionosphere become severe.
In this talk, I will present the deepest-ever image produced at decametre wavelengths, targeted on the famous cluster Abell 2256, made with the LOFAR telescope. By combining with literature data, we study the spectrum of cluster diffuse emission over three orders of magnitude in frequency. Finally, I will show how we can directly constrain the origin of the radio halo through the combination of the radio observations with upper limits from 13.5 years of observations of the Fermi Large Area Telescope in the gamma-rays.

Primary author: OSINGA, Erik (Leiden University)

Presenter: OSINGA, Erik (Leiden University)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **55** Type: **Contributed talk**

Studying the sources of reionisation with low-z galaxies

Tuesday, 16 May 2023 16:30 (15 minutes)

Cosmic reionisation is one of the last major milestones in the global evolution of the Universe: by z~6, the hydrogen in the intergalactic medium becomes fully ionised by the radiation produced predominantly by massive stars in star-forming galaxies. Because of the increasing opacity of the IGM, completing the census of these ionising sources is still a major challenge on both the observational and theoretical sides.
In the past few years, low-z star-forming galaxies have been used to study how ionising photons are produced and how they escape in the IGM. In this talk, I will present some results from the largest of these surveys to date, the Low-Redshift Lyman Continuum Survey. I will then show how results obtained from these low-z studies can be applied to the Epoch of Reionisation by making use of semi-analytical tools.

Primary author: TREBITSCH, Maxime (Kapteyn Astronomical Institute)

Presenter: TREBITSCH, Maxime (Kapteyn Astronomical Institute)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **56** Type: **Poster**

Gaia DR3 view of dynamical substructure in the local stellar halo

Wednesday, 17 May 2023 13:15 (1 minute)

Galaxies stellar haloes are known to build up through the accretion of smaller systems, with stars from a single merger being deposited onto similar orbits. Since orbits can be characterized by their integrals of motion such as energy or angular momenta, we can thus search for the stellar debris of past accretion events by looking for over-densities in integrals of motion space (IOM). Using the Gaia DR3 data-set we identify such merger debris in the Milky Way halo near the Sun. We utilise a parameter-free clustering algorithm that allows us not only to find over-densities in IOM space but also to assess their statistical significance. We characterise the statistically significant over-densities using metallicity and chemical abundance information from Gaia DR3, LAMOST LRS DR7 and APOGEE DR17. We find that the local stellar halo contains 7 main dynamical groups, including in-situ structures, several previously known accreted substructures and one new substructure. In addition, we identify a large number of smaller clumps that are interesting dynamically with chemistry suggestive of an accreted origin. I will present an updated view of the Milky Way's accretion history that emerges from this analysis.

Primary author: DODD, Emma

Presenter: DODD, Emma

Session Classification: Poster Prizes & closing

Contribution ID: **57** Type: **Poster**

Sub-haloes or systematics: Flux ratios anomalies of quadruply lensed radio AGN

Wednesday, 17 May 2023 13:15 (1 minute)

Anomalous flux ratios between lensed images can provide a key test of the dark matter sub-halo population, and hence the properties of dark matter particles. However, the observed anomalous flux ratios at radio frequencies can also be the result of systematics associated with our lack of knowledge about the source structure, source variability, and propagation effects within the lensing galaxy. Removing or ruling-out these systematic effects is crucial for confirming and improving existing constraints on dark matter. Here, I present some early results of high-resolution imaging with the High Sensitivity Array and monitoring with the Very Large Array at 15 GHz of a sample of 6 radio-loud lensed quasars. In some cases, the high resolution imaging shows evidence of extended source structure, which provides a more accurate determination of the image magnification's compared to when assuming a point source. From high cadence monitoring, we rule out any intrinsic source variability for the systems analysed thus far. However, we do find evidence for a frequency-dependent flux ratio in at least one case, likely from free-free absorption within the lensing galaxy, and scattering of the lensed images by the ionised medium in the lens.

Primary author: WEN, Di (Kapteyn Astronomical Institute, University of Groningen)

Presenter: WEN, Di (Kapteyn Astronomical Institute, University of Groningen)

Session Classification: Poster Prizes & closing

Contribution ID: **58** Type: **Poster**

Become a programme coordinator at NWO, the Dutch Research Council

Wednesday, 17 May 2023 13:15 (1 minute)

Are you considering a career change and would you like to remain closely involved in scientific research but from a different perspective? Maybe working at NWO, the Dutch research council, is something for you! NWO welcomes new employees with a scientific background to facilitate the funding of outstanding research and to help define strategies for funding research. Become a programme coordinator! Good Dutch written and verbal skills are required.

Primary author: Dr UYTTERHOEVEN, Katrien (NWO (Dutch Research Council))

Co-authors: Dr GIESE, Claudia-Corina (NWO (Dutch Research Council)); Dr JONGBLOED, Linda (NWO (Dutch Research Council)); Dr VAN DEN BERG, Maureen (NWO (Dutch Research Council)); Dr MATHEUSSEN, Saskia (NWO (Dutch Research Council))

Presenter: Dr UYTTERHOEVEN, Katrien (NWO (Dutch Research Council))

Session Classification: Poster Prizes & closing

Contribution ID: **59** Type: **Contributed talk**

Dense Forests of Microshots in Fast Radio Bursts

Monday, 15 May 2023 16:00 (15 minutes)

Fast Radio Bursts are millisecond duration, extragalactic, coherent flashes of radio emission. Some repeating fast radio bursts are exceptionally more active than others. FRB 20220912A was discovered in the last quarter of 2022 as it entered an intense active period. During this time, we detected many bursts as part of our repeating FRB monitoring campaign on the Nançay Radio Telescope, ECLAT (Extragalactic Coherent Light from Astrophysical Transients). I will introduce ECLAT and report on some exceptionally bright bursts detected from FRB 20220912A. These detections are further enhanced by the excellent time resolution (16 μs), bandwidth (512 MHz) and dynamic range (32 bit) of the NRT data. Additionally we have overlapping raw-voltage observations for some bursts making use of the Westerbork RT-1 25-m dish, enabling us to probe time and frequency scales every further, down to the Nyquist limit. We see dense forests of clustered microshots in the bursts (~ 16 μs) that are extremely bright (occasionally exceeding a S/N of 1000). After correcting for the dispersion measure, an additional residual drift is present in wider subburst components. We propose that the emission mechanism that causes the bright microshots is potentially different from the one responsible for the wider components, phenomenologically analogous to different types of solar radio bursts and potentially caused by a magnetar flare.

Primary author: HEWITT, Danté (University of Amsterdam)

Presenter: HEWITT, Danté (University of Amsterdam)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **60** Type: **Poster**

Low-frequency radio observations of recurrent nova RS Ophiuchi with MeerKAT and LOFAR

Wednesday, 17 May 2023 13:15 (1 minute)

We report low-frequency radio observations of the 2021 outburst of the recurrent nova RS Ophiuchi. These observations include the lowest frequency observations of this system to date. Detailed light curves are obtained by MeerKAT at 0.82 and 1.28 GHz and LOFAR at 54 and 154 MHz. These low-frequency detections allow us to put stringent constraints on the brightness temperature that clearly favour a non-thermal emission mechanism. The radio emission is interpreted and modelled as synchrotron emission from the shock interaction between the nova ejecta and the circumbinary medium. The light curve shows a plateauing behaviour after the first peak, which can be explained by either a non-uniform density of the circumbinary medium or a second emission component. Further modelling of the light curves allows us to constrain the red giant mass loss rate. Radio emission from stellar wind or synchrotron jets are ruled out as the possible origin of the radio emission. Finally, we suggest a strategy for future observations that would advance our understanding of the physical properties of RS Oph.

Primary author: DE RUITER, Iris (Anton Pannekoek Institute/University of Amsterdam)

Presenter: DE RUITER, Iris (Anton Pannekoek Institute/University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **61** Type: **Contributed talk**

The flaring potential of plasmoid formation around black holes

Monday, 15 May 2023 16:30 (15 minutes)

The flaring events observed in the Sagittarius A* supermassive black hole system can be attributed to the nonhomogeneous nature of the near-horizon accretion flow. Bright regions in this flow may be associated with density or temperature anisotropies, corresponding to so-called “bright spots” or “hot spots.” Such orbiting features may explain observations at infrared wavelengths, as well as recent findings at millimeter wavelengths. A physical mechanism that could explain the formation of these hot spots is the creation of magnetic islands (or plasmoids) after a magnetic reconnection event. We present a novel method for detecting these plasmoids in a suite of two-dimensional general-relativistic magnetohydrodynamical simulations. This enables us to better understand the plasmoids’ plasma composition and flaring potential.

Primary author: VOS, Jesse (Radboud University)

Presenter: VOS, Jesse (Radboud University)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **62** Type: **Contributed talk**

The binary fraction of carbon/oxygen-rich Wolf-Rayet stars (WC/WO) in the Large Magellanic Cloud: Uncovering the companions of immediate black-hole progenitors

Wednesday, 17 May 2023 12:15 (15 minutes)

Since the first detection by LIGO in 2015, gravitational-wave detectors observe mergers of black holes which formed in the low-metallicity, high-redshift Universe. A main uncertainty in our understanding of these mergers is the evolution of the progenitor stars of these black holes –stars more massive than ~20 solar masses. WC/WO stars are hot, post main-sequence stars with powerful winds that have lost their outer layers through processes related to stellar winds or binary interactions. They are thought to represent the final phase prior to core-collapse into black holes. However, it remains unknown how often they reside in binary systems and it is unclear what role companions play in forming them. Especially in lower metallicity environments such as those of the Magellanic Clouds, where stellar winds are weak, the majority of WC/WO stars were proposed to be the products of binary interaction. However, out of all 28 WC/WO stars in the Large Magellanic Cloud only 3 have been confirmed as binaries, while ~70% of their massive-star progenitors host a close companion. Should we revise our theories, or did we miss some companions in our search?

I will present results from a modern radial-velocity survey of the complete sample of WC/WO stars in the LMC to derive their bias-corrected multiplicity properties. Over 18 months, 6 spectra were taken with the X-SHOOTER spectrograph on the Very Large Telescope. In my talk, I will describe the monitoring spectroscopic survey and present preliminary conclusions on the production of Wolf-Rayet stars at subsolar metallicity environments.

Primary author: TEMMING, Freek (University of Amsterdam)

Presenter: TEMMING, Freek (University of Amsterdam)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **63** Type: **Contributed talk**

Observations of the Sun and Heliosphere Using LOFAR for a Coordinated Ground- and Space-Based Approach to Space-Weather Research.

Wednesday, 17 May 2023 12:30 (15 minutes)

Understanding and modelling the complex state of the Sun-solar wind-heliosphere system, requires a comprehensive set of multiwavelength observations. LOFAR has unique capabilities in the radio domain. Some examples of these include: a) the ability to take high-resolution solar dynamic spectra and radio images of the Sun; b) observing the ionospheric scintillation and the iterplanetary scintillation (IPS) of distant, compact, astronomical radio sources to determine the density, velocity and turbulence structure of the solar wind; and c) the use of Faraday rotation as a tool to probe the interplanetary magnetic-field strength and direction. However, to better understand and predict how the Sun, its atmosphere, and more in general the Heliosphere works and impacts Earth, the combination of in-situ spacecraft measurements and ground-based remote-sensing observations of coronal and heliospheric plasma parameters is extremely useful. The PSP mission is observing the solar corona and near-Sun interplanetary space. Two instruments on the spacecraft are of particular interest, FIELDS measuring the radio emission, electric and magnetic fields, and WISPR imaging coronal streamers, coronal mass ejections (CMEs), their associated shocks, and other solar wind structures in the corona and near-Sun interplanetary space. In this talk, the different observing modes of LOFAR and several results of the joint LOFAR/PSP campaign will be presented, including fine structures of radio bursts, localization and kinematics of propagating radio sources in the heliosphere, and the challenges and plans for future observing campaigns including PSP and Solar Orbiter.

Primary author: ZUCCA, Pietro (ASTRON)

Presenter: ZUCCA, Pietro (ASTRON)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **64** Type: **Contributed talk**

Using a [CII]-selected sample of companion galaxies to quantify the contribution of dust-obscured star formation at z ~ 6

Wednesday, 17 May 2023 09:45 (15 minutes)

One of the most exciting frontiers in extragalactic astronomy is understanding how rapidly galaxies formed stars in the Early Universe. This involves us constraining the Star Formation Rate Density (SFRD) at z >~ 6. Given the much greater ease in surveying the z > 4 universe in the rest-UV, the SFRD at z > 4 is biased to the unobscured, less dusty sources. Recent work shows that the dust-obscured sources could contribute quite meaningfully, up to 40-60%, to the z > 6 SFRD. Here we present a new method for correcting the SFRD at z ~ 6 for dust-obscured galaxies missed by rest-UV surveys. This method uses serendipitous sources found through [CII] (158 μm) emission which is sensitive to both dust-obscured and unobscured star formation. The advantage of this method over using galaxies that are UV-selected is that we are not biased to unobscured sources. Using a sample of serendipitous sources detected by ALMA, we characterize the obscuration in galaxies as a function of their total star formation rate and derive a corrected UV luminosity function and SFRD at z ~ 6. We find that the obscured fraction of the SFR is larger than one would expect from commonly used dust-corrections, such as the IRX-M_*relation. This motivates investigating more resources probing the obscured SFR density at z > 4, both of use to techniques like our own and also for more direct searches of obscured star forming systems at z > 6.

