



A prototype SKA Science Regional Centre in Spain

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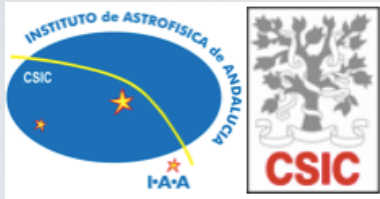
AENEAS ESRC Design Meeting, 27 June 2019, Lyon



Instituto de Astrofísica de Andalucía, IAA-CSIC



CENTRE OF EXCELLENCE “SEVERO OCHOA” DISTINCTION



- An accreditation from the Spanish Ministry of Science that acknowledges the Spanish centers that carry out cutting-edge research and demonstrate scientific leadership and impact at global level
- A renewable 4-years grant
- A **prototype of SKA Regional Centre fully engaged with Open Science**, included in the Severo Ochoa scientific programme presented by IAA-CSIC

PROTO-SRC. LEVERAGING IAA EXPERTISE

- Radio-Astronomy
- e-Science and Open Science (Regional, national, international projects - FP7, H2020)
- Membership to the SKA Regional Centre Coordination Group, to the SDP Consortium and participation in definition of SKA European Regional Centre (AENEAS-H2020) and ESCAPE
- As coordinators of SKA Spain in ideal position to gather the national community, aiming to be transversal

PROTO-SRC. LEVERAGING IAA EXPERTISE

- Radio-Astronomy
- e-Science and Open Science (Regional, national, international projects - FP7, H2020) — since 2007 (IRAM-30m archive)
- Membership to the SKA Regional Centre Coordination Group, to the SDP Consortium and participation in definition of SKA European Regional Centre (AENEAS-H2020) and ESCAPE
- As coordinators of SKA Spain in ideal position to gather the national community, aiming to be transversal

...Our motivation:

SKA will be a game changer in the way we do science, this will happen at the SRCs, we want to contribute to make it possible



OBJECTIVES OF THE PROT-SRC@IAA

Perform the first steps to be accredited as a SRC

Strengthen scientific activities related to SKA and its precursors

Embrace Open Science

Transversality/wavelength agnostic

REQUIREMENTS FOR THE PROTO-SRC@IAA

Proto-SRC@IAA

SRC@IAA

GOALS vs REQS.

Reqs. From use cases associated to IAA Participation in SKA precursors LPs

Reqs. From use cases associated to Spanish community participation in SKA precursors LPs

Special effort to prioritize as well needs that are particularly transversal

Reqs. in terms of computing/storage capacity and tools to support Spanish community in Open Science

ACHIEVING SRC ACCREDITATION

1. Governance
2. Science Archive
3. Data Processing & Storage
4. Accessibility & Software Tools
5. Network Connectivity
6. User Support & Access

GOVERNANCE

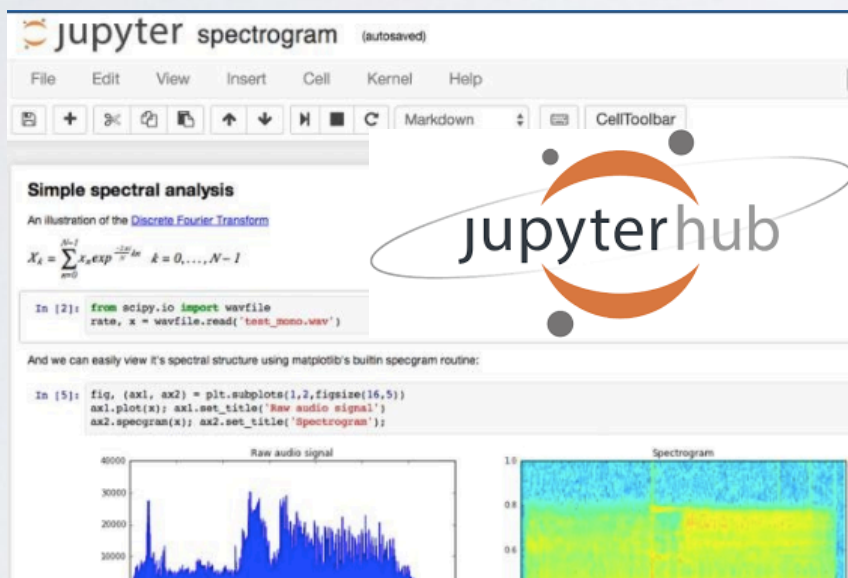
- Integration in the global prototype network
- Partnership with national computing facilities , e-Science network and other research centres (MoU signing etc): approach just starting at technical/scientific level

