

UCAM & Square Kilometre Array Telescope – OBELICS PLANS

Rome OBELICS F2F

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THE SQUARE KILOMETRE ARRAY TELESCOPE

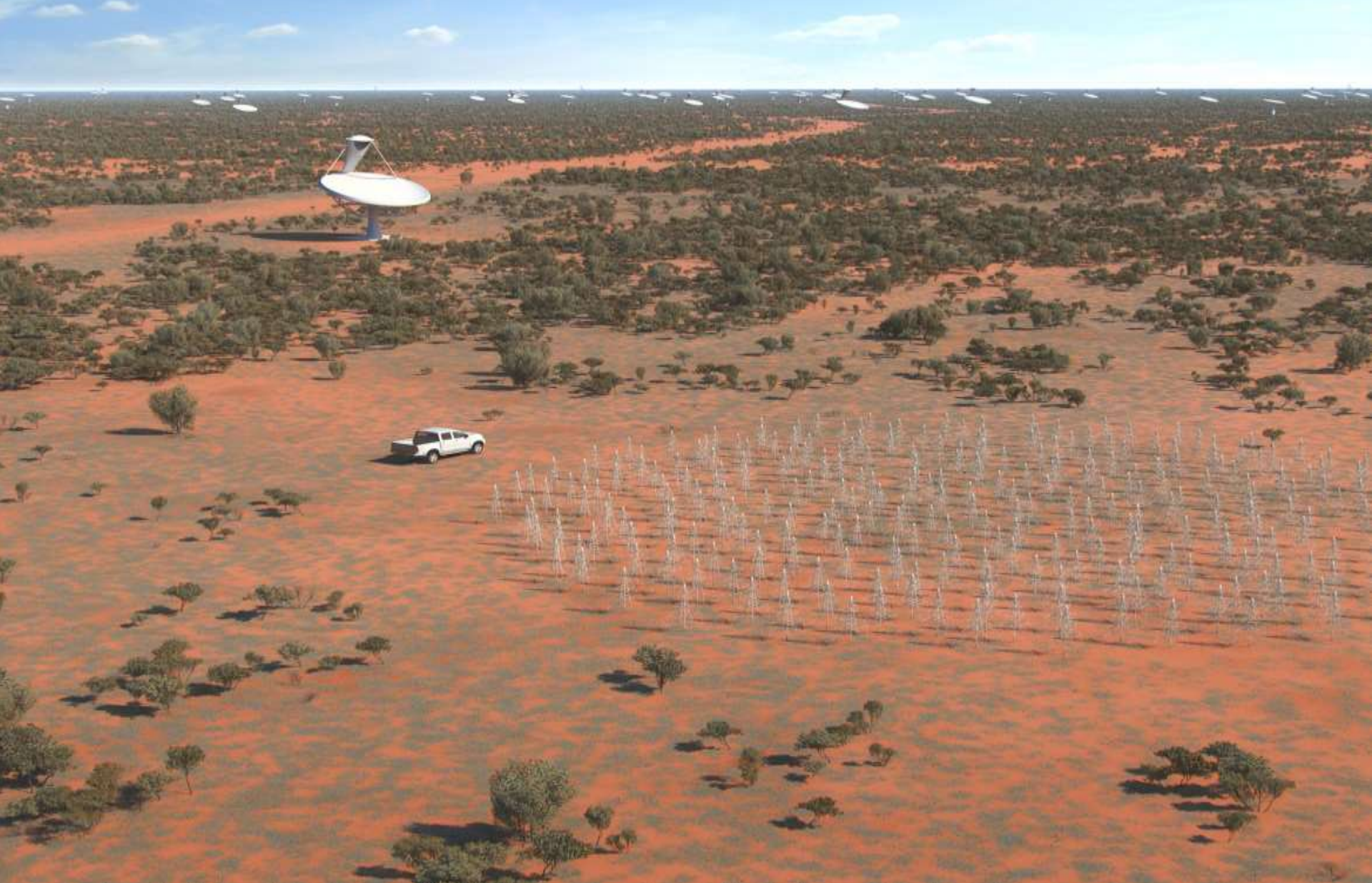
What is the Square Kilometre Array (SKA) ?