Primary author: VAN LEEUWEN, Ivana (Leiden Observatory)

Co-authors: Dr BOUWENS, Rychard (Leiden Observatory); SCHOUWS, Sander (Leiden Observatory)

Presenter: VAN LEEUWEN, Ivana (Leiden Observatory)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **65** Type: **Poster**

Expanding Sgr A* dynamical imaging capabilities with an African extension to the Event Horizon Telescope

Wednesday, 17 May 2023 13:15 (1 minute)

The Event Horizon Telescope (EHT) has recently published the first images of the supermassive black hole at the center of our Galaxy, Sagittarius A* (Sgr A*). Imaging Sgr A* is plagued by two major challenges: variability on short (approximately minutes) timescales and interstellar scattering along our line of sight. While the scattering is well studied, the source variability continues to push the limits of current imaging algorithms. In particular, movie reconstructions are hindered by the sparse and time-variable coverage of the array. In this work, we discuss the impact of the planned Africa Millimetre Telescope (AMT, in Namibia) and Canary Islands telescope (CNI) additions to the time-dependent coverage and imaging fidelity of the EHT array. This African array extension to the EHT further increases the eastwest (u, v) coverage and provides a wider time window to perform high-fidelity movie reconstructions of Sgr A* . Moreover, I will show that the combination of two telescopes on the African continent, in Namibia and in the Canary Islands, produces a very sensitive array to reconstruct the variability of Sgr A* on horizon scales.

Primary author: LA BELLA, Noemi (Radboud University)

Presenter: LA BELLA, Noemi (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **66** Type: **Poster**

Unveiling disk wind features in low mass X-ray binaries

Wednesday, 17 May 2023 13:15 (1 minute)

Primary author: Mr VAN EEDEN, Simon (University of Amsterdam)

Presenter: Mr VAN EEDEN, Simon (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **67** Type: **Poster**

The Blue Compact dwarf galaxy UM 462 as laboratory to learn about stellar feedback in primeval galaxies

Wednesday, 17 May 2023 13:15 (1 minute)

Stellar feedback in high-redshift galaxies plays an important, if not dominant, role in the re-ionization epoch of the Universe. Because of their extreme star formation, very nearby Blue Compact Dwarf galaxies (BCDs) postulate as favorite local analogs where to carry out detailed studies to anchor our investigations on high-redshift galaxies. In this contribution, we will discuss recent results on a detailed study of an extreme BCD, UM 462, based on high quality optical integral field spectroscopy data obtained with MUSE. The galaxy has emission line ratios and equivalent widths, stellar mass, and metallicity similar to the targets now regularly observed at z>~7 by JWST, thus ideally suited as corner stone and reference galaxy. We will jointly discuss the ionised gas and the stars. We will present results on the 2D distribution of the physical and chemical properties, as well as the kinematics and ionisations mechanism of the ionised gas. Besides, we will present an overview of the stellar populations in the system, including the presence of Wolf-Rayet stars and supernova remnants.

Primary author: MONREAL IBERO, Ana

Presenter: MONREAL IBERO, Ana

Session Classification: Poster Prizes & closing

Contribution ID: **68** Type: **Contributed talk**

Anomalous HI gas around MHONGOOSE galaxy NGC 5068

Wednesday, 17 May 2023 11:15 (15 minutes)

How galaxies replenish their gas supply in order to sustain star formation, is a research topic of many of the new and upcoming neutral atomic hydrogen (HI) surveys on the SKA precursor instruments.
I present recent deep HI observations of NGC 5068, an isolated nearby star-forming galaxy observed by MeerKAT as part of the MHONGOOSE survey. This survey is the deepest HI survey of nearby galaxies until the advent of the SKA and is reaching column densities of NHI (3sigma) ~3x10^19 cm^-2 at 11”to ~7x10^17 cm^-2 at 90”resolution. These deep observations show that the galaxy comprises of three components: a settled, regularly rotating inner disk that is coincident with the star-forming disk, a more chaotic warped outer disk, and a third component that comprises of a number of clouds to the north west of the galaxy that appear to be linked to “fingers” of HI seen stretching out from the inner HI disk. While the origin of these features remains a mystery for now, the dynamics of the main galaxy disk and the warped outer disk, as well as the morphology of the fingers and clouds, do not seem to suggest a previous merger event. It is possible that we are observing accretion of HI onto the disk of NGC 5068

Primary author: HEALY, Julia (ASTRON)

Presenter: HEALY, Julia (ASTRON)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **69** Type: **Poster**

AutoSourceID-FeatureExtractor. Optical images analysis using a Two-Step Network for accurate feature estimation and uncertainty characterization.

Wednesday, 17 May 2023 13:15 (1 minute)

In astronomy, machine learning has succeeded in various tasks, such as source localization, classification, anomaly detection, and segmentation. However, feature regression remains an area with room for improvement.
We aim to design a network that can accurately estimate sources'features and their uncertainties from single-band image cutouts. The algorithm presented here, AutoSourceID-FeatureExtractor (ASID-FE), uses single-band cutouts of 32x32 pixels around the localized sources to estimate flux, more accurate centre coordinates and their uncertainties. The method uses two convolutional neural networks (CNN) in a two-step approach to first estimate the features and then their uncertainties without the need for any additional information.
We show that ASID-FE, trained on synthetic images from the MeerLICHT telescope, can predict more accurate features with respect to similar codes like SExtractor and that the two-step method can estimate well-calibrated uncertainties that are better behaved compared to similar methods that use deep ensemble regression techniques. Finally, we evaluate the model on real images from the MeerLICHT telescope to test its transfer learning abilities.

Primary author: STOPPA, Fiorenzo (Radboud University)

Co-authors: Dr RUIZ DE AUSTRI, Roberto (nstituto de Física Corpuscular, Valencia); Dr VREESWIJK, Paul (Radboud University); Dr BHATTACHARYYA, Saptashwa (Center for Astrophysics and Cosmology, University of Nova Gorica); Prof. CARON, Sasha (Radboud University); Dr BLOEMEN, Steven (Radboud University); Prof. ZAHARIJAS, Gabrijela (Center for Astrophysics and Cosmology, University of Nova Gorica); Prof. CATOR, Eric (Radboud University); Prof. NELEMANS, Gijs (Radboud University)

Presenter: STOPPA, Fiorenzo (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **70** Type: **Poster**

Wide-field Spectroscopic Telescope design options

Wednesday, 17 May 2023 13:15 (1 minute)

Wide-field Spectroscopic Telescope (WST) is a project of a next generation 10m-class telescope intended for spectroscopic surveys. It will include a multi-object spectrograph (MOS) unit covering a large field from 2.5 to 5 square degrees and providing medium (up to R7000) and high (R40 000) resolution spectra in the range of 360-1300 nm with a high multiplex of 20 000 and 2000, respectively. It will work simultaneously with a panoramic integral field spectrograph (IFS) operating in 79 square arcmin field with the spectral resolution of R5000 in the range of 360-970 nm. The telescope design must provide coverage of the maximum possible field of view, with a good and uniform seeing-limited image quality and minimum obscuration. The MOS branch requires a fast F/3 beam, while the IFS should work with the F/# of approximately 30. In addition, it should have atmospheric dispersion compensation (ADC) functionality. Currently we consider two telescope design options, which can fit these challenging specifications –a Cassegrain telescope with wide-field lens corrector and a Four-mirror anastigmate. In both of the cases the ADC is implemented with a set of decentering lenses. In each case the IFS branch is fed by a Korsch-type system. In the present work we discuss the main difficulties related to the telescope performance and packaging and possible technical solutions and compromises.

Primary authors: MUSLIMOV, Eduard (NOVA-ASTRON); NAVARRO, Ramon (NOVA)

Presenter: MUSLIMOV, Eduard (NOVA-ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **71** Type: **Poster**

Pollux: a European high-resolution spectropolarimeter for the Habitable Worlds Observatory

Wednesday, 17 May 2023 13:15 (1 minute)

Habitable Worlds Observatory is a next-generation space telescope started by NASA following the recommendation of the US astronomy decadal survey in 2021. It will combine the key features of LUVOIR-B and HabEx projects and promises to provide unprecedented capabilities for exoplanetary science and astrophysics. As a continuation of our study for LUVOIR-A project, we propose a European-led, high-resolution spectropolarimeter, Pollux, to become part of the telescope payload. Pollux includes a core instrument consisting of two channels operating in the near (236-472 nm) and medium (118-236 nm) ultraviolet with the spectral resolution of R=133 000 and 95 000, respectively. The corresponding instrument's maximum throughput values are 17 and 10%. Each of the channels represents an echelle spectrograph with a dedicated birefringent polarimeter and a concave toroidal grating acting as the camera mirror and cross-disperser. We also suggest to supplement it with one or two additional channels. A visible-NIR (427-1050 nm) option is more easily feasible. It could be based on an echelle spectrograph with cross-dispersing immersed grating and a simple refractive camera working with a birefringent polarimeter. Using optical components with high technological readiness and using the experience of building ground-based instruments like X-Shooter NIR, we expect to reach the resolution of R=77 000 and maximum throughput of 62%. A more challenging option is to create a dedicated far UV (below 120 nm) channel based on either a large (>210mm) echelle grating with high resolution R=120 000 or a single concave grating (~60 mm) with a medium resolution of R=18 000.

Primary authors: MUSLIMOV, Eduard (NOVA-ASTRON); Dr NEINER, Coralie (LESIA, Observatoire de Paris); Dr BOURET, Jean-Claude (Laboratoire d'Astrophysique de Marseille)

Presenter: MUSLIMOV, Eduard (NOVA-ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **72** Type: **Poster**

The Outcome of Massive Star Formation

Wednesday, 17 May 2023 13:15 (1 minute)

Runaway stars (massive stars moving away from the star clusters where they were born at unusually high velocities) have been observed for more than half a century, yet the origins of these high velocities remain elusive to this day. One of the most prominent theories for the origins of runaway stars is the dynamical ejection scenario in which binaries are thought to dynamically interact with either single stars or other binaries and in doing so eject stars from the star cluster. In my project, I explore the dynamical ejection scenario and the conditions under which massive stars are ejected from star clusters through simulations with AMUSE (the Astrophysical Multipurpose Software Environment).

In this poster I present simulations of young star clusters evolved until runaways are detected. The simulations use a variation of initial conditions and parameters such as the initial number of stars, binary fraction, and binary period distribution. Preliminary results show that the majority of ejected stars in these simulations have significantly lower masses and velocities than the massive runaways observed, even under a range of different initial conditions.

Primary author: CURTIS, Beatrix (University of Amsterdam)

Co-authors: KAPER, Lex (Anton Pannekoek Institute); RIEDER, Steven (Geneva Observatory, University of Geneva)

Presenter: CURTIS, Beatrix (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **73** Type: **Poster**

Radio emission as a stellar activity indicator

Radio observations are excellent probes of the environmental conditions in the coronae/magnetospheres of stars and brown dwarfs. In particular, radio emission traces the impact of stellar plasma on exoplanet atmospheres, the processes of coronal heating, and key parameters for assessing exo-habitability. The strong magnetic field of these stellar systems leads to radio emission via different mechanisms such as gyrosynchrotron radiation, electron cyclotron maser instability, and plasma oscillation. As the ongoing LOFAR Two-metre Sky Survey (LoTSS) and VLA Sky Survey (VLASS) are some of the deepest and most sensitive radio sky surveys ever conducted, I shall present our latest efforts on identifying different radio emissions from stellar systems in these surveys. By using the radio-detected population's properties, I shall differentiate the two possible acceleration mechanisms (the so-called engines): (a) chromospheric/coronal acceleration similar to that observed on the Sun, and (b) magnetospheric acceleration occurring far from the stellar surface similar to that observed on Jupiter. Since one expects stars to have Sun-like engines, and brown dwarfs to have Jupiter-like engines, our aim is to search for a transition from one to another in the realm of M dwarfs: the tail of the main-sequence stars. Furthermore, to understand how stellar activity impacts radio detectability, I shall also investigate whether the radio detection rate in our samples correlate with canonical activity indicators in the optical and X-ray bands.

Primary author: YIU, Timothy Wing Hei (ASTRON, the Netherlands Institute for Radio Astronomy; Kapteyn Astronomical Institute, University of Groningen)

Presenter: YIU, Timothy Wing Hei (ASTRON, the Netherlands Institute for Radio Astronomy; Kapteyn Astronomical Institute, University of Groningen)

Session Classification: Poster Prizes & closing

Contribution ID: **74** Type: **Contributed talk**

Search for Intermediate mass Black Holes using optical variability

Monday, 15 May 2023 15:15 (15 minutes)

Active Galactic Nuclei (AGN) are intrinsically variable sources. The observed variability in the optical can be explained as the sum of the reprocessing of very fast variations in the far UV or X-rays, and intrinsic variability from the accretion disk. Considering only reprocessing, which most likely corresponds to the fastest varying component, we can associate the shortest timescale of variability to the light-travel time of the variable signal from the inner regions to the region of reprocessing. Therefore, we can relate fast optical variability with a smaller accretion disk surrounding a small black hole. For instance, NGC 4395 holds a 4x10^5 solar mass black hole and presents optical variability in timescales of hours. Martinez-Palomera et al. 2020 presented the Search for Intermediate mass BLack holes (SIBLING) survey, a sample of low redshift galaxies selected by fast optical variability in their nuclei. In this research, we test the reliability of SIBLING by revisiting the photometry utilizing Image Subtraction. Additionally, we do the same analysis for the Eridanus group, which is part of the Dorado-Fornax-Eridanus complex and has about 50 galaxy members. The proximity of this system makes it ideal for a detailed follow-up of IMBH candidates. The software used to process the images and construct the light curves is the state-of-art LSST Science Pipelines. For the results of this work, we present the constructed light curves and the selection of fast variable sources for Eridanus and SIBLING.