Data/pipeline provenance - Open Science -Reproducibility



Identification of Open Science tools to support community with:

- » Sharing data / tools following open science standards (e.g VO)
- » Exposing their research / increasing its visibility
- » Re-use of tools (methods) to exploit the archive by the same team, other teams, and repurpose
- » Enhancing collaboration with other teams



Integration of these tools in the SRC prototype

Data Sharing - Data Product Index - Data transfer

- » Collaboration with other SRC prototypes/first global prototype SRC network



DATA PROCESSING AND STORAGE

- » **Partnership with national computing facilities**

- » Previous collaborations with BSC, FCSCCL
- » Contact with U. of Málaga (Red Española de Supercomputación)



- » **Raising additional funds** for resources at IAA

- » Computing/storage hardware

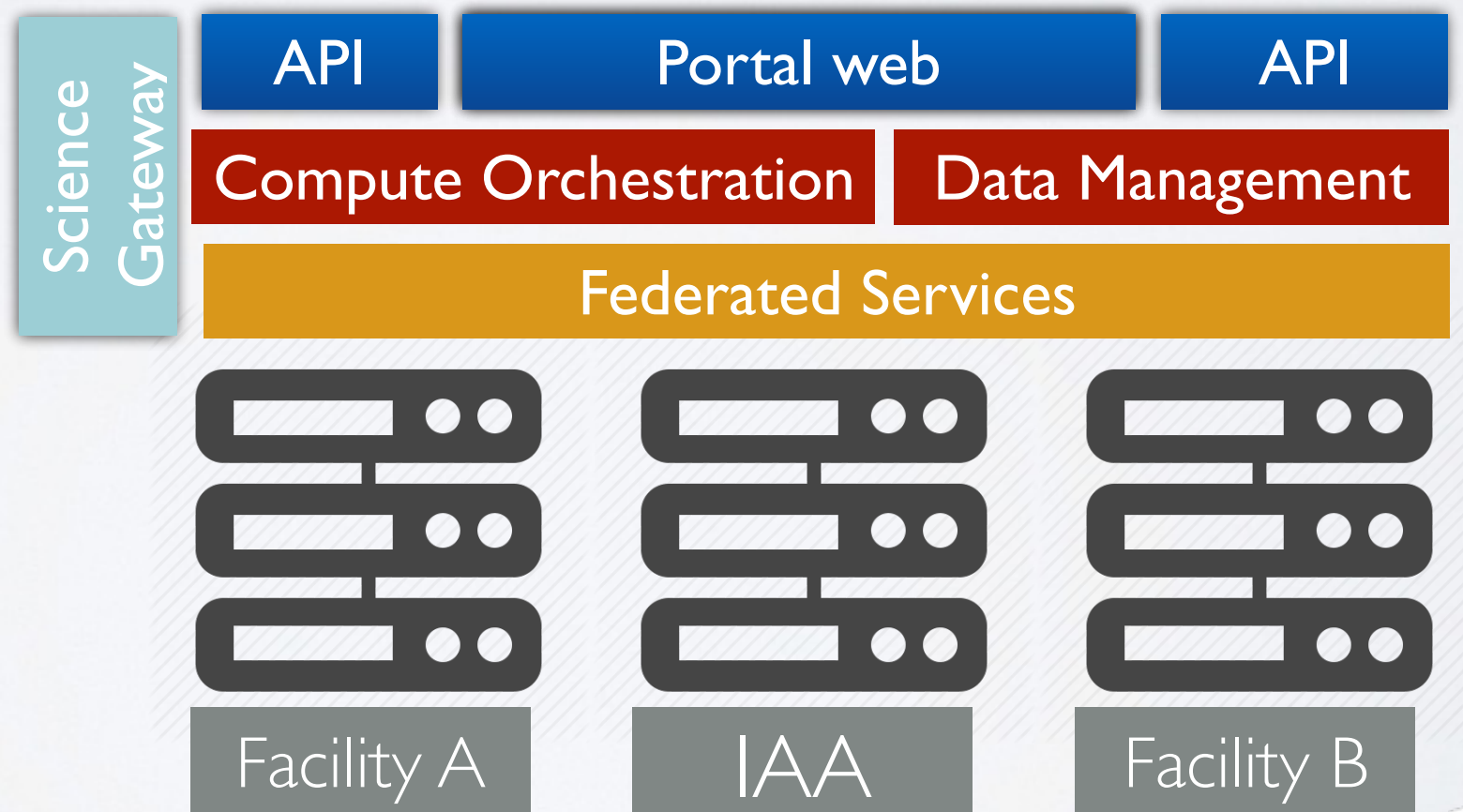
- » **Hiring engineers** to set-up the protoSRC computing infrastructure