Mid frequency dishes and dense aperture array concept



Low frequency array and the survey telescope concept



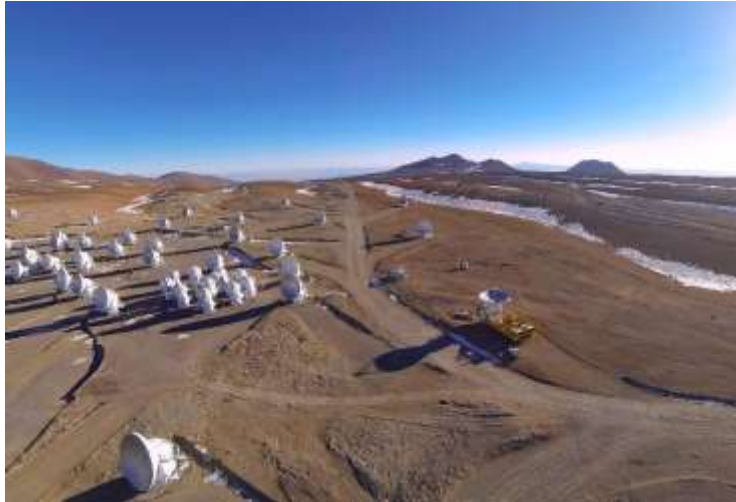
Phased Aperture array for 40 – 650 MHz



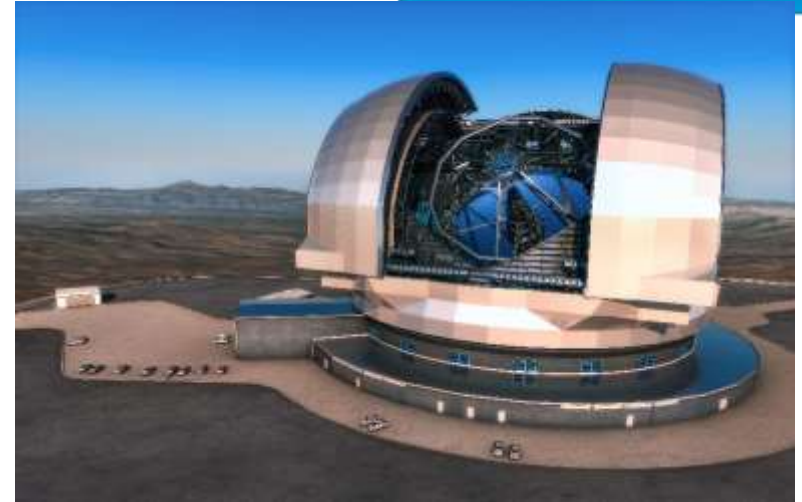
Phased Aperture array: 3 million antennas



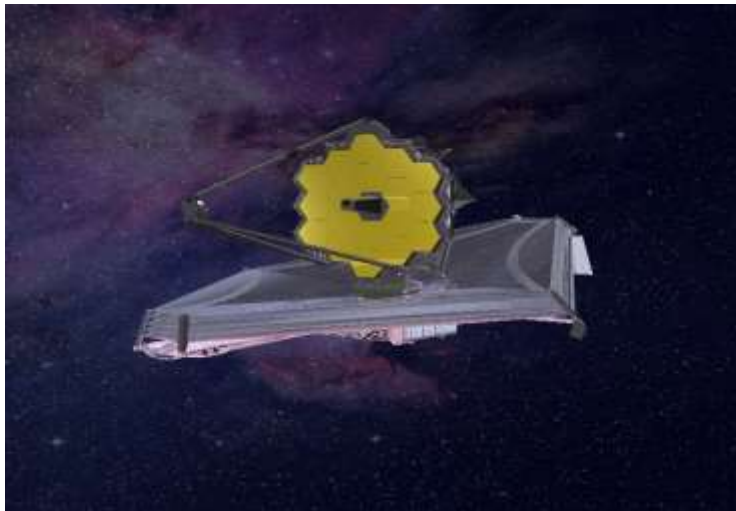
Scientific Context – a partner to ALMA, EELT, JWST



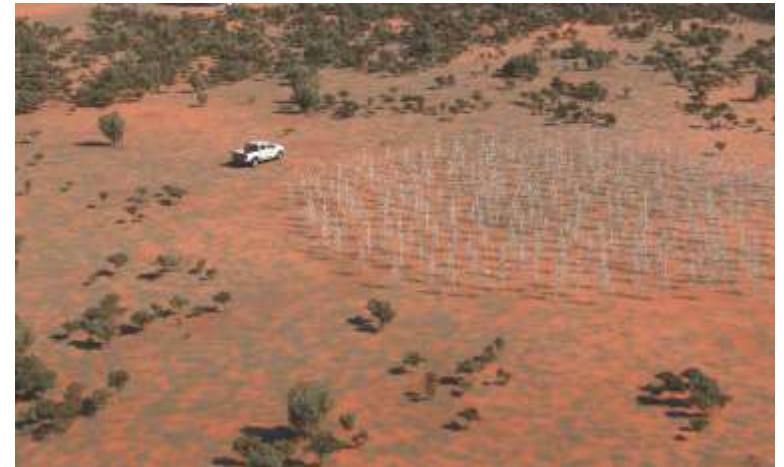
Credit:A.
Marinkovic/XCam/ALMA(ESO/NAOJ/NRAO)