Primary author: CÁCERES-BURGOS, Paula (University of Groningen)

Presenter: CÁCERES-BURGOS, Paula (University of Groningen)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **75** Type: **Poster**

Latent space out-of-distribution detection of galaxies for deblending in weak lensing surveys

Wednesday, 17 May 2023 13:15 (1 minute)

Upcoming surveys such as the Legacy Survey of Space and Time (LSST) will image billions of galaxies to extract the faint weak lensing signal for cosmological parameter inference. A pressing issue is that 50% of the galaxies will be "blended", where its projection on our detectors will overlap with other astronomical objects along the same line of sight. Without appropriate "deblending" algorithms, the blends add an unacceptable bias and variance to the weak lensing signal.
The most promising deblending algorithms use deep neural networks (DNNs), which are known to be highly sensitive to a difference in the distributions of the training and validation datasets. Many galaxies and blends observed by the LSST will be out of distribution (o.o.d.) compared to the (simulated) training data and therefore the DNNs will perform poorly on them. We have developed a method to classify blends on being o.o.d. or in-distribution (i.i.d.) based on the distribution of an input blend sample in the latent space of a β-VAE, compared to the latent space distribution of the training sample.
The blends flagged as o.o.d. can, in future pipelines, be separated from the i.i.d. blends to prevent contamination of the weak lensing signal or be deblended with a method specifically tuned to o.o.d. blends. We will present the first results of the o.o.d. flagging and the resulting reduction on the error of shear and photometry measurements. Future work lies with increasing the diversity of the training data distribution to increase the i.i.d. to o.o.d. ratio.

Primary author: MES, Jelle (Leiden Observatory)

Presenter: MES, Jelle (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **76** Type: **Contributed talk**

The radio star AU Microscopii: Hunting for signatures of star-planet interaction in the presence of stellar activity

Monday, 15 May 2023 15:15 (15 minutes)

A key question in stellar astronomy is whether there are habitable planets around stars other than our Sun. An important factor in determining this is stellar activity, as stellar eruptions have direct impact on the atmosphere of an exoplanet. Radio emission, especially with a high degree of circular polarization, can provide a direct measurement of the magnetic field and the plasma properties of the star. Although many stars have been observed at radio frequencies, very few have been studied extensively enough to see the full phenomenology of radio emission. In this talk, I will present our year-long observing campaign of AU Microscopii, a young M-dwarf system with three detected planets. This system has been studied in detail at many wavelengths, but not at radio frequencies. With over 100 hours of observations, this campaign has allowed us to describe and categorize different types of stellar radio emission in a detail never before attainable for a single star. This includes characterizing rare types of emission such as those similar to solar radio bursts and Jovian magnetospheric emission. I will conclude with an interpretation of the physical processes causing these types of emission.

Primary author: BLOOT, Sanne (ASTRON / Kapteyn Astronomical Institute)

Presenter: BLOOT, Sanne (ASTRON / Kapteyn Astronomical Institute)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **77** Type: **Contributed talk**

Low mass galaxies in the Apertif HI surveys

Tuesday, 16 May 2023 15:30 (15 minutes)

Low mass galaxies present great challenges for the current leading cosmological model ΛCDM. Hydrodynamical simulations based on ΛCDM have been unsuccessful in reproducing a number of galaxy properties at these scales, such as the diversity in the shapes of rotation curves as well as the scatter seen in scaling relations such as the baryonic Tully-Fisher (BTFR) and stellar mass-size relation. Additionally, ultra-diffuse galaxies have been shown to deviate from the BTFR, which is considered a very tight scaling relation for rotating galaxies. In general, there is currently a poor understanding of how the baryonic content of galaxies connects to the dark matter content at low mass scales. In this work, we aim to contribute to this understanding by studying resolved neutral hydrogen (HI) content which allows us to conduct kinematic modelling of galaxy rotation using ^{3D}Barolo. We select our sample using the first few months of observations from the Apertif HI surveys. By basing our selection on a blind HI survey, we are able to find galaxies independent of their stellar content, meaning we are able to easily find optically faint galaxies. To study the complete baryonic content, we complement our HI data with Pan-STARRS 1 photometric survey allowing us to explore the placement of our HI-selected low mass galaxies with regards to samples from the literature in both BTFR and stellar mass-size relation.

Primary authors: ŠILJEG, Barbara; Dr ADAMS, Elizabeth A. K. (ASTRON and Kapteyn Astronomical Institute); Prof. FRATERNALI, Filippo (Kapteyn Astronomical Institute); Dr HESS, Kelley (Instituto de Astrofísica de Andalucía)

Presenter: ŠILJEG, Barbara

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **78** Type: **Poster**

Dynamical Interactions in young stellar clusters

Wednesday, 17 May 2023 13:15 (1 minute)

Primary author: PATEL, Maitrey (Anton Pannekoek Institute, University of Amsterdam)

Co-authors: CURTIS, Beatrix (University of Amsterdam); KAPER, Lex (Anton Pannekoek Institute); RIEDER, Steven (Geneva Observatory, University of Geneva)

Presenter: PATEL, Maitrey (Anton Pannekoek Institute, University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **79** Type: **Poster**

Modeling planetary mass-loss of metal rich atmosphere for sub-Neptune size planets

Wednesday, 17 May 2023 13:15 (1 minute)

Primary authors: Prof. OKLOPČIĆ, Antonija (University of Amsterdam); Mr LINSSEN, Dion (University of Amsterdam); SHIH, Jim (University of Amsterdam)

Presenter: Prof. OKLOPČIĆ, Antonija (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **80** Type: **Poster**

Modelling the escape of Lyman Continuum photons from galaxies in the Epoch of Reionization

Wednesday, 17 May 2023 13:15 (1 minute)

We couple the DELPHI framework for galaxy formation with a model for the escape of ionizing photons to study both its variability with galaxy assembly and the resulting key reionization sources. In this model, leakage either occurs through a fully ionized gas distribution (ionization bounded) or additionally through channels cleared of gas by supernova explosions (ionization bounded + holes). The escape fraction is therefore governed by a combination of the density and star formation rate. Having calibrated our star formation efficiencies to match high-redshift observables, we find the central gas density to regulate the boundary between high (>0.70) and low (<0.06) escape fractions. As galaxies become denser at higher redshifts, this boundary shifts from Mh~10^9.5Msol at z~5 to Mh~10^7.8Msol at z~15. While leakage is entirely governed through holes above this mass range, it is not affecting general trends for lower masses. We find the co-evolution of galaxy assembly and the degree of leakage to be mass and redshift dependent, driven by an increasing fraction of fesc<0.06 galaxies at increasing mass and redshift. The variability in the escape of ionizing photons is driven by the underlying variations in our dark matter assembly histories. Galaxies with Mh<10^7.9 (10^8.9)Msol provide half of the escaping ionizing emissivity by z~10(5) in the ionization bounded model. On the other hand, galaxies that purely leak through holes contribute 6 (13)% at z~5(15). Reionization ends slightly (~50Myr) earlier in the ionization bounded + holes model, leaving the overall shape of the reionization history unaffected.

Primary author: BREMER, Jonas (Kapteyn Institute)

Co-author: DAYAL, Pratika (Kapteyn Institute, Groningen University)

Presenter: BREMER, Jonas (Kapteyn Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **81** Type: **Poster**

ED-2: a 360 degree stellar stream crossing the solar neighbourhood

Wednesday, 17 May 2023 13:15 (1 minute)

ED-2 is a stellar stream identified in integrals of motion on the third Gaia data release. It forms a compact group in energy and angular momentum in a local sample (<3 kpc), and its stellar population resembles one of an old metal-poor simple stellar population. It forms a compact group in the R-z (or x-z) plane, showing a ribbon-like structure in the solar neighbourhood, crossing the Sun's position. Its orbit is most similar the globular clusters NGC 3201 and NGC 6101, and the stellar stream Ylgr and Phlegethon. Of a total of 12 unique members with a metallicity (low-res LAMOST), we find the stream to have [Fe/H] = -2.5 $\pm$ 0.25. ED-2 seems to be in a similar category as the recently discovered Phoenix and C-19 stellar streams, being the third most metal-poor stream in the halo. Stellar streams have long been a promising proxy for dark matter (total mass and granularity) in the Galaxy outskirts, however these new metal poor streams are challenging our expectations regarding the number and properties of these objects. Better understanding these progenitor-less streams and where they stem from is crucial to better use streams as proxies of the Galaxy properties, especially in the imminence of Rubin's LSST, which is likely to reveal dozens of new stellar streams. ED-2 is a unique target right at our doorstep, giving us access to a very metal-poor stellar population that can be studied in great detail.

Primary author: BALBINOT, Eduardo (Leiden and RUG)

Presenter: BALBINOT, Eduardo (Leiden and RUG)

Session Classification: Poster Prizes & closing

Contribution ID: **82** Type: **Poster**

Learning reionization history from high-redshift quasars

The damping wing signature of high-redshift quasars in the intergalactic medium (IGM) provides a unique way of probing the history of reionization. Next-generation surveys will collect a multitude of spectra that call for powerful statistical methods to constrain the underlying astrophysical parameters such as the global IGM neutral fraction as tightly as possible. Inferring these parameters from the observed spectra is challenging because non-Gaussian processes such as IGM transmission causing the damping wing imprint make it impossible to write down the correct likelihood of the spectra.

We will present a tractable Gaussian approximation of the likelihood that forms the basis of a fully differentiable Hamiltonian Monte-Carlo inference scheme. Our scheme can be readily applied to real observational data and is based on realistic forward-modelling of high-redshift quasar spectra including IGM transmission and heteroscedastic observational noise.

We improve upon our Gaussian likelihood approximation by learning the true likelihood with a likelihood-free version of the inference scheme. To this end, we train a normalizing flow as neural likelihood estimator as well as a binary classifier as likelihood ratio estimator and incorporate them into our inference pipeline.

We provide a full reionization forecast for Euclid by applying our procedure to a set of realistic mock observational spectra resembling the anticipated Euclid oberservations. By inferring the IGM neutral fraction as a function of redshift, we show that our method applied to upcoming observational data can significantly tighten present constraints on reionization history.

Primary author: KIST, Timo (Leiden Observatory)

Co-author: Prof. HENNAWI, Joseph F. (Leiden Observatory, UC Santa Barbara)

Presenter: KIST, Timo (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **83** Type: **Poster**

CARMENES high-resolution spectroscopy of young planet V1298 Tau b

Wednesday, 17 May 2023 13:15 (1 minute)

Primary authors: MRAZ, Georgia (University of Amsterdam); Dr BAEYENS, Robin (University of Amsterdam)

Co-authors: Ms SHIVKUMAR, Hinna (University of Amsterdam); Dr SIKORA, James (University of Amsterdam); Dr DESERT, Jean-Michel (University of Amsterdam); Dr ALLART, Romain (Université de Montréal); Mr BARAT, Saugata (University of Amsterdam); Dr PANWAR, Vatsal (University of Warwick)

Presenter: MRAZ, Georgia (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **84** Type: **Contributed talk**

AT2018cow and its environment at late times

Monday, 15 May 2023 15:30 (15 minutes)

AT2018cow is a well studied fast blue optical transient. Dispite a plethora of data, there is no consensus on the nature of the event. We use *HST* data between two and four years after the event to investigate the environment of this transient. Surprisingly there is still transient emission detected at the location of AT2018cow in this time period. This late time emission resembles emission from tidal disruption events, but we cannot rule out a peculiar supernova as the nature of the event.

Primary author: INKENHAAG, Anne (Radboud University)

Presenter: INKENHAAG, Anne (Radboud University)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **85** Type: **Poster**

The Synoptic Wide-field e-MERLIN EVN Program (SWEEPs)

Wednesday, 17 May 2023 13:15 (1 minute)

The high angular resolution and sensitivity of VLBI offers a unique tool to identify and study AGN and star-formation activity. Radio imaging across a large range of angular scales is needed to determine the role of black hole feedback and jet-induced star formation in galaxies. All-sky VLBI surveys can answer these questions and find rare radio sources, such as gravitational lenses. Despite recent technical advances only a limited part of the sky has been observed within a few well-studied fields. To enter the realm of large statistics, a significantly larger area must be observed. SWEEPs (Synoptic Wide-field e-MERLIN EVN Program) is a commensal survey mode for the e-MERLIN + EVN, where single-target PI-led observations are re-correlated at the position of all sources within 12 arcmins. The phase centres are selected using an e-MERLIN-only wide-field image generated during the initial correlation. This program can potentially observe ~9000 sources per year, yielding an expected 1900 VLBI detections without any additional observing. Here, we present preliminary results and methods from a pilot program, using a single target observation where we obtained 257 additional phase centres. In this study, we investigated imaging methods for the multiple angular scales of e-MERLIN + EVN, tested robust pipelines to accurately detect sources and studied the correlation and data processing requirements of this potential wide-field observing mode for the EVN. This understanding is important for its implementation as part of a future SKA-VLBI, a mode that will observe significantly more phase centres (1000s) due to SKA's increased sensitivity.