ACCESSIBILITY AND SOFTWARE TOOLS

Science Gateway

- » Integrate/Federate resources (from different facilities)
- » Provide a uniform access to the platform services
- » Hide technical complexities of the underlying infrastructure



USER SUPPORT AND ACCESS

Helpdesk - Knowledgebase

- » Training the future postdoc in charge of the user support:
 - » 1 postdoc hired
- » Generating a documentation set that will evolve to a knowledgebase
 - » 1 postdoc hired
- » IAA protoSRC platform will include specific tools for providing a helpdesk and a knowledgebase service.

USER SUPPORT IN OPEN SCIENCE

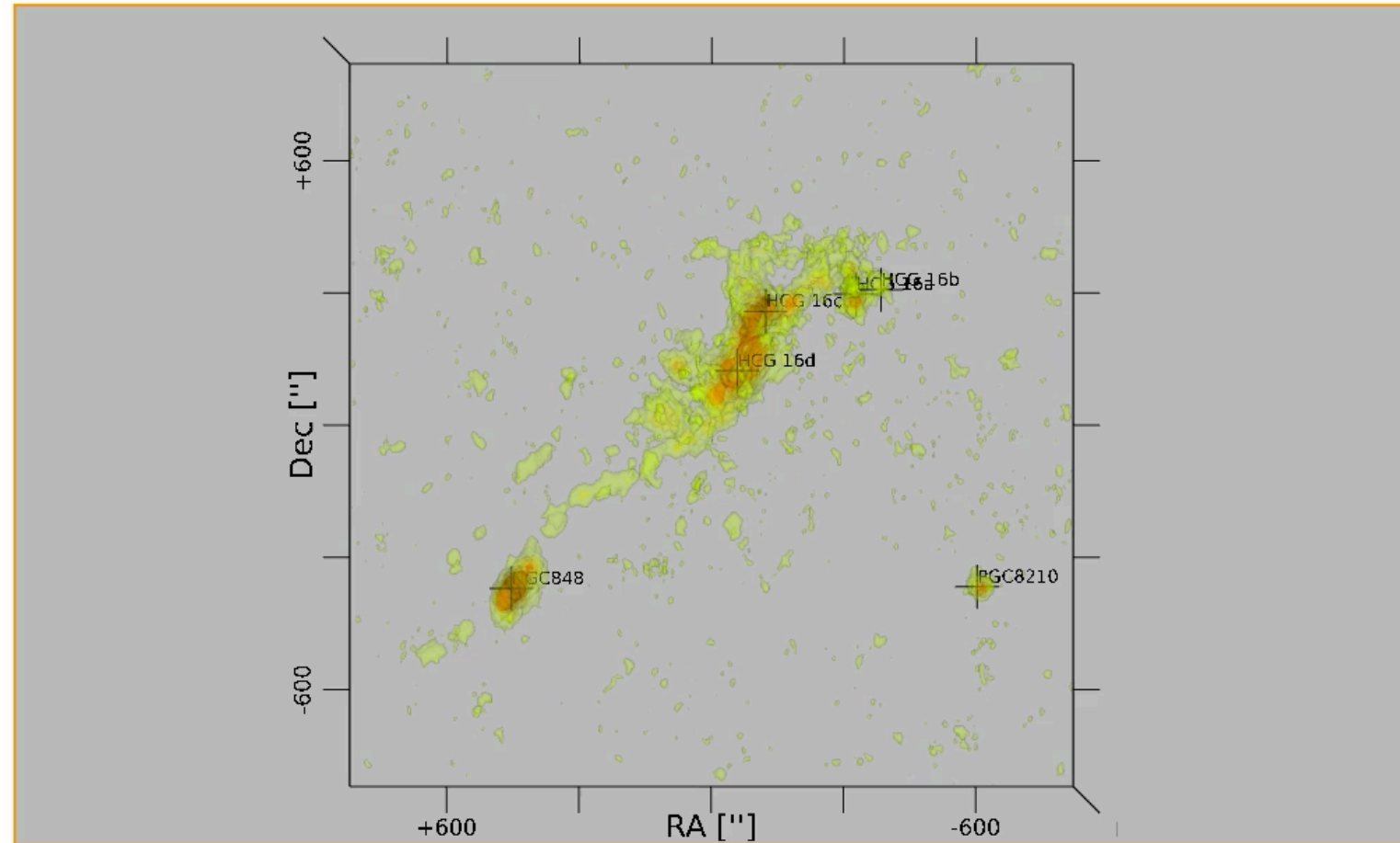
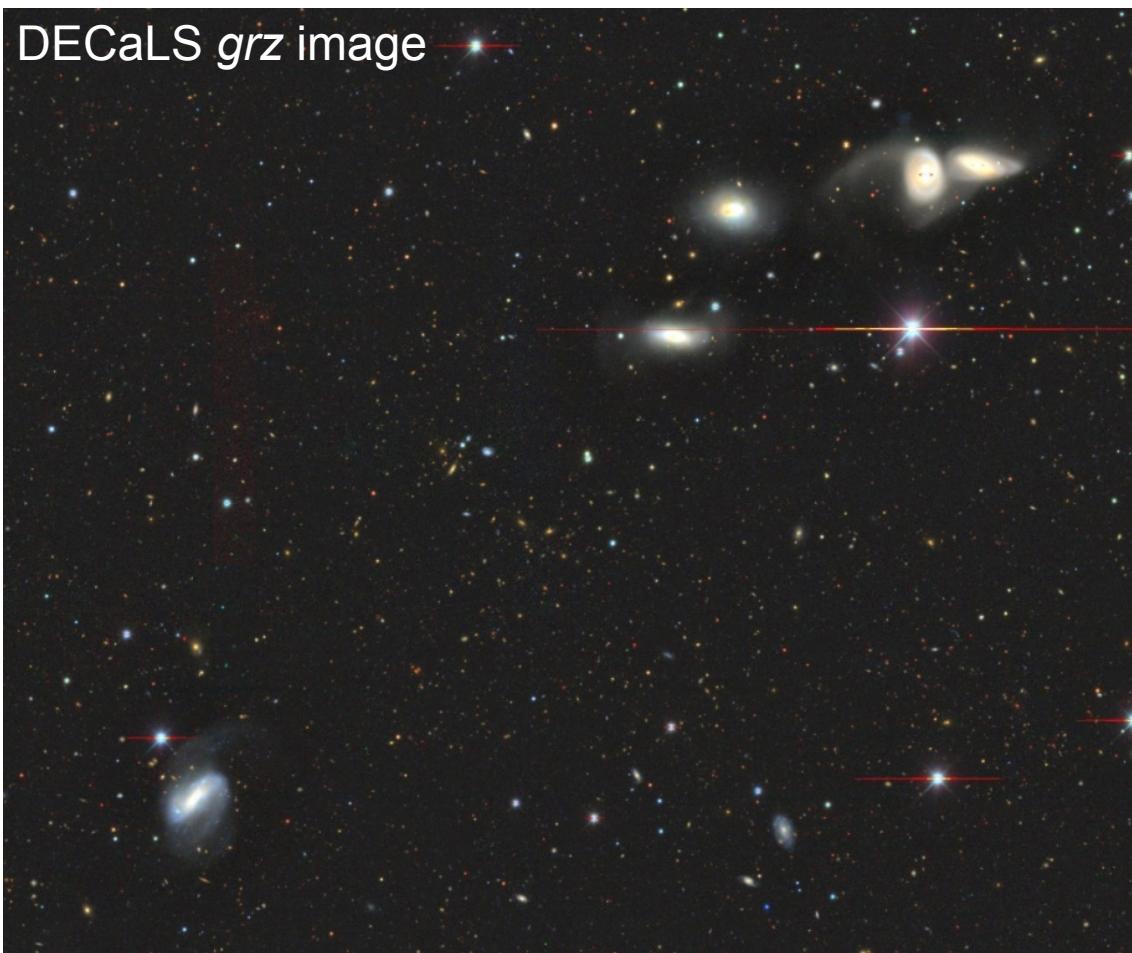
Open Science in a real HI experiment