Credit:ESO/L. Calçada (artists impression)



Credit: Northrop Grumman (artists impression)



Credit: SKA Organisation (artists impression)

Scientific Context – a partner to ALMA, EELT, JWST



ALMA:

- 66 high precision sub-mm antennas
- **Completed** in 2013
- Budget ~1.5 bn USD



Credit: A.
Marinkovic/XCam/ALMA(ESO/NAOJ/NRAO)

European ELT

- ~40m optical telescope
- Completion ~2025
- Budget ~1.1 bn EUR



Credit: ESO/L. Calçada (artists impression)

JWST:

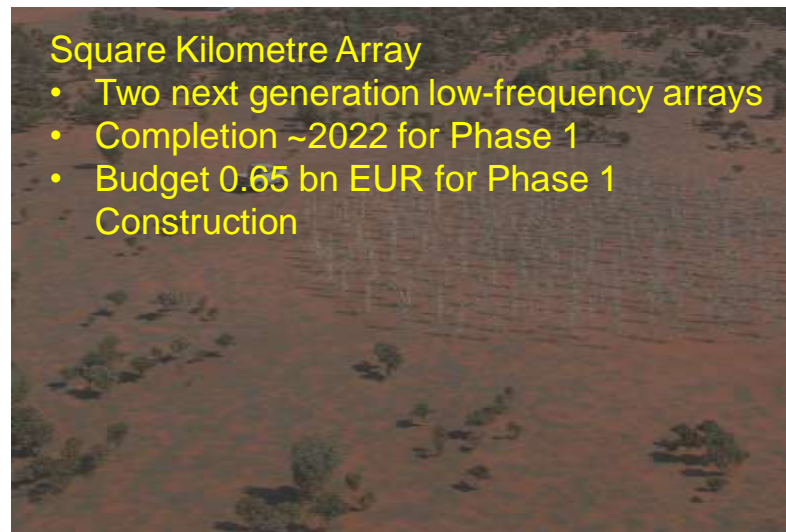
- 6.5m space near-infrared telescope
- Launch 2018
- Budget ~8 bn USD



Credit: Northrop Grumman (artists impression)

Square Kilometre Array

- Two next generation low-frequency arrays
- Completion ~2022 for Phase 1
- Budget 0.65 bn EUR for Phase 1 Construction



Credit: SKA Organisation (artists impression)

What will the Square Kilometre Array (SKA) be?