Primary authors: HERBE-GEORGE, Célestin (Kapteyn Institute); Prof. MCKEAN, John (Kapteyn Institute)

Presenter: HERBE-GEORGE, Célestin (Kapteyn Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **86** Type: **Poster**

Understanding Lyman continuum leaker candidates with MUSE, HST and JWST

Wednesday, 17 May 2023 13:15 (1 minute)

It has become clear in recent years, that the most important contributors of the ionising Lyman continuum photons at the epoch of reionisation are star-forming galaxies. To better understand their properties, we look at a sample of Lyman alpha emitters (LAEs) from MUSE at intermediate redshifts z=3-6.7 and find 12 Lyman continuum leaker candidates (Kerutt et al. in prep.) in the Hubble Deep Ultra Violet (HDUV) legacy survey (Oesch et al. 2018). I will present our analysis of these objects, which have escape fractions between 22% and 90%, assuming a high transmission in the intergalactic medium (IGM). However, contrary to observations at lower redshifts and predictions from models (e.g. Verhamme et al. 2017; Vanzella et al. 2020; Izotov et al. 2021), we do not find a strong correlation between the LyC escape fraction and the properties of the Lya line, such as the peak separation and the Lya equivalent width. A possible explanation for this discrepancy would be that the Lya photons do not originate from the same star-forming regions as the Lyman continuum emission we detect. We investigate this by using data from the JWST program FRESCO (PI Pascal Oesch), providing Ha line maps, which we compare to the Lya positions from MUSE.

Primary author: KERUTT, Josephine

Co-authors: Prof. CAPUTI, Karina; Prof. OESCH, Pascal

Presenter: KERUTT, Josephine

Session Classification: Poster Prizes & closing

Contribution ID: **87** Type: **Poster**

Modelling the dust properties and visibility of high-redshift galaxies

Wednesday, 17 May 2023 13:15 (1 minute)

Recent observations of high redshift galaxies are unveiling unexpected properties of early galaxy-formation. Observations in both rest-frame ultraviolet with the James Webb Space Telescope and rest-frame far-infrared with the Atacama Large Millimeter Array suggest an early population of bright massive galaxy, with a significant dust-obscuration already at redshift 7. To better understand the implications of those observations, we model the growth of galaxies and their dust content with the semi-analytical code DELPHI, which includes growth by mergers and accretion, star-formation, supernova feedback and dust evolution. We use the observed UV luminosity function from redshift 5 to 10 to constrain our model parameters: a star-formation efficiency of 15% and a coupling between supernova energy and ISM of 6%.
With this model we provide predictions of stellar mass function, dust masses, dust attenuation, dust temperatures, far-infrared luminosities and others, at all redshifts between 5 and 20. One of our main results is that to be consistent with the luminosity function of recent JWST detections at redshifts above 13, all the gas in galaxies has to convert into stars, with no feedback. This raises the question whether this population of galaxies is biased towards an unusually intensely star-bursting population, or has incorrect photometric redshifts. Otherwise, standard cosmology would need to be modified or we would need exotic stellar physics.

Primary author: MAUERHOFER, Valentin (Kapteyn Institute)

Co-author: Prof. DAYAL, Pratika (Kapteyn institute)

Presenter: MAUERHOFER, Valentin (Kapteyn Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **88** Type: **Poster**

Polycyclic Aromatic Hydrocarbon (PAH) radial transfer in planet forming disks

Wednesday, 17 May 2023 13:15 (1 minute)

Polycyclic aromatic hydrocarbons (PAHs) are very stable molecules made of aromatic carbon rings. Their prominent infrared features were found in interstellar space, in asteroids, and are one form of carbon in circumstellar disks. Even though they are not the dominant form of carbon, these molecules can be easily observed making them an object of active research interest. Professor Carsten Dominik and his PhD candidate, Kevin Lange, are currently working on investigating how PAHs interact with dust grains, such as freeze-out, desorption from grains under UV radiation, and migration onto grains to the inner parts of the disks. In this project, I am be building up on this work to model the radial transport of PAHs in planet forming disks using the 1D disk evolution code, DISKLAB.
With this, we aim at investigating local changes of the PAH abundance throughout the disk which will become relevant with the first observations from the James Webb Space Telescope.

Primary author: NOWOWIEJSKA, Maria (Anton Pannekoek Instituut)

Presenter: NOWOWIEJSKA, Maria (Anton Pannekoek Instituut)

Session Classification: Poster Prizes & closing

Contribution ID: **89** Type: **Poster**

Gravitational wave spectral synthesis

Wednesday, 17 May 2023 13:15 (1 minute)

Using stellar models from BPASS population synthesis, we calculate the full GW spectrum of a stellar population, including all types of compact binaries as well as those with living stars. We use these results to look at the detectability of star clusters with LISA. We find at late times the dominant sources are WD–WD binaries, but surprisingly at earlier times we find a significant population of NS–WD and BH–WD binaries. This suggests that star clusters may be strong emitters of GWs throughout their evolution.

Primary author: VAN ZEIST, Wouter (Radboud University)

Presenter: VAN ZEIST, Wouter (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **90** Type: **Poster**

Geometrical models of the linearly polarized pulsar radio emission in the presence of large-scale quadrupolar magnetospheric field

Wednesday, 17 May 2023 13:15 (1 minute)

For nearly six decades of pulsar radio astronomy virtually all observational data interpretation was based on a simplifying assumption that the external magnetic field of a neutron star is that of an inclined dipole. Dipole field model correctly predicts some of key properties of radio pulses, but on per-source basis the discrepancies are ubiquitous. Most recently, compelling evidence for a more complex global magnetic field was provided by modeling the waveforms of thermal X-ray pulsations from a few nearby recycled pulsars. In this work I simulate the behavior of position angle (PA) of the linearly polarized emission component within the framework of a classical Rotating Vector Model, but for a magnetic field with both dipolar and quadrupolar components. I find that for an observationally-supported range of relative magnetic component strength the behavior PA curves show much larger diversity than in the pure dipole case. In the presence of quadrupole field, PA curves can mimic classical S-swing shape for narrow on-pulse windows, however using them to estimate inclination and impact angles may lead to incorrect magnetospheric geometry inferences.

Primary author: BILOUS, Anna

Presenter: BILOUS, Anna

Session Classification: Poster Prizes & closing

Contribution ID: **91** Type: **Poster**

Studying Jeans Equations in the Milky Way disk

Wednesday, 17 May 2023 13:15 (1 minute)

Determining the circular velocity curve of a galaxy is a powerful tool for studying its overall shape. One can fit a potential and determine the dark matter distribution and density, or even the virial mass of the system.
One way of determining the rotation curve is through Jeans equations (Eilers et al. 2019, Ou et al. 2023). However, when using Jeans equations one needs to assume axisymmetry and time-independence. In this talk, I will show how the components in Jeans equations behave in different regions in the Milky Way disk, determined with *Gaia DR3* data. I will talk about how well the aforementioned assumptions hold up, and show what the uncertainty in our conclusions can be if they don't.
I will also show how an interaction with a Sagittarius-like perturber can change this analysis using an N-body simulation.

Primary author: KOOP, Orlin (Kapteyn Astronomical Institute, Rijksuniversiteit Groningen)

Co-authors: Prof. HELMI, Amina (Kapteyn Astronomical Institute, Rijksuniversiteit Groningen); Dr ANTOJA, Teresa (ICCUB, University of Barcelona)

Presenter: KOOP, Orlin (Kapteyn Astronomical Institute, Rijksuniversiteit Groningen)

Session Classification: Poster Prizes & closing

Contribution ID: **92** Type: **Poster**

Probing the transient and variable night sky with the Dutch-led multi-colour BlackGEM array

Wednesday, 17 May 2023 13:15 (1 minute)

In recent decades, numerous telescopes have been built to identify transients and periodic variables in the night sky. These telescopes have provided a boom in our understanding of the wide variety of transients and their progenitor systems in many astrophysical contexts. While the Northern hemisphere has enjoyed several dedicated telescopes observing both transient and periodic phenomena on various time-scales, the Southern hemisphere is relatively under-explored in comparison. The BlackGEM array is comprised of three telescopes with 6 filters located at the La Silla observatory in Chile and is tasked with rapidly identifying and characterising the electromagnetic counterparts to gravitational wave events detected by the LIGO-Virgo-KAGRA array. In addition to gravitational wave follow-up, BlackGEM and its predecessor MeerLICHT regularly identify transients of all types and provide dedicated high-cadence time-series observations of select fields down to 20th magnitude. In the talk, I will discuss the initial results of the BlackGEM mission and its five observing programs aimed at exploring
variability of the faint sky at multiple time scales. Specifically, I will present our sample of various transients as well as the initial
populations of O&B star binaries, compact binaries and compact pulsators contemporaneously observed in multiple filters. Finally, I will present the ongoing mission of BlackGEM to probe the multi-colour variability of the faint Southern sky.

Primary author: JOHNSTON, Cole (Radboud University)

Co-authors: Prof. GROOT, Paul (Radboud University); BLOEMEN, Steven (Radboud University)

Presenter: JOHNSTON, Cole (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **93** Type: **Contributed talk**

A coherent radio flash following a neutron star merger: The birth of a magnetar

Monday, 15 May 2023 13:25 (15 minutes)

The mergers of two neutron stars are exceptional multi-messenger events including short gamma-ray burst (GRB), gravitational wave and kilonova/afterglow emission. These events enable us to probe fundamental physics in one of the most extreme environments in the Universe. A key outstanding question is the remnant's nature: with its expected mass and rapid spin, it could either be a black hole or a supramassive, likely highly magnetised neutron star (a magnetar). Both can power a GRB, but rapidly spinning magnetars are additionally predicted to emit coherent radio bursts following their formation and may constitute a small fraction of the progenitors of fast radio bursts. Black holes, by contrast, are not expected to emit coherent radio bursts in the time following the GRB itself.
In this talk we will present rapid follow-up observations of the short GRB 201006A using LOFAR. We have detected an associated short, coherent radio flash at 144 MHz at 76.5 mins post-burst. The radio flash is tentatively shown to be highly dispersed, allowing a distance estimate, that is in the range of typical short GRB distances. This emission indicates prolonged activity from the central engine, further providing evidence that the merger remnant is a newborn magnetar and not a black hole. This discovery of a coincident radio burst with a short GRB demonstrates that searches for this emission could be highly useful for the multi-messenger campaigns following binary mergers of neutron stars and associated gravitational wave events.

Primary authors: ROWLINSON, Antonia (UvA & ASTRON); DE RUITER, Iris (Anton Pannekoek Institute/University of Amsterdam)

Presenter: ROWLINSON, Antonia (UvA & ASTRON)

Session Classification: Plenary Session

Track Classification: Time Domain

Contribution ID: **94** Type: **Contributed talk**

A search for ultra-high energy neutrinos particles using the Pierre Auger Observatory

Monday, 15 May 2023 15:00 (15 minutes)

Neutral particles play a crucial role in understanding the origin of ultra-high energy cosmic rays. Neutrinos keep the directional information as they are not deviated by the magnetic fields and would point back to the sources. In the 1.0 EeV energy range, neutrinos are expected to be produced in the same sources where cosmic rays are thought to be accelerated. The Radio Detector of the Pierre Auger Observatory is sensitive to neutrinos of all flavours above 1.0 EeV. The neutrinos interact through charged and neutral currents in the atmosphere giving rise to extensive air showers. When interacting deeply in the atmosphere at nearly horizontal incidence, neutrinos can be distinguished from regular hadronic cosmic rays by the geometry of the radio footprint of the air showers. In this talk, I will present an analysis based on down-going neutrinos using radio detectors and summarize the search procedure and the reconstruction of the air showers.

Primary author: KHAKURDIKAR, Abha (IMAPP, Radboud University)

Presenter: KHAKURDIKAR, Abha (IMAPP, Radboud University)

Session Classification: Parallel session

Track Classification: NOVA NW3

Contribution ID: **95** Type: **Poster**

The spectral history of exoplanet atmospheres due to hydrodynamic escape

Wednesday, 17 May 2023 13:15 (1 minute)

The evolution of stars on grand time-scales affect their surroundings in many ways. Due to their intrinsic rotation, causing strong magnetic activity, they vary greatly in radiative activity in X-ray and ultraviolet (XUV) throughout their lifetime. Planets orbiting these stars close-in could, consequently, be affected by these drastic radiative changes. Close-in exoplanet atmospheres heat up due to XUV radiation from the host-star, resulting in bulk motion of light particles. This extreme flow of light particles escaping the atmosphere is also known as hydrodynamic escape. In this work we look at how extreme hydrodynamic escape affects the metallicity of planetary atmospheres in a large population study. By coupling thermal evolution codes to radiative and chemical kinetics codes, we show that CO2 and SO2 features can be found in the transmission spectrum of exoplanet atmospheres as consequence of millions to billions of years of extreme hydrodynamic escape. With the successful launch of the James Webb Space Telescope we are now able to look ever so closely at hydrodynamical escape processes and its effect on exoplanet atmospheres. Recent observations on WASP 39b have shown prominent CO2 features in the transmission spectra (Ahrer et al. 2022), hinting that the planet underwent metallicity enhancement at some point throughout its lifetime. Using our models we are now able to connect such features to escape models and describe the evolving history of exoplanets.

Primary author: LOUCA, Amy (Leiden Observatory)

Co-author: Dr MIGUEL, Yamila (Leiden Observatory)

Presenter: LOUCA, Amy (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **96** Type: **Poster**

Investigating jet physics via the joint modelling of Event Horizon Telescope images and multi-wavelength observations

Wednesday, 17 May 2023 13:15 (1 minute)

A key characteristic of some active galactic nuclei (AGN), such as radio galaxies, is that they possess powerful jets that can extend through or beyond their host galaxy. However, the exact mechanisms of their launch and their internal properties are still not well understood. In this talk, I will focus on Event Horizon Telescope (EHT) and multi-wavelength image and spectral observations of our neighbouring AGN, M87. In particular, I investigate what processes are responsible for the particle acceleration physics by calculating the electron distribution function (eDF), as well as interpreting the resultant images and spectrum, to explore the origins of the observed jet power. Once a certain eDF choice is made, it is important that the observed emission is interpreted thoroughly because the process in which these simulated images are created has consequences for the overall spectrum. There is a degeneracy in the simulation process because we do not calculate the eDFs from first principles but rather explore preset parameterised eDFs based on particle-in-cell (PIC) simulations that consist of more accurate plasma physics simulations. In this talk, I will present an optimisation and fitting pipeline for simulating images of M87 and simultaneously compare them to 2017 multi-wavelength data published by the EHT multi-wavelength group. This pipeline will be used in future EHT and multi-wavelength studies.

Primary author: MULAUDZI, Wanga (Anton Pannekoek Institute for Astronomy)

Presenter: MULAUDZI, Wanga (Anton Pannekoek Institute for Astronomy)

Session Classification: Poster Prizes & closing

Contribution ID: **97** Type: **Contributed talk**

Detecting mergers on simulations and observations with machine learning

Tuesday, 16 May 2023 16:45 (15 minutes)

Galaxy mergers are one of the most violent processes and play a crucial role in galaxy evolution. However, the relative importance of mergers in mass growth and evolutionary events like AGN activity is not understood in detail. One of the main reasons is that mergers are difficult to identify with traditional methods and, in addition to being rare events, lead to incomplete and unreliable samples of mergers.

Machine learning methods, and in particular deep learning algorithms have proven to have high success for galaxy classification and recently, have been used with promising performance in selecting mergers from simulated data. However, the relatively high accuracy is obtained under assumptions that do not reflect the real observations completely. And the reliability of such methods on real data is not clearly understood.

We explore how hydrodynamical simulations can be used to predict merger detection on real observations (Hyper Suprime-Cam survey) with traditional machine learning techniques as well as with deep learning methods. We use a larger than previously used sample of mergers from Illustris TNG simulations to train our network. This larger sample allows capturing the variation in merger morphologies based on the interacting galaxies as well as the merger stage. We explore different machine-learning techniques in order to understand the current limitations and the best practices moving forward to detect mergers on observational datasets such as JWST and Euclid.

Primary author: MARGALEF BENTABOL, Berta (SRON - Netherlands Institute for Space Research)

Presenter: MARGALEF BENTABOL, Berta (SRON - Netherlands Institute for Space Research)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **98** Type: **Poster**

The astrometric contribution of Gaia binary systems

Wednesday, 17 May 2023 13:15 (1 minute)

With *Gaia* we have a thousand-fold increase in the number of stars and the precision with which we can observe their motion, which allows us to see previously rare phenomena in great numbers and detail. Astrometric binaries are a fantastic example of this - around half of all stars are binaries and precise astrometry enables us to detect a large fraction of these, with periods from months to decades. I'll talk about the different astrometric signals binary systems produce, how we can identify them now, and how those observations will evolve and improve over the lifetime of the *Gaia* survey. Finally, I'll show how combing astrometric and spectroscopic noise we can go on to infer a first guess at the period and mass ratio of these binaries.

Primary author: PENOYRE, zephyr (leiden observatory)

Presenter: PENOYRE, zephyr (leiden observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **99** Type: **Contributed talk**

Apertif: new continuum data release and project update

Tuesday, 16 May 2023 14:15 (15 minutes)

New phased array feed for the Westerbork synthesis radio telescope, Apertif, provides L-band continuum radio images of the sky with angular resolution and sensitivity significantly better than the previous state-of-art northern survey, the NRAO VLA Sky Survey (NVSS). We continue processing Apertif data and releasing it for the community.
In this work we mosaic together Apertif observations of the Boötes field and extract a source catalog. The image covers 25 square degrees, has an angular resolution of 27×11.5″ and a median background noise of 40 μJy/beam. The catalog has 9000 sources and is complete down to the 0.3 mJy level. We combine the Apertif image with the LOFAR deep images of the Boötes field at 54 and 150 MHz to study spectral properties of the sources. There is a steepening of spectral index both with a flux density and redshift seen in the data. This can be explained if most of the sources have peaked spectra with a turnover frequency around the LOFAR band. We also give an update on the overall status of the Apertif project and discuss future plans.

Primary author: KUTKIN, Alexander (ASTRON)

Presenter: KUTKIN, Alexander (ASTRON)

Session Classification: Plenary Session

Track Classification: Instrumentation

Contribution ID: **100** Type: **Poster**

The Radar Echo Telescope

Wednesday, 17 May 2023 13:15 (1 minute)

High energy neutrinos(>10PeV) are integral to the multi-messenger astronomy and notoriously hard to detect. When a high energy neutrino interacts in ice, it produces a relativistic cascade of charged particles, which in turn leaves behind a plasma which can reflect radio waves. This is the concept of the Radar Echo Telescope (RET). But as a first step it's important to understand the method by detection of the continuation of cosmic ray showers in ice. Radar Echo Telescope for cosmic rays(RET-CR) is currently being deployed in the high-altitude summit station at Greenland. The primary objective is to detect the in-ice continuation of the cosmic-ray induced air showers using the radar echo method. The surface stations of RET-CR triggers and reconstructs the primary particle energies, and arrival directions. The in-ice radar system also detects the signal in compliment to the surface stations. A successful search for the in-ice cosmic ray signal with the radar echo technique would be critical to the validation and viability of the method, thus providing valuable insights into the further establishment of the radar echo telescope for neutrinos (RET-N).

Primary author: GOPINATH, Krishna Nivedita (Radboud University)

Presenter: GOPINATH, Krishna Nivedita (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **101** Type: **Contributed talk**

Probing the cold/obscured/distant universe: Upcoming opportunities in the space-based infrared

Monday, 15 May 2023 16:30 (15 minutes)

Today, ALMA and JWST are revolutionizing our views of star & planet formation and galaxy evolution with their unprecedented sensitivity and resolution at submillimeter and near/mid-IR wavelengths.
However, many outstanding questions in these areas can only be answered with observations in the far-infrared domain, which generally need space-based instrumentation.
For planet formation, these include the gas masses and dispersal mechanisms of disks, as well as the distribution of their refractory and volatile material with time.
For galaxy evolution, key questions include the origin of dust and heavy elements, the physics of the evolving interstellar medium, as well as a census of the cosmic star-formation history and stellar mass assembly including the dust-obscured galaxies, and the role of feedback by stars and AGN.
This talk reviews far-infrared missions that have been proposed for the next decade, with a focus on NASA's Astrophysics Probe program.
Detector technology from SRON is a key element of the FIRSST, PRIMA and SALTUS mission concepts, and will provide unique opportunities for their scientific exploitation and synergies to astronomers in the Netherlands.

Primary authors: VAN DER TAK, Floris (SRON / Kapteyn); Dr BASELMANS, Jochem (SRON); Dr WANG, Lingyu (SRON); Dr ROELFSEMA, Peter (SRON); Dr JELLEMA, Willem (SRON)

Presenter: VAN DER TAK, Floris (SRON / Kapteyn)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **102** Type: **Contributed talk**

Radio-mode feedback in high-redshift galaxy clusters with the International LOFAR Telescope

Monday, 15 May 2023 14:10 (15 minutes)

As the intracluster medium (ICM) in galaxy clusters cools through the emission of X-ray radiation, it sinks down toward the central galaxy where it fuels the AGN. This AGN subsequently emits radio-mode feedback in the form of powerful jets of relativistic plasma which re-energize the ICM, completing the feedback cycle. Measurements of the energy injected by radio-mode feedback into the cluster environment have mostly relied on X-ray observations, which reveal cavities in the ICM excavated by the radio lobes. However, the sensitivity required to accurately constrain the dimensions of these cavities has proven to be a major limiting factor, and forms the main bottleneck on high-redshift (z>0.6) measurements. Recent developments by Timmerman et al. (2022) opened a new observational window on radio-mode feedback by demonstrating that low-frequency radio observations taken with the International LOFAR Telescope (ILT) provide the combination of sensitivity and resolution required to reliably map the radio lobes in detail. Sufficiently sensitive and detailed radio observations resolve the primary bottleneck experienced with X-ray observations and enable radio-mode feedback studies toward the high-redshift regime for the first time. In this talk, we explain this method for measuring the amount of radio-mode feedback in galaxy clusters and present the first results of applying this method using ILT observations of galaxy clusters up to a redshift of z=1.

Primary author: TIMMERMAN, Roland (Leiden Observatory)

Co-authors: Dr VAN WEEREN, Reinout (Leiden Observatory); Dr BOTTEON, Andrea (INAF-IRA); Dr MORABITO, Leah (Durham University); Prof. RÖTTGERING, Huub (Leiden Observatory); Mr SWEIJEN, Frits (Leiden Observatory)

Presenter: TIMMERMAN, Roland (Leiden Observatory)

Session Classification: Plenary Session

Track Classification: Time Domain

Contribution ID: **103** Type: **Poster**

Unveiling the nuclear activity in the least dense regions of the nearby Universe

Wednesday, 17 May 2023 13:15 (1 minute)

Unveiling the mechanisms that trigger active galactic nuclei (AGN) is a badly understood problem, that is crucial for our understanding of the galaxy formation and evolution. While interactions and galaxy mergers are associated with the triggering of powerful AGN, less luminous AGN would be driven by secular processes (Treister et. al., 2012). Over the last few years, several observational studies performed at optical wavelengths have tried to identify AGN triggering mechanisms in the local Universe. Despite these efforts, the main drivers for AGN triggering in isolated galaxies still remain unclear.

In this contribution, firstly, I will present the on-going CAVITY survey, an international collaboration with more than 40 members from different countries (Spain, Netherlands, Canada, France, Germany, and the United States). It will perform the first statistical study of galaxies in voids, the least dense areas of the Universe. Compared with the large number of works studying active galaxies in clusters and groups of galaxies, the number of studies characterising AGN in void regions is scarce to date. The void galaxies might have gone through a different dark halo mass assembly than galaxies in denser environments, suggesting an influence of the void large-scale environment on the black-hole growth. In fact, recently, void galaxies have been found to have different SFH than galaxies in denser environments (Domínguez-Gómez, J., et. al. accepted in Nature). Secondly, I will present our careful sample selection reducing possible bias in the selection and our preliminary results studying the nuclear activity in void regions overcoming previous limitations.

Primary authors: DEL MORAL CASTRO, Ignacio (Kapteyn Astronomical Institute); PELETIER, Reynier (University of Groningen, Kapteyn Astronomical Institute, 9747 AD Groningen, The Netherlands)

Presenter: DEL MORAL CASTRO, Ignacio (Kapteyn Astronomical Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **104** Type: **Poster**

General relativistic hydrodynamic simulations of perturbed transonic accretion

Wednesday, 17 May 2023 13:15 (1 minute)

Comparison of horizon-scale observations of Sgr A*and M87* with numerical simulations has provided considerable insight in their interpretation. Most of these simulations are variations of the same physical scenario consisting of a rotation-supported torus seeded with poloidal magnetic fields. This setup has several well known limitations, most notably, it differs in important ways from what observed in simulations of accretion from large scales. We aim to study the flow patterns that arise at horizon scales in more general scenarios, that have a clearer connection with the large scale flow and are at the same time controlled by a reduced set of parameters. As a first step in this direction, we perform three dimensional general relativistic hydrodynamic simulations of rotating transonic flows with velocity perturbations injected from a spherical boundary located 1000 gravitational radii away from the central object. We study the general properties of these flows by varying angular momentum and perturbation amplitudes. We observe a rich phenomenology in accretion patterns, that includes smooth Bondi-like flows, turbulent torus-like structures, shocks, filaments, and complex sonic structures. For sufficiently large perturbations and angular momentum, our models show evidence of entropy generation and angular momentum redistribution not mediated by magnetic fields. Fluctuations are amplified and extend further in frequency than the injected white noise spectrum, producing a red noise spectrum for synthetic Bremsstrahlung light curves. Future inclusion of magnetic fields and radiative cooling could make this type of simulations a viable alternative for numerical modeling of general low-luminosity active galactic nuclei.

Primary authors: OLIVARES, Hector (Radboud University); Dr MOSCIBRODZKA, Monika (Radboud University); PORTH, Oliver (University of Amsterdam)

Presenter: OLIVARES, Hector (Radboud University)

Session Classification: Poster Prizes & closing

Contribution ID: **105** Type: **Poster**

Results from the Auger Engineering Radio Array: investigating the elements making up ultra-high energy cosmic rays.

Wednesday, 17 May 2023 13:15 (1 minute)

The Auger Engineering Radio Array (AERA) is an array of 153 radio antennas spanning an area of 17 km^2, currently the largest of its kind, that probes the nature of ultra-high energy cosmic rays at energies around the transition from Galactic to extragalactic origin. It measures the MHz radio emission of extensive air showers produced by cosmic rays hitting our atmosphere. The elemental composition of cosmic rays is a crucial piece of information in determining what the sources of cosmic rays are and how cosmic rays are accelerated. We have measured the composition and show our method to be compatible and competitive with the established fluorescence method, opening up a new window to investigate the sources of cosmic rays at the highest energies and the interactions of particles at energies beyond LHC energies.

Primary author: PONT, Bjarni (Radboud University Nijmegen)

Presenter: PONT, Bjarni (Radboud University Nijmegen)

Session Classification: Poster Prizes & closing

Contribution ID: **106** Type: **Poster**

Opening up the decameter radio band with LOFAR

Wednesday, 17 May 2023 13:15 (1 minute)

The Decameter radio band (< 30 MHz) has been scarcily explored since the inception of radio astronomy, largely due to the perturbing effects of the ionosphere. However, the decameter wavelength band is an important part of the electromagnetic spectrum. In particular, decameter observations of radio halos in galaxy clusters will allow us to constrain the particle reaccerlation mechanisms responsible for the bright and extended synchrotron emission. With the LOw Frequency ARray (LOFAR), we are able to observe the decameter wavelength band with unprecedented detail and sensitivity, opening up a new spectral window for observations. In this talk, we will present current LOFAR decameter observations, in particular of radio halos in galaxy clusters. We will specifically discuss how LOFAR corrects for the severe perturbing effects of the ionosphere at decameter wavelenghts, and the current plans for expansion to a full northern-sky survey.

Primary author: GROENEVELD, Christian (Leiden Observatory)

Presenter: GROENEVELD, Christian (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **107** Type: **Poster**

Surface-atmosphere interactions on hot rocky exoplanets

Wednesday, 17 May 2023 13:15 (1 minute)

Hot-rocky exoplanets with surface temperatures above 1500 K are thought to support magma oceans. The presence of these magma oceans offers a unique opportunity for inferring the interior composition of these planets through the characterization of their atmosphere. With hundreds of hot-rocky exoplanets discovered and a dozen of good targets for JWST characterisation, understanding the links between the interior and atmospheres of these worlds and what we can learn from the observations is more relevant than ever.

With this goal in mind we developed a chemical equilibrium code able to calculate the composition of a gas vapor above a magma ocean of a given composition, temperature and surface pressure. By coupling this to atmospheric chemistry and radiative transfer codes we are able to produce model spectra for different hypothetical mantle compositions, showing us what we need to be looking for to identify magma oceans. In this ongoing work we are also working on the influence of water on the interiors and atmospheres of these planets. In this talk we will explain how we went about developing LavAtmos, the initial results of its application, and what this means for the observability of hot rocky exoplanet atmosphere and the ability to detect magma oceans.

Primary authors: VAN BUCHEM, Christiaan (Leiden University); Prof. VAN WESTRENEN, Wim (VU Amsterdam); Prof. MIGUEL, Yamila (Leiden University)

Presenter: VAN BUCHEM, Christiaan (Leiden University)

Session Classification: Poster Prizes & closing

Contribution ID: **108** Type: **Contributed talk**

One year of operation of JWST MIRI

Monday, 15 May 2023 15:30 (15 minutes)

JWST's science operations began in July 2022 after a successful launch and six months of commissioning. NOVA played a major role in the development of the Mid-Infrared Instrument (MIRI), in particular in its Medium Resolution Spectrometer (MRS). MIRI is the only instrument that covers wavelengths beyond 5 microns and is used to investigate a wide variety of objects, from galaxies to star forming regions, protoplanetary disks, and exoplanets. In this talk, I will describe the in-flight performance of JWST focusing on MIRI and I will present some science highlights that were enabled by MIRI in its first year of operation.

Primary authors: CROUZET, Nicolas (Leiden Observatory); Dr MUELLER, Michael Migo (Rijksuniversiteit Groningen); YANG, Guang (Kapteyn Astronomical Institute); ROELFSEMA, Peter (SRON); Prof. BRANDL, Bernhard (Leiden Observatory); Prof. VAN DISHOECK, Ewine (Leiden Observatory)

Presenter: CROUZET, Nicolas (Leiden Observatory)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **109** Type: **Poster**

Baryonic impact on weak lensing peak statistics

Wednesday, 17 May 2023 13:15 (1 minute)

Next-generation weak gravitational lensing surveys, including Euclid, will be able to measure weak lensing signals with high statistical accuracy all the way into the regime probing the scales of non-linear collapse. To be able to exploit these measurements to the fullest extent and, in the end, most accurately determine the cosmology, we must have an accurate understanding of the baryonic physics that impacts these scales. Using the new hydrodynamical simulation suite FLAMINGO, which contains subgrid models for the most prominent astrophysical feedback processes (i.e. accretion by SMBHs and supernova feedback) that affect the large-scale structure of the Universe, and has been calibrated to match key observables (i.e. galaxy stellar mass function and cluster baryon fractions), I focus on the baryonic impact on weak lensing peak counts. Peak counts are the highest values of weak lensing convergence maps and thereby correspond to the most massive clusters along the line of sight. These statistics are therefore very sensitive to small-scale baryonic physics but also contain valuable information about the evolution of the structures within the Universe and have been shown to be complementary to traditional n-point statistics. Understanding their properties can ultimately help us constrain both cosmology as well as galaxy physics as they are highly sensitive to both. I focus on the impact the different baryonic models have and to what extent we expect this to impact the cosmology inference from Euclid's measurements at small scales.

Primary author: BROXTERMAN, Jeger (Lorentz Institute / Leiden Observatory)

Presenter: BROXTERMAN, Jeger (Lorentz Institute / Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **110** Type: **Poster**

A novel constraint on the Milky Way's inner dark matter halo's shape using phase-mixed streams

Wednesday, 17 May 2023 13:15 (1 minute)

Stellar streams are promising tools to study the mass distribution of galaxies. In particular, they have been used to constrain the shape and mass of the Milky Way's dark matter halo. Narrow distant streams are commonly used to this end, but I will instead focus on the nearby Helmi Streams' stars with full 6D phase-space information. These streams, the remnants of an accreted dwarf galaxy, are phase-mixed and depict peculiar dynamical properties. Specifically, they appear to be separated into two clumps in angular momentum space, they depict different degrees of phase-mixing and are located close to orbital resonances. To explain these dynamical peculiarities we explore Galactic potential models with a triaxial NFW halo. I find that a mildly triaxial halo is required to explain these phenomena. Because the orbital structure and presence of resonances are very sensitive to the specific configuration of the Galactic potential, the dynamics of these streams places very strong constraints on the characteristics of the Galactic dark matter halo in the inner 20 kpc, the region probed by the Helmi stream stars.

Primary author: WOUDENBERG, Hanneke

Co-author: HELMI, Amina (Kapteyn Astronomical Institute, Rijksuniversiteit Groningen)

Presenter: WOUDENBERG, Hanneke

Session Classification: Poster Prizes & closing

Contribution ID: **111** Type: **Poster**

Towards an Improved Model for Dynamical Friction on SMBHs

Wednesday, 17 May 2023 13:15 (1 minute)

Supermassive black holes experience dynamical friction, a drag force caused by momentum exchange with the surrounding medium of stars, dark matter, and gas. In this study, we investigate dynamical friction on massive black holes in depth, including testing a commonly used analytic model based on Chandrasekhar's 1943 study. Our goal is to develop a functional subgrid model that can be incorporated into cosmological simulations.

Primary author: BELCHEVA, Zorry (Leiden Observatory)

Presenter: BELCHEVA, Zorry (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **112** Type: **Contributed talk**

Sub-kpc gas kinematics of a massive rotating disk 700 Myr after the Big Bang

Wednesday, 17 May 2023 11:00 (15 minutes)

Recent studies have revealed the existence of particularly massive galaxies within the first Gyr after the Big Bang. These findings push the limits of galaxy evolution models, but our understanding of the formation of such galaxies is limited due to a lack of sub-kpc resolution observations of bright, spectroscopically-confirmed targets.

The REBELS ALMA large program have observed [CII] and dust continuum emission in ~30 massive z>6.5 galaxies. One particularly exciting galaxy within this sample, REBELS-25 (redshift z~7.3), shows a clear [CII] velocity gradient, a clumpy UV morphology, an ultra-luminous IR luminosity (ULIRG) and a possible outflow or companion. However, the resolution of the original dataset is too low to determine the mechanisms powering its extreme IR luminosity or how it's building its stellar mass. Follow-up [CII] and dust-continuum ALMA observations at ~780 pc scales (a factor of ~10 improvement in resolution) are now in hand, providing an unprecedented view of massive galaxy formation in the early Universe.

Preliminary analysis indicates that this galaxy is well-fit by a rotation-dominated disk model. By contrast, current cosmological simulations struggle to reproduce such an observation, and predict more chaotic, dispersion-dominated systems at z>3. Well-tested 3D fitting tools (e.g. 3DBarolo and CANNUBI) will be used to obtain robust estimates of the geometric and kinematic properties of this galaxy, and to investigate how it compares to other high redshift populations. Analysis of this exciting, massive rotating disk galaxy just 700 Myr after the Big Bang can therefore place stringent constraints on galaxy formation scenarios.

Primary author: ROWLAND, Lucie (Leiden Observatory)

Co-authors: Dr HODGE, Jacqueline (Leiden Observatory); Dr BOUWENS, Rychard (Leiden Observatory)

Presenter: ROWLAND, Lucie (Leiden Observatory)

Session Classification: Plenary Session

Track Classification: Galaxy Evolution & Cosmology

Contribution ID: **113** Type: **Contributed talk**

A new view on galaxy clusters with the FLAMINGO simulations

Tuesday, 16 May 2023 17:00 (15 minutes)

We use FLAMINGO, the biggest full hydro cosmological simulation ever, to study the most massive objects in the universe and do a direct comparison with observations. FLAMINGO hosts many thousands of massive clusters, in their full cosmological environment, making it an ideal testing ground to do a statistically relevant comparison with observations. Using a new forward modelling pipeline, including photo-ionization models from CLOUDY, we can accurately model the x-ray emission from clusters and their surroundings in a wide mass-range. We study how x-ray scaling relations are impacted by mass, cool-core fractions and redshift. Tracing galaxy cluster mergers through time, we show how merging clusters move on x-ray scaling relations and elucidate whether merging clusters have a discernable offset from relaxed objects. Furthermore, because FLAMINGO has 9 observationally motivated feedback variations, we show the impact of AGN and stellar feedback on cluster profiles. For all FLAMINGO clusters, we also fit their profiles to estimate the hydrostatic bias, which we can now do for thousands of massive clusters, and as a function of cluster properties. With the unprecedented size of the FLAMINGO simulations, we can do all these things for statistically relevant sample sizes, enabling a real comparison with observations at all masses.

Primary author: BRASPENNING, Joey (Leiden Observatory)

Presenter: BRASPENNING, Joey (Leiden Observatory)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **114** Type: **Poster**

Chromosome maps and SFR in galaxy clusters, INT WFC student results.

Wednesday, 17 May 2023 13:15 (1 minute)

We present results obtained by the Isaac Newton Telescope Wide Field Camera in March and April 2023 as part of a graduate class from Rijksuniversiteit Groningen. We present results from projects designed by the master students including: strategies to obtain a chromosome map of the globular cluster GCL38, a method to potentially determine metallicities making use of photometry and pseudo-colour magnitude diagrams. Furthermore the SFR of the galaxy cluster Abell 1185 using H-alpha will be presented, potentially showing quenching of star formation due to tidal interactions and ram pressure stripping.

Primary authors: Mr ANGRILLI MUGLIA, Alessandro (Kapteyn Astronomical Institute); Mr VAN DER GEEST, Dirk (Kapteyn Astronomical Institute); DZIOUBA, Maria (Kapteyn Astronomical Institute); Ms BETHLEHEM, Yfke (Kapteyn Astronomical Institute)

Presenter: Mr ANGRILLI MUGLIA, Alessandro (Kapteyn Astronomical Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **115** Type: **Poster**

Filling in the Blanks: Inferring the Dynamics and Substructure Membership of 5D Gaia Stars

Wednesday, 17 May 2023 13:15 (1 minute)

The release of Gaia DR3 has substantially enriched our understanding of the current state of the Milky Way (MW), and its assembly history. A driving force behind this is the increase of stars with complete 6d phase space (positions and velocities) necessary for complex dynamical analysis, such as identifying stellar substructures in the MW's stellar halo. However, far more stars are still stuck in 5D, still lacking a line-of-sight velocity (vlos), severely limiting the scope of dynamical analysis and the possibility of attributing these stars to known substructures.

In this talk, I explore a novel method to predict the likely vlos of these 5d stars, using the density of the known 6d stars in action space. This technique also allows us to infer the probability that a 5d star is associated with known stellar substructures, potentially increasing the membership of poorly populated structures. The method is first tested and verified on both the Gaia DR3 6d sample and stars crossmatched from other surveys, allowing the method's limitations to be studied in detail. Furthermore, by robustly bringing stars from 5D to 6D, this method could enhance other dynamical studies of the MW.

Primary author: CALLINGHAM, Thomas (Kapteyn Institute, University of Groningen)

Presenter: CALLINGHAM, Thomas (Kapteyn Institute, University of Groningen)

Session Classification: Poster Prizes & closing

Contribution ID: **116** Type: **Poster**

A comprehensive ionization chemical network for protoplanetary disks

Wednesday, 17 May 2023 13:15 (1 minute)

Ionization plays a critical role in the gas dynamics of protoplanetary disks (PPDs), which is further related with disk evolution and planet formation. While non-thermal ionization mechanisms, such as X-rays and cosmic rays, dominate the bulk regions of PPDs, the innermost regions are characterized by high temperatures (>1000K) with thermal ionization of alkali species and dust thermionic emission. Such processes are expected to dramatically enhance the disk ionization fraction, leading to a revival of the magneto-rotational instability. To better understand the complex ionization processes in PPDs, we develop a comprehensive ionization chemical network that accounts for both thermal and non-thermal ionization. Using this model, we calculate the ionization fraction and the resulting magnetic diffusivities throughout the full range of physical conditions present in PPDs and discuss the implications on the gas dynamics of the innermost disk regions. Our findings provide a robust microphysical basis for future magnetohydrodynamical simulations.