Specific Example: HI in HCG 16

HCG 16 is complex compact group with starburst galaxies, AGN, tidal tails, etc. The main goal of this project is to study the HI content of the group and to determine which on-going processes are causing it to change.

Collaborators: *L. Verdes-Montenegro, A. Damas, S. Borthakur, M. Yun, A. del Olmo, J. Perea, B. Williams, D. Lopez Gutierrez, F. Vogt, S. Luna, J. Román, J. Garrido, S. Sanchez, J. Cannon & P. Ramírez*



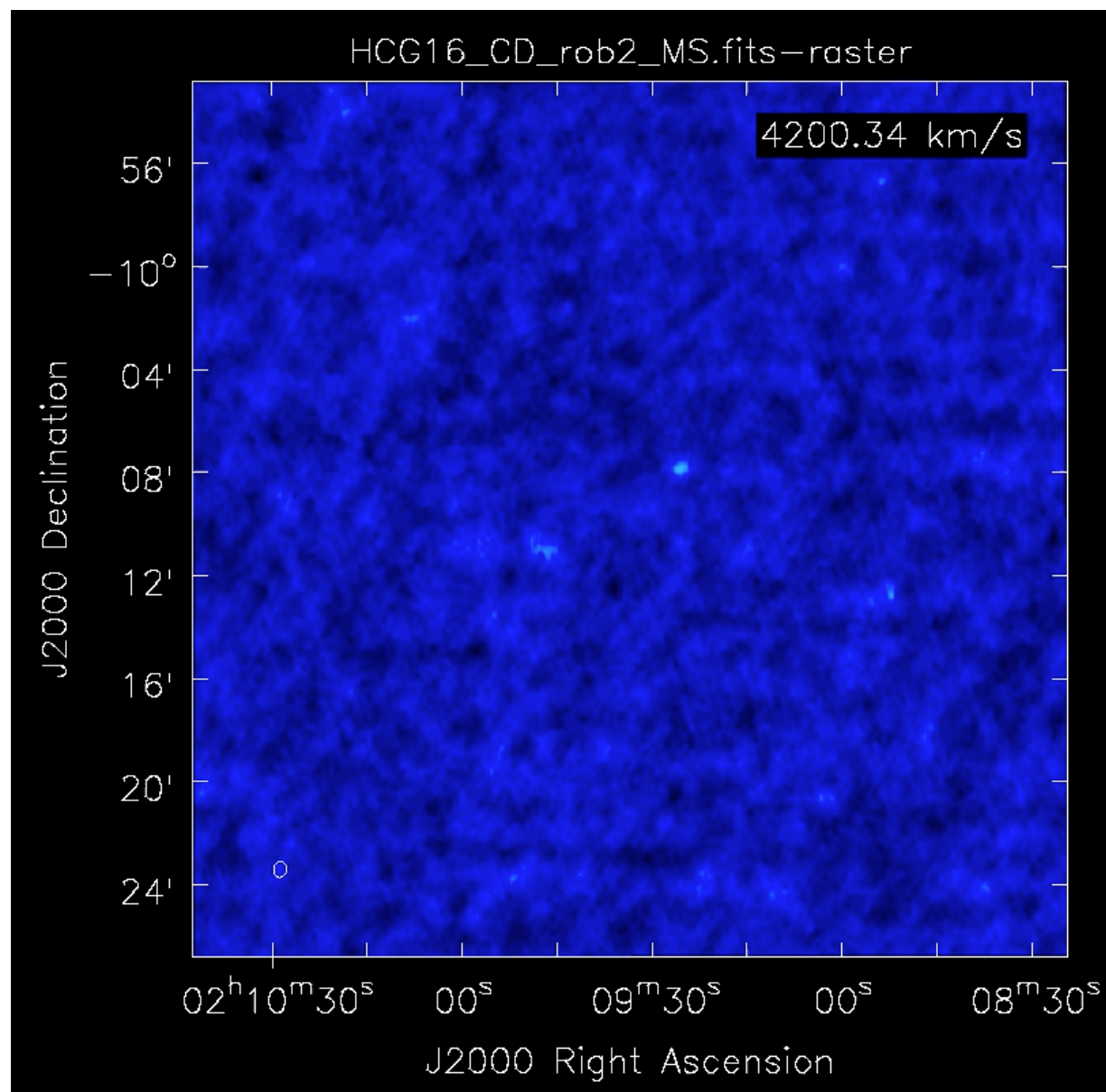
Viewpoints: [Reset View](#) [R.A. - Dec.](#) [V - Dec.](#) [V - R.A.](#) [Perspective View](#) [Next View](#)