Radio Telescope

Makes Images of the Sky at radio (5m-3cm) wavelengths

~100 more sensitive than current telescopes

Complements ALMA, JWST (successor to Hubble), and E-ELT

Currently in Design

Construction begins 2018

Full operations expected at end 2022

Significant funds already committed by participating countries

Major Engineering Project

Two remote desert sites

>100k receiving elements

Major ICT Project

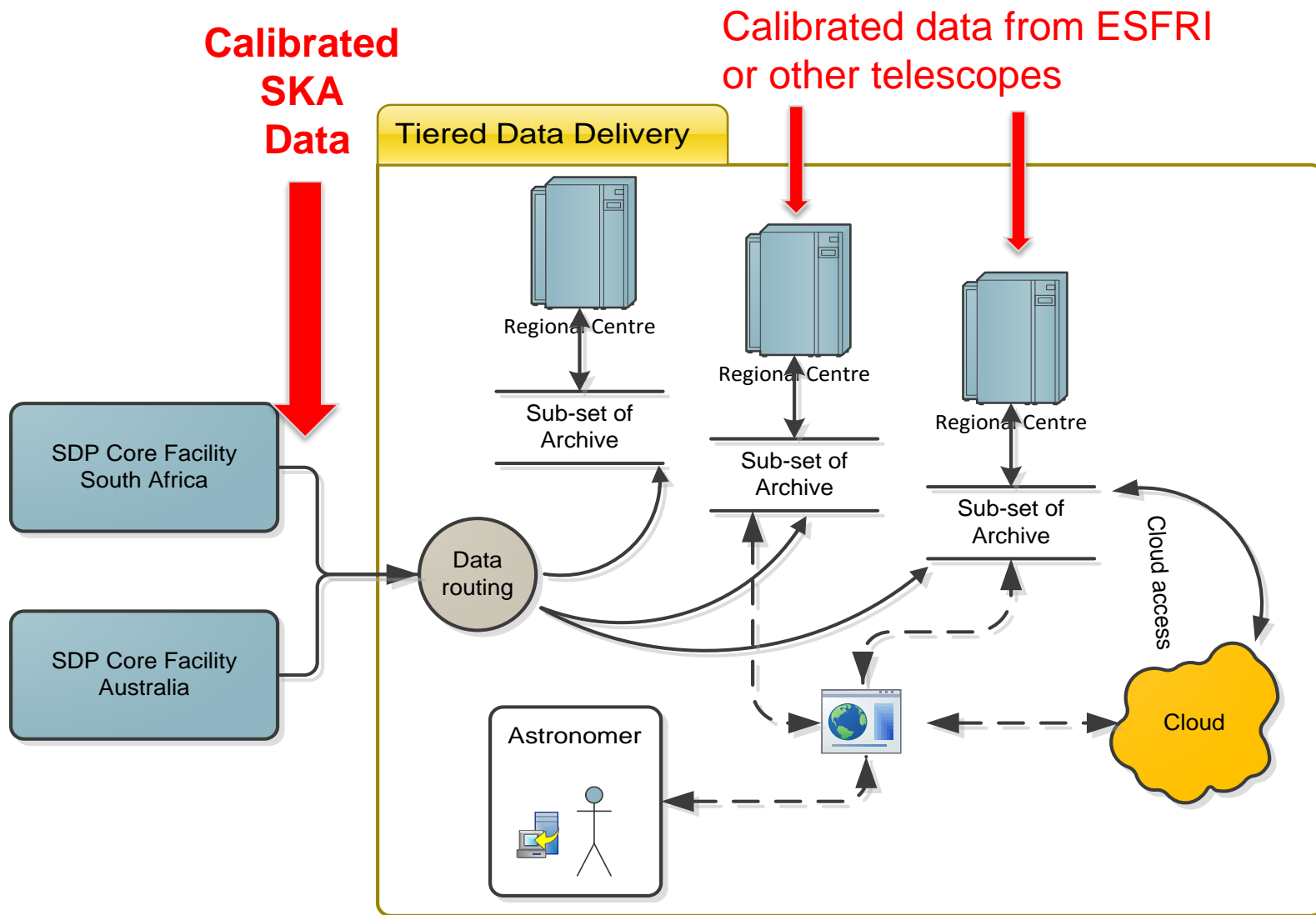
OBELIS to contribute to a contained, but significant and neglected, part of the ICT challenge

UCAM OBELICS PLANS



- University of Cambridge is the lead organisation in the international consortium designing the science data processor for the SKA
- The University is also closely involved in JWST, LSST, ALMA and other telescopes and a number of large scale surveys
- Obelics is uniting expertise across a number of different astronomy groups in Cambridge

SDP + SKA Regional Centres





- *Science-Led*: technology to do science (not science to use technology)
- Computationally and statistically efficient
- Joint analysis of data from multiple telescopes
- Practical:
 - Usable by astronomers daily
 - Scientifically validated



1. MW-Inference: Multi-wavelength/messenger/observatory Bayesian Analysis and Machine Learning Library
2. StatPlanner: Tool for planning statistical analysis of large surveys and statistical re-analysis of archival data
3. “Recipe” – practical handling of large-data set data reduction (in cooperation with JIVE)



Developing a collection of statistically robust and domain independent open source software libraries for data analysis and data mining on Peta-scale datasets. This will enable a sustained community-based effort towards excellent exploitation of all data generated by the ESFRI and pathfinder facilities. The initial set of libraries developed within this task are in particular.

1. Statistically robust approaches (Bayesian and likelihood analyses) to advance cross-matching between catalogues and transients detected via different instruments
2. Domain independent image analysis for simultaneous feature classification and extraction in multi-dimensional/multi-resolution data where the data are from multiple instruments.
3. Effective likelihood reconstruction methods and new graphical processing approaches (mainly for event-based and signal-based projects but not exclusively) optimised for new computing technologies and maximum efficiency.



- Bayesian multi-wavelength & transient source detection and analysis with evidence calculation
- Neural Network multi-wavelength & transient source detection and classification
- Machine learning supervision front-end
- Experiment with implementation on standard “Big Data” framework



- Initial milestone to be a baseline from published Cambridge codes
 - MultiNEST
 - SkyNet
- Packaged, appropriate licensing, driver scripts + possibly some tidy up re-implementation



From the OBELICS plan:

- *designing and testing of workflow engines on distributed compute-intensive systems*
- Practical tool for explorative data analysis with minimal re-computation
- Building on RadioNET/HILADO work
- Initial milestone can be a baseline based on this work
- More from JIVE



- Aim: How to plan a archival statistical study?
- Create a baseline on current telescope tools (LSST, Gemini, SDSS)