Primary authors: ZHENG, Xinyu (Leiden Observatory); BAI, Xuening

Presenter: ZHENG, Xinyu (Leiden Observatory)

Session Classification: Poster Prizes & closing

Contribution ID: **117** Type: **Poster**

Particle Production by Gravitational Fields

Wednesday, 17 May 2023 13:15 (1 minute)

While from a classical perspective we think of vacuum as empty space, it is filled by virtual particles from a quantum perspective. In flat spacetimes, these virtual particles arise in pairs, exist for a short amount of time, and then re-annihilate. As a result, no real particles are created.
In this talk, we show that real particles are created in curved spacetimes. This is because gravitational forces suppress the probability for re-annihilation, independent of the presence of event horizons. We investigate this particle production effect for the spacetime of a static, spherically symmetric Schwarzschild black hole and compare its predictions with those from Hawking radiation.

Primary author: WONDRAK, Michael Florian

Co-authors: VAN SUIJLEKOM, Walter D.; FALCKE, Heino

Presenter: WONDRAK, Michael Florian

Session Classification: Poster Prizes & closing

Contribution ID: **118** Type: **Contributed talk**

Turbulent processing of polycyclic aromatic hydrocarbons (PAHs) in protoplanetary discs

Monday, 15 May 2023 15:45 (15 minutes)

The infrared signals of polycyclic aromatic hydrocarbons (PAHs) have been detected in numerous circumstellar discs. PAHs contribute to the heating of the disc's photosphere through efficient UV absorption and are crucial for disc evaporation models. Despite a correlation between effective stellar temperature and low PAH detection rates, the diversity of PAH detections at similar stellar properties is not well understood. In the era of the James Webb Space Telescope (JWST), the infrared spectrum is becoming more accessible than ever.

To explain this diversity in observations, we propose the formation of PAH clusters, the adsorption of PAHs and PAH clusters on dust grains, and their reverse-processes as key mechanisms in protoplanetary discs. Driven by vertical turbulence, these processes happen on cycles throughout the lifetime of a disc.

We developed a theoretical model to estimate the relevance and timescale of these processes in a Herbig Ae/Be disc environment and calculated the gas-phase depletion of PAHs. Our results show that the clustering of gas-phase PAHs is very efficient which prevents them from evaporating off the grains even in UV-rich environments. Evaluated over the lifetime of protoplanetary discs ($1 - 10\,\mathrm{Myr}$), we find a depletion of PAHs by a factor that ranges between 50 and 1000 compared to the standard interstellar medium (ISM) abundance in the inner disc. Through these processes, we favour small PAHs ($\leq$ 60 C atoms) as the major gas-phase emitters of the disc's photosphere as larger PAHs remain on the grain surface.

Primary author: LANGE, Kevin (University of Amsterdam)

Co-authors: TIELENS, Alexander (Leiden University/University of Maryland); DOMINIK, Carsten (University of Amsterdam)

Presenter: LANGE, Kevin (University of Amsterdam)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **119** Type: **Poster**

Mapping Ionized Bubbles in the First Billion Years with the JWST FRESCO Survey

Wednesday, 17 May 2023 13:15 (1 minute)

After the Dark Ages, when the universe was completely neutral, the first sources of light appeared, marking the beginning of the Epoch of Reionization (EoR). During this epoch, the first stars and galaxies formed, emitting intense radiation that ionized the surrounding neutral hydrogen gas, creating ionized regions in the intergalactic medium (IGM), which grew and overlapped, making our universe completely ionized at redshift 6. Lyman alpha emitters (LAEs), are one of the tracers used to study the EoR. However, the detection of LAEs becomes more complicated at redshifts greater than 7, as the universe is mostly neutral, and energetic Lyman alpha photons are absorbed by the IGM. Nevertheless, some LAEs have been detected at very high redshifts, possibly because Lyman alpha photons had time to stretch enough inside ionized region due to cosmic expansion and avoid being absorbed by neutral hydrogen.
It is suggested that LAEs by themselves cannot create such large enough ionized bubbles. Instead, it is likely that these emitters are embedded in overdense regions where neighboring galaxies contribute to the ionizing budget, allowing us to detect Lyman alpha.
In this work, I will present the results of studying the environment of detected Lyman alpha emitters using JWST data. We identify companions to these emitters that could explain the visibility of Lyman alpha lines even for very faint sources. We find the expected sizes of ionized bubbles around LAEs at their redshifts and check whether the detected companions could contribute enough ionizing photons to create these ionized regions.

Primary author: LEONOVA, Ecaterina (University of Amsterdam)

Presenter: LEONOVA, Ecaterina (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **120** Type: **Contributed talk**

Galactic archaeology of the old Milky Way using the most metal-poor stars

Tuesday, 16 May 2023 17:15 (15 minutes)

Our Galactic halo hosts some of the most metal-poor stars. These are relics from the era of the smallest, earliest galaxies that merged into the Milky Way.
However, finding many of these extremely metal-poor (EMP) stars is challenging because they are rare among the more metal-rich populations in the Galaxy. The staggering Gaia DR3 provides low-resolution spectrophotometry for about 220 million stars. We use these data to mimic a narrow-band CaHK filter used by the successful Pristine survey previously to find these EMP stars. This gives us an all-sky map of the metal-poor Milky Way.
Here I present the first spectroscopic follow-up of ~200 stars with predicted [Fe/H] < -2.5 (EMP) in the Milky Way from this new dataset. We find that 72% of the stars have indeed [Fe/H] < -2.5, while all of them are very metal-poor ([Fe/H] < -2). This means a large improvement over the existing methods that search for EMP stars. Additionally, we probe further out, going beyond 30 kpc. Some of the EMP stars we discovered are on prograde disk-like orbits, which needs further investigation. The most metal-poor stars from this follow-up are on high-energy orbits indicating tracers of low-mass mergers. A chemodynamical analysis of this sample allows us to find more member stars from the same progenitor, and construct their disruption history.
Identifying remnants from these earliest metal-poor low-mass mergers buried in the Milky Way is intriguing and a unique pathway to the past, as even JWST cannot directly observe these low-mass high-redshift galaxies.

Primary author: VISWANATHAN, Akshara (Kapteyn Astronomical Institute, University of Groningen)

Co-authors: Dr ARENTSEN, Anke (Institute of Astronomy, University of Cambridge); Prof. STARKENBURG, Else (Kapteyn Astronomical Institute, University of Groningen); Dr MARTIN, Nicolas (Strasbourg Observatory); Prof. IBATA, Rodrigo (Strasbourg Observatory); Dr YUAN, Zhen (Strasbourg Observatory)

Presenter: VISWANATHAN, Akshara (Kapteyn Astronomical Institute, University of Groningen)

Session Classification: Parallel session

Track Classification: NOVA NW1

Contribution ID: **121** Type: **Contributed talk**

LOFAR2.0 - a premier low-frequency radio telescope for the 2020s and beyond

Tuesday, 16 May 2023 14:30 (15 minutes)

The LOw Frequency ARray (LOFAR) is in many respects the world's largest and most sensitive low-frequency radio telescope. LOFAR stretches across Europe, from Ireland to Latvia, with a dense core and 38 stations distributed throughout the Netherlands, as well as 14 additional stations located in 8 partner countries. The pan-European array is called the International LOFAR Telescope (ILT). LOFAR2.0 is a coordinated set of staged upgrades that are being implemented from 2019-2024 and will keep LOFAR cutting-edge. These upgrades will allow all low-/high-band antennas to be used simultaneously, will increase the field-of-view, and allow for new parallel observing modes on the LOFAR central beam-former and correlator. LOFAR will continue to be unique and world-leading, with an angular resolution > 10 higher than that of the planned Square Kilometre Array low-frequency component (SKA-Low), and also accessing the largely unexplored spectral window below 50 MHz. I will present the status of the LOFAR2.0 programme, and highlight some of the scientific goals for the upgraded array.

Primary author: HESSELS, Jason (ASTRON)

Presenter: HESSELS, Jason (ASTRON)

Session Classification: Plenary Session

Track Classification: Instrumentation

Contribution ID: **122** Type: **Poster**

Precise constrained cosmological simulations of the Local Group

Wednesday, 17 May 2023 13:15 (1 minute)

Cosmological simulations have been used to understand the formation of structure in the ΛCDM paradigm on small and large scales. Most simulations start with unconstrained Gaussian initial conditions, and therefore generically do not produce good analogues of the Local Group at present day. While constrained simulations exist, these have difficulty in precisely satisfying all our observational constraints on the Local Group, and their result is not an unbiased and fair sample of the posterior distribution of ΛCDM universes subject to the observational constraints of the Local Group. Some applications of such a sample include putting into cosmological context our distribution of satellites, the alignment of the dark-matter haloes and their spin and the relation to the assembly history, and to determine the effect of our environment on the Local Group's spatial configuration and kinematics.

In this work, we extend the BORG algorithm (Bayesian Origin Reconstruction from Galaxies), that has already been used to model the Local Large-Scale Structure, to reconstruct the Local Group. Using this toolset, we perform a statistical inference on the history of the Local Group, following a ΛCDM prior on the cosmological initial conditions, and a likelihood that constrains local observational quantities, like the masses, positions, velocities of the Milky Way and M31 haloes, and the quiet local Hubble flow. In the near future, we also plan to embed our Local Group in a realistic large-scale structure. This is the first time a cosmological simulation has been able to reproduce all these properties simultaneously with high precision.

Primary author: WEMPE, Ewoud (Kapteyn Astronomical Institute)

Co-authors: HELMI, Amina (Kapteyn Astronomical Institute, Rijksuniversiteit Groningen); Dr LAVAUX, Guilhem (Institut d'Astrophysique de Paris / CNRS, Paris); Prof. JASCHE, Jens (Stockholm University, Stockholm); Prof. WHITE, Simon (Max-Planck-Institut für Astrophysik, Garching b. München)

Presenter: WEMPE, Ewoud (Kapteyn Astronomical Institute)

Session Classification: Poster Prizes & closing

Contribution ID: **123** Type: **Contributed talk**

From core to disk fragmentation in high-mass star formation

Monday, 15 May 2023 16:00 (15 minutes)

There is growing consensus that the formation of high-mass stars proceeds through disk accretion, similar to that of lower mass stars. To this end, we have undertaken a large observational program (CORE) making use of interferometric observations from the NOrthern Extended Millimetre Array (NOEMA) for a sample of 20 high-mass protostellar objects in the 1.3 millimetre wavelength regime reaching ~0.4" resolution (800 au at 2 kpc). We find rotational signatures in dense gas perpendicular to bipolar molecular outflows in most regions. Modelling the level populations of various rotational transitions of the dense gas tracer CH3CN, we find the disk candidates to be on average warm (~200 K). Studying the Toomre stability of the disk-like structures reveals that most high-mass young stellar objects are gravitationally unstable and prone to disk fragmentation. Since most high-mass stars are found to have companions, disk fragmentation seems to be an important mechanism by which such systems may be formed. While observations at hundreds of au resolution have now shown that rotational signatures are common around such young and massive accreting protostars, it is difficult to differentiate between rotating and infalling envelope material and true disk structures which likely reside on much smaller scales. In this talk, I will take you on a tour across scales from our findings at hundreds of au resolution with NOEMA reaching down to sub 100 au observations with ALMA showcasing a keplerian disk surrounding a massive binary system.

Primary author: AHMADI, Aida (Leiden University)

Presenter: AHMADI, Aida (Leiden University)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **124** Type: **Poster**

Corona as the energy reservoir for radio jet: a case study of GRS 1915+105

Wednesday, 17 May 2023 13:15 (1 minute)

GRS 1915+105 regularly shows type-C quasi-periodic oscillations (QPOs) in the power density spectrum, sometimes together with a broad bump at around 30-150 Hz. We study the power spectra of GRS 1915+105 with the Rossi X-ray Timing Explorer when the source was in the hard-intermediate state. We find that the rms amplitude of the bump depends strongly upon both the frequency of the type-C QPO and the hardness ratio, and is correlated with the corona temperature and anti-correlated with the radio flux at 15 GHz. The rms amplitude of the bump generally increases with energy from ~1-2 per cent at ~3 keV to ~10-15 per cent at ~30 keV. We suggest that the bump originates from the corona. Finally, we discuss the anticorrelation between the rms amplitude of the bump and the radio flux in the context of the relation between the corona and the jet, and suggest that the corona serves as the energy reservoir for the radio jet.

Primary author: ZHANG, Yuexin (Kapteyn)

Presenter: ZHANG, Yuexin (Kapteyn)

Session Classification: Poster Prizes & closing

Contribution ID: **126** Type: **Contributed talk**

Activities of the National Astronomy Equity and Inclusion Committee

Tuesday, 16 May 2023 11:20 (15 minutes)

We are working on is a work climate survey of Dutch astronomy, under the direction of the NWO tafel voor astronomie and would like to update the community on this and other activities.

Primary author: ADAMS, Elizabeth A. K. (ASTRON and Kapteyn Astronomical Institute)

Presenter: ADAMS, Elizabeth A. K. (ASTRON and Kapteyn Astronomical Institute)

Session Classification: Plenary Session

Track Classification: Astronomy

Contribution ID: **127** Type: **Contributed talk**

VLBI astrometry of radio stars

Monday, 15 May 2023 16:15 (15 minutes)

A fraction of the nearby M dwarfs have detectable radio emission, which can be driven by several emission mechanisms. By observing the polarization, position and temporal behavior of this emission, we want to characterize it, and understand what mechanism is active in these radio stars.

We make use of the high astrometric accuracy and sensitivity available through the European VLBI Network. To further improve the astrometric accuracy, we make use of techniques such as MultiView and in-beam phase calibrators. After taking the effects of proper motion and parallax into account, we aim to achieve an astrometric accuracy that is comparable to that of the Gaia mission. This allows us to see whether the radio emission is offset from the optical position, or perhaps extended. We can also detect reflex motion due to binary or planetary companions.