HI layers: 12-sigma 9-sigma 6-sigma 3-sigma

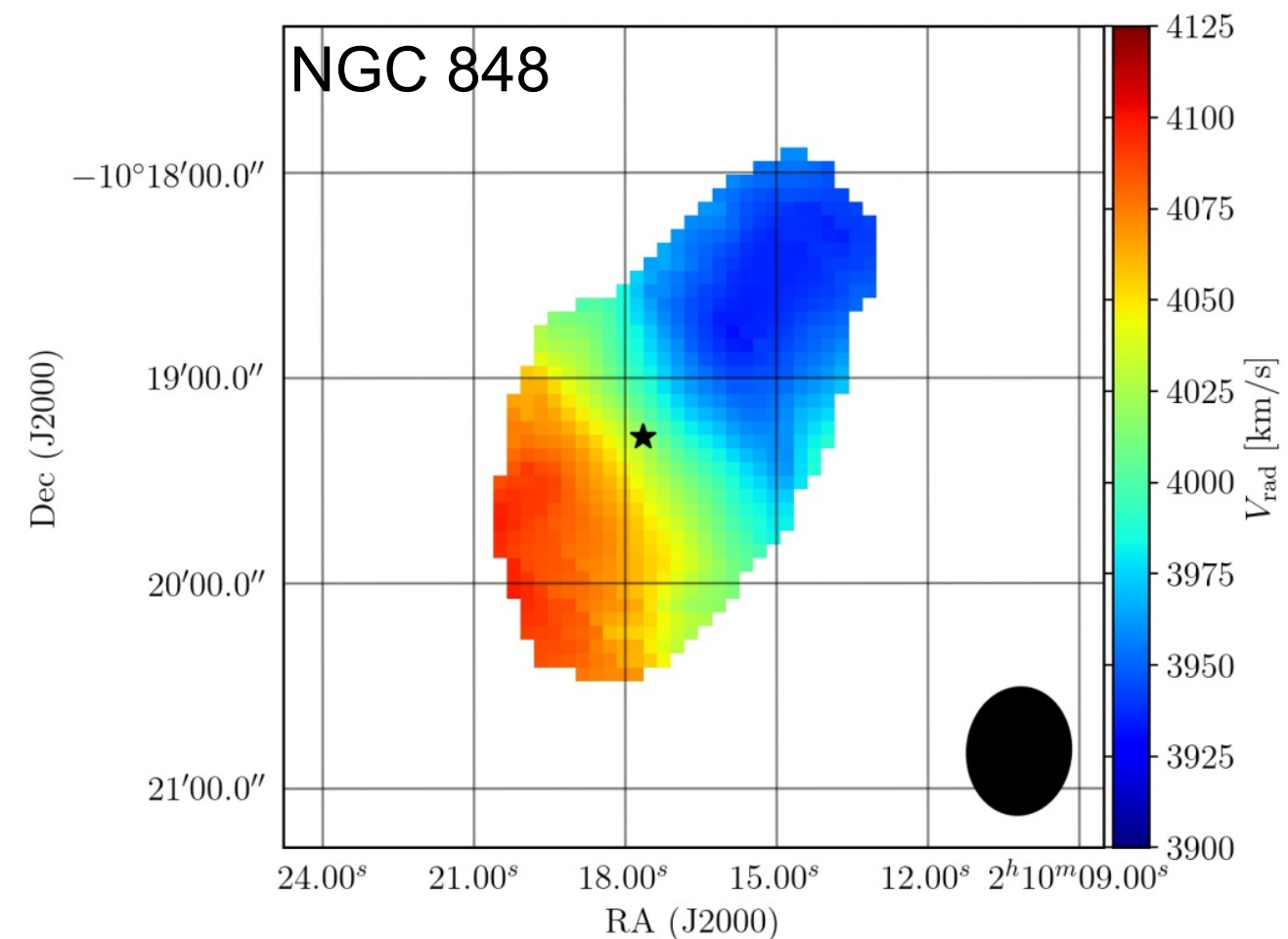
Aside: Data Products

The SKA Observatory will provide basic calibrated data products to the SRCs. Any advanced data