

INAF



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NATIONAL INSTITUTE FOR ASTROPHYSICS

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Istituto di Radioastronomia

# SKA Technologies @ INAF



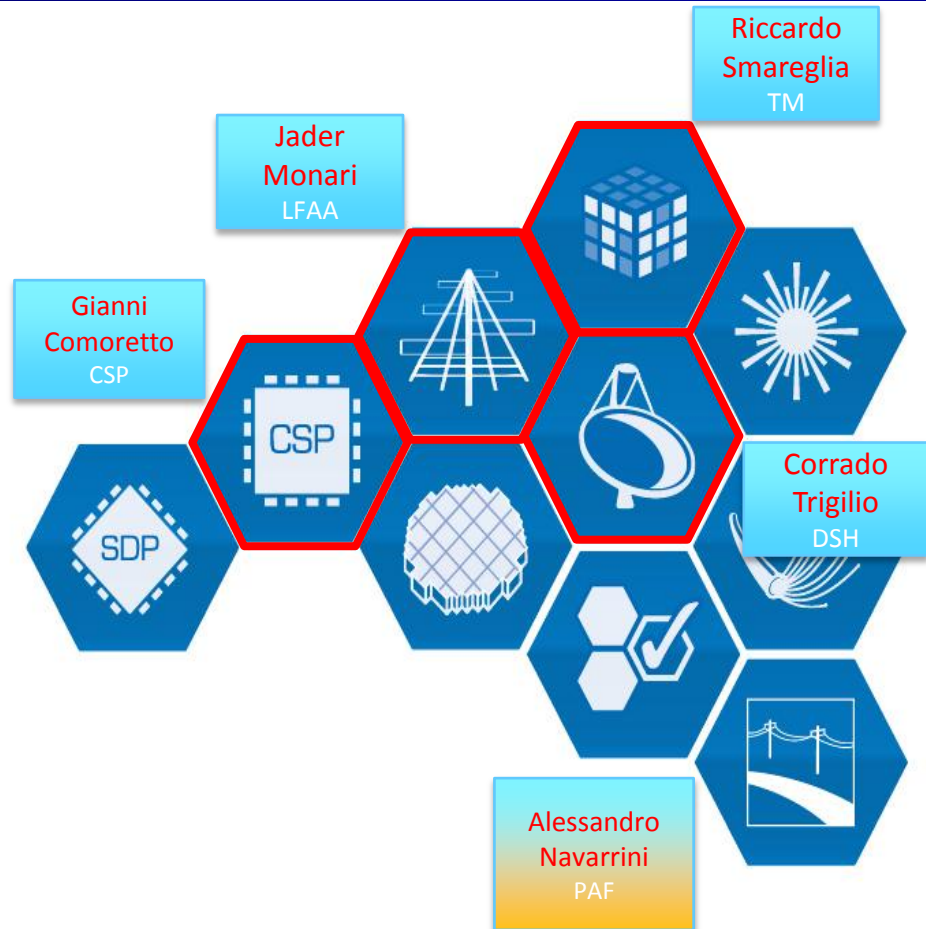
# SKA

SQUARE KILOMETRE ARRAY

# Current SKA INAF Italian Organization



**SKA Board Italy**  
**Davide Fierro**  
Program Manager



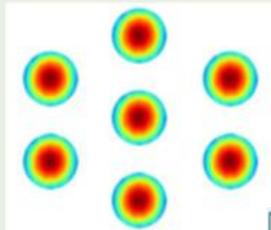
# Italian Contribution to PAF



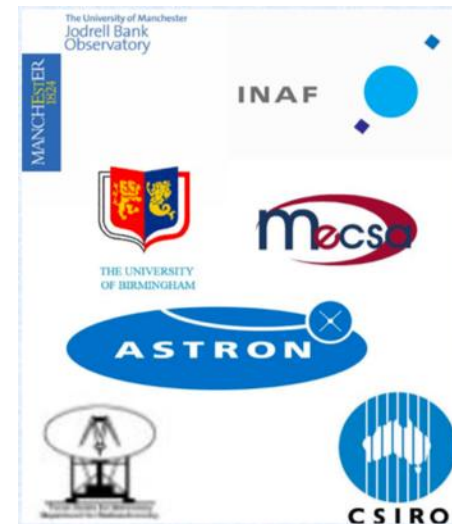
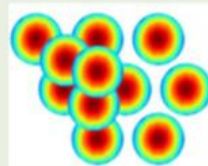
Radiation beam from single pixel feed



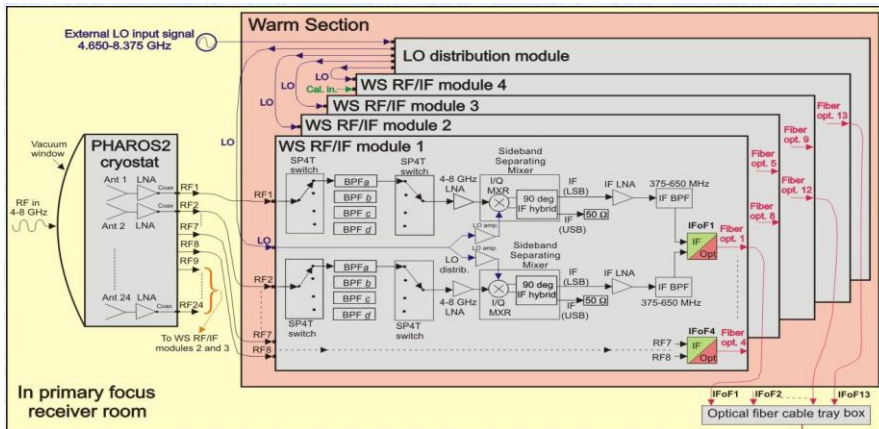
Radiation beams from 7-beam receiver



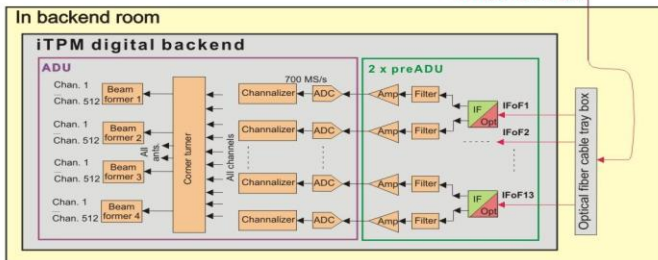
One possible configuration of the radiation beams from a PAF (with 13 beams)



# Schematic Diagram of Pharos2



In primary focus receiver room



13 optical fibers (Ant 1 to 24 plus 1 calib. signal)



o telescope

# TM Workpackage - Modules



Key responsibilities plus domain analysis identified two key top level software modules:

- Observatory Science Operations (OSO) Software
  - Supports major functions of the Observatory, tying the science observation management to its execution at each telescope
- Telescope Monitoring and Control (TMC) Software
  - Manages the operations of each telescope, from lower levels of execution to each external system.

And two cross-cutting support software modules:

- TM Services (SER) Software
- Authentication, Authorization and Auditing (AAA)
  - Note: TM asked to cover AAA as additional scope during the design phase.

Plus

- User Interface concepts (UI) - delivered for CDR
  - UI Architecture - in progress

# INAF & Italy contribution for DSH WP



**Il feed indexer  
(SAM)**



**LMC**

E

largest radio telescope