In this contribution, we'll showcase the latest results of this project on several nearby M dwarfs.

Primary author: BOVEN, Paul (JIVE / Leiden University)

Presenter: BOVEN, Paul (JIVE / Leiden University)

Session Classification: Parallel session

Track Classification: NOVA NW2

Contribution ID: **128** Type: **Contributed talk**

The Future in Feedback: prospects for the next generation of NASA X-ray Probes

Tuesday, 16 May 2023 14:45 (15 minutes)

The recommendations from the most recent Decadal Survey on Astronomy and Astrophysics include a NASA-led probe-class X-ray telescope to be launched in the 2030s. I will discuss the mission concepts that are being developed as a response, with particular focus on SRON's contribution to the observatories that will address the priority area "Unveiling the Drivers of Galaxy Growth" . Galaxy formation connects processes happening over a vast range of spatial scales, striking a fine balance between gas inflows from the cosmic web and gas outflows driven by supernovae and supermassive black hole feedback. Sensitive, high-spectral resolution X-ray observations are poised to reveal in fine detail the imprint of these processes onto the interstellar, circumgalactic, and intergalactic media, providing an important missing piece of the puzzle in our understanding of stellar and galactic ecosystems.

Primary author: SIMIONESCU, Aurora (SRON, Netherlands Institute for Space Research; Leiden Observatory, Leiden University; Kavli Institute for the Physics and Mathematics of the Universe (WPI), The University of Tokyo)

Presenter: SIMIONESCU, Aurora (SRON, Netherlands Institute for Space Research; Leiden Observatory, Leiden University; Kavli Institute for the Physics and Mathematics of the Universe (WPI), The University of Tokyo)

Session Classification: Plenary Session

Track Classification: Instrumentation

Contribution ID: **129** Type: **Poster**

The local radio environment of fast radio bursts and their progenitor implications

Wednesday, 17 May 2023 13:15 (1 minute)

Fast Radio Bursts (FRBs) are millisecond-duration transient sources of intense, coherent radiation originating in distant galaxies that are signposts of extreme astronomical environments. Telescopes all over the world are used to conduct searches for FRBs, localise them, and study their host galaxy and local environment. The European VLBI Network in particular is a prime instrument to study the radio environment of FRB sources in their host galaxies at milli-arcsecond scales. Such VLBI observations are needed to characterise the nature of radio emission caused by star formation or a compact persistent radio source (PRS), as well as to constrain the size of any radio nebulae. In this talk, I will present radio observations of the local environment of repeating and non-repeating FRBs, as well as the implications for FRB progenitor models.

Primary author: BHANDARI, Shivani (ASTRON)

Presenter: BHANDARI, Shivani (ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **130** Type: **Contributed talk**

Update on the Square Kilometre Array

Tuesday, 16 May 2023 09:00 (30 minutes)

Presenter: DIAMOND, Phil (SKAO)

Session Classification: Plenary Session

Contribution ID: **131** Type: **Contributed talk**

NL and SKA Construction

Tuesday, 16 May 2023 09:30 (10 minutes)

Presenter: VAN HAARLEM, Michiel (ASTRON)

Session Classification: Plenary Session

Contribution ID: **132** Type: **Contributed talk**

NL and SKA Science Interest

Tuesday, 16 May 2023 09:40 (10 minutes)

Presenter: Dr CALLINGHAM, Joseph (ASTRON / Leiden University)

Session Classification: Plenary Session

Contribution ID: **133** Type: **Contributed talk**

NL and SKA SRC

Tuesday, 16 May 2023 09:50 (10 minutes)

Presenter: SWINBANK, John (ASTRON)

Session Classification: Plenary Session

Contribution ID: **134** Type: **Contributed talk**

Panel Discussion on SKA

Tuesday, 16 May 2023 10:00 (30 minutes)

Presenter: DEMPSEY, Jessica (ASTRON)

Session Classification: Plenary Session

Contribution ID: **135** Type: **Contributed talk**

Updates from the NWO Tafel

Tuesday, 16 May 2023 11:00 (20 minutes)

Presenter: MARKOFF, Sera (University of Amsterdam)

Session Classification: Plenary Session

Contribution ID: **136** Type: **Contributed talk**

Updates from the Institutes and NOVA

Tuesday, 16 May 2023 11:35 (40 minutes)

Presenters: SLOWIKOWSKA, Agnieszka (JIVE); DEMPSEY, Jessica (ASTRON); WISE, Michael (SRON, Netherlands Institute for Space Research; Anton Pannekoek Institute, University of Amsterdam); RODENHUIS, Michiel (NOVA)

Session Classification: Plenary Session

Contribution ID: **137** Type: **Contributed talk**

The Fast Radio Burst sky revealed by two Dutch telescopes.

Monday, 15 May 2023 12:55 (15 minutes)

Fast radio bursts (FRBs) are so crazily bright that they must be powered by uniquely energetic emission mechanisms. Identifying their physical nature requires good localisation of more detections, and broadband studies enabled by real-time telescope combinations. I will present the results from the Apertif FRB survey (ALERT) that ran 2019-2022. ALERT performed wide-field, fully coherent, real-time FRB detection and localisation on the Westerbork interferometer. We detected a new FRB every week of observing, interferometrically localised to ~0.4-10 sq.arcmin, leading to confident host associations.

The 24 discovered FRBs are broad band and very narrow, of order 1ms duration. Only through our very high time and frequency resolution are these hard-to-find FRBs detected, producing an unbiased view of the intrinsic population. Apertif can localise one-off FRBs with an accuracy that maps magneto-ionic material along well-defined lines of sight. Our combination of detection rate and localisation accuracy exemplifies a new phase in which a growing number of bursts can be used to probe our Universe.

We also cojoined two of the most sensitive telescopes in the world, that are both in the Netherlands: Apertif and LOFAR. Using simultaneous radio data spanning over a factor 10 in wavelength, we detected FRB emission below 300 MHz for the first time. We thus show that the chromatic behavior of periodically repeating FRB 20180916B strongly disfavors scenarios in which absorption from strong stellar winds causes FRB periodicity. We establish some FRBs live in clean environments – a prerequisite for certain FRB applications to cosmology.

Primary author: VAN LEEUWEN, Joeri (ASTRON)

Presenter: VAN LEEUWEN, Joeri (ASTRON)

Session Classification: Plenary Session

Track Classification: Time Domain

Contribution ID: **138** Type: **Contributed talk**

Introduction

Tuesday, 16 May 2023 15:30 (5 minutes)

Presenters: NUIJENS, Frank (ASTRON); BAAN, Marieke (Netherlands Research School for Astronomy (NOVA))

Session Classification: Parallel session

Contribution ID: **139** Type: **Contributed talk**

Communicating SKAO

Tuesday, 16 May 2023 15:35 (25 minutes)

Presenter: ISIDRO, Matthieu (SKAO)

Session Classification: Parallel session

Contribution ID: **140** Type: **Contributed talk**

Tips for inclusive science communication

Tuesday, 16 May 2023 16:00 (25 minutes)

Presenter: JOSEPH, Tana (Univ of Amsterdam)

Session Classification: Parallel session

Contribution ID: **141** Type: **Contributed talk**

Making a Successful STEM Project Inclusive

Tuesday, 16 May 2023 16:25 (25 minutes)

Presenter: HOLT, Joanna (NOVA)

Session Classification: Parallel session

Contribution ID: **142** Type: **Contributed talk**

Data to Dome: Science Communication with BlackGEM

Tuesday, 16 May 2023 16:50 (20 minutes)

Presenter: BAAN, Marieke (Netherlands Research School for Astronomy (NOVA))

Session Classification: Parallel session

Contribution ID: **143** Type: **Contributed talk**

Discussion and Updates

Tuesday, 16 May 2023 17:10 (20 minutes)

Presenter: BAAN, Marieke (Netherlands Research School for Astronomy (NOVA))

Session Classification: Parallel session

Contribution ID: **144** Type: **Contributed talk**

BlackGEM First Light

Tuesday, 16 May 2023 13:30 (15 minutes)

Presenter: GROOT, Paul (Radboud University)

Session Classification: Plenary Session

Contribution ID: **145** Type: **Contributed talk**

BlackGEM Science

Tuesday, 16 May 2023 13:45 (15 minutes)

Presenter: JONKER, Peter (Nijmegen)

Session Classification: Plenary Session

Contribution ID: **146** Type: **Contributed talk**

Builder of Heavens. The Story of Eise Eisinga who made the Greatest Planetarium of his Time

Monday, 15 May 2023 20:00 (1h 30m)

At the end of the 18th century, amateur astronomer Eise Eisinga built the largest planetarium the world had ever seen. He placed it on the ceiling of the living room of his house in Franeker, in the northern part of the Netherlands. The project took him seven years of designing, building and constructing. By the time it was nearly finished, the news about the planetarium was widespread. He welcomed visitors from all over the world to talk about our solar system. The planetarium made Eisinga a celebrity. But what do we really know about Eise Eisinga? Why did he build a planetarium in his home? And what makes this planetarium so unique? Historian Arjen Dijkstra will paint a lively picture of the creator of the Franeker Planetarium.
Today Eisinga's planetarium is still one of the best visited sites of cultural heritage in Friesland. It is recognised as one of the 50 items on the national 'Canon of the Netherlands'. The current custodians are preparing their final bid to have it included on the UNESCO World Heritage List - which is expected to be decided on this September.

Arjen Dijkstra is a historian of science and specializes in the history of astronomy and mathematics. He also published on the history of ideas, books and universities. Dijkstra is director at Tresoar, the Frisian Library, Literary Museum and Archive in Leeuwarden, the Netherlands. He took his PhD at the University of Twente and he previously worked as director of the museum of the University of Groningen.

Presenter: DIJKSTRA, Arjen (Tresoar, the Frisian Library, Literary Museum and Archive)

Session Classification: Social Event

Contribution ID: **147** Type: **Contributed talk**

Navigating academia

Tuesday, 16 May 2023 12:45 (20 minutes)

Presenter: DEGENAAR, Nathalie (Univ of Amsterdam)

Session Classification: Parallel session

Contribution ID: **148** Type: **Poster**

Weighing the Milky Way with paint cans

Wednesday, 17 May 2023 13:29 (1 minute)

At Leiden University's radio astronomy course, we observe the Milky Way using radio telescopes made of 5 litre paint cans, commercial Low Noise Amplifiers (LNAs) and Software Defined Radios (SDRs). Galactic neutral hydrogen can be detected on student's own laptops in mere seconds! This experiment involves the whole process from systems engineering, through signal processing, field experiments, and data analysis to astrophysics.

Presenter: BRENTJENS, Michiel (ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **149** Type: **Poster**

Dynamical modelling and study of turbulence in disc galaxies at z=4.5

Wednesday, 17 May 2023 13:29 (1 minute)

Presenter: ROMAN OLIVEIRA, Fernanda (Groningen)

Session Classification: Poster Prizes & closing

Contribution ID: **150** Type: **Poster**

MeerKAT resolved HI in nearby galaxies

Wednesday, 17 May 2023 13:29 (1 minute)

I will present new results from two MeerKAT Large Survey Programs - The MeerKAT Fornax Survey (MFS) and MHONGOOSE. The exquisite combined sensitivity and resolution of the MeerKAT telescope has opened the door to exploring the realm of resolved, low column density (10^17 - 10^18 cm^-2) neutral hydrogen (HI) emission in a broad range of environments. In the Fornax cluster, we detect (and resolve in most cases) HI in 16 dwarf galaxies that range between MHI ~ 10^6 - 10^9 Msol. Up until now, galaxies of this HI mass have only been detected in the Local Group. I will present the collection of evidence that results in late type star-forming dwarf galaxies losing their HI in only a few hundred Myr once the tidal and / or hydrodynamical forces in the cluster act on their interstellar medium. I will connect these results to those obtained in lower density environments as observed in MHONGOOSE, which is even more sensitive than the MFS. We detect a previously unknown interacting triplet. The central galaxy contains massive amounts of extra-planar gas and the satellite galaxies are connected via extended HI tails. Tidal forces are a clear component of the interactions, although two of the three galaxies show undisturbed stellar bodies. The HI emission shows coherent regions of high (~ 40 - 90 km/s) velocity dispersion, which is caused by two distinct components in the spectra. The multi-component spectra may be a result of an extremely distorted outer HI disk, or the components having different origins.

Presenter: KLEINER, Dane (ASTRON)

Session Classification: Poster Prizes & closing

Contribution ID: **151** Type: **Contributed talk**

Discussion

Tuesday, 16 May 2023 13:05 (25 minutes)

Session Classification: Parallel session

Contribution ID: **152** Type: **Poster**

Not just a drawing anymore: Status update on the Central Wheel Mechanism for MICADO

Wednesday, 17 May 2023 13:29 (1 minute)

Primary author: VAN DEN BORN, Joost (NOVA)

Session Classification: Poster Prizes & closing

Contribution ID: **153** Type: **Poster**

Catalyzing stellar mergers in hierarchical triple-star systems

Wednesday, 17 May 2023 13:29 (1 minute)

Primary author: SIMION, Gabriel (University of Amsterdam)

Session Classification: Poster Prizes & closing

Contribution ID: **154** Type: **Poster**

Tracking dust particles under the influence of non-local disk processes with SHAMPOO

Wednesday, 17 May 2023 13:29 (1 minute)

Primary author: OOSTERLOO, Mark (University of Groningen)

Session Classification: Poster Prizes & closing