products will be generated in the SRCs, thus they will need to the tools to do so.

Data cube – Observatory product



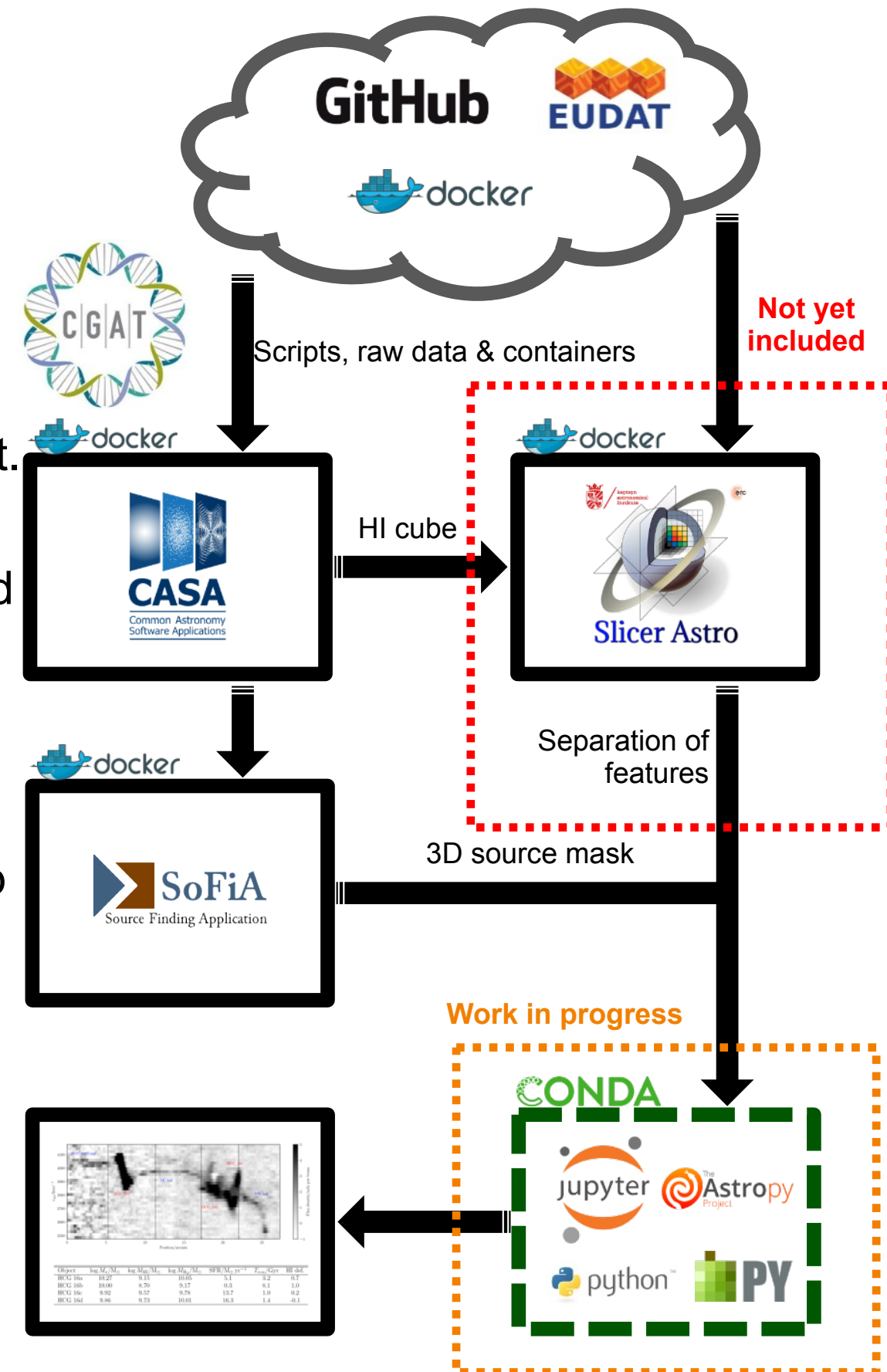
Velocity field – Will be produced in SRC



Current Workflow

R

- FAIR focuses on the data, we want to go beyond this and include also the methods.
- We constructed a modular workflow for this project.
- It is executed entirely within Docker containers and Conda environments. So it can be run on any platform with Docker and Conda, using a single bash script.
- The code and data are publicly available in GitHub (to support exposing methods) and EUDAT (for now)
- The workflow can also be executed in EGI federated cloud (EOSC) and we are working on a SciServer implementation as well. Identifying bottlenecks and solutions



Reproducible Figures

Figure X: HCG 16 HI moment zero map and overlay

This notebook will compile together the relevant output from the HCG 16 workflow and produce Figure X from the paper Jones et al. 2019 (in prep).

```
In [1]: import numpy
import aplpy
import astropy.io.fits

import matplotlib
import matplotlib.pyplot as plt
import matplotlib as mpl
%matplotlib inline
from matplotlib.font_manager import FontProperties
font = FontProperties()
font.set_family('serif')
font.set_size(14)
plt.rcParams['image.interpolation'] = 'nearest'
plt.rcParams['image.cmap'] = 'gray_r'
plt.rcParams['lines.linewidth'] = 1
plt.rcParams['axes.linewidth'] = 1
```

The files used to make the plot are:

```
In [2]: moment0_CASA = 'HCG16_CD_rob2_MS.mom0.pbcor.fits'
DECaLS_r = 'HCG16_DECaLS_r_cutout.fits'
DECaLS_grz = 'HCG16_DECaLS_cutout.jpeg'
```

The moment zero map was created using a 3σ threshold mask in CASA. This is implemented in the *imaging* step of the workflow and depends on all previous steps. The command is located at line XX of the [imaging.py](#) script.

The DECaLS *r*-band and *grz* images were obtained using two `wget` commands in the *get_decals_fits* and *get_decals_jpeg* steps of the workflow, which are independent of all previous steps as these images are only used for plotting. The specific commands are contained in the [pipeline.yml](#) file.

Next steps within the protoSRC

- (Future) SRCs archive
- Science Gateway to access resources and execution environments in a transparent way
- IVOA services
- In general, adapting platform and tools to users (and not the other way round)
- Application to training and to new users (e.g new groups members)



Overly Honest Method

@OverlyHonestly



You can download our code from the URL supplied. Good luck downloading the only postdoc that can get it to run, though [#OverlyHonestMethods](#)

Connected with the international SRC prototype activities/SRC Steering Committee:

- Be **part of the first global prototype SRC network** and of **EOSC** at European level
- Be a **wavelength agnostic** facility
- Provide **tools for reuse** of SKA data products (multi-messenger, multi-wavelength)
- **Share infrastructure** with other disciplines
- Provide a **collaborative** software platform that can **interoperate among SRCs**
- Access through **IVOA** services - SRC data will be IVOA compliant

THANKS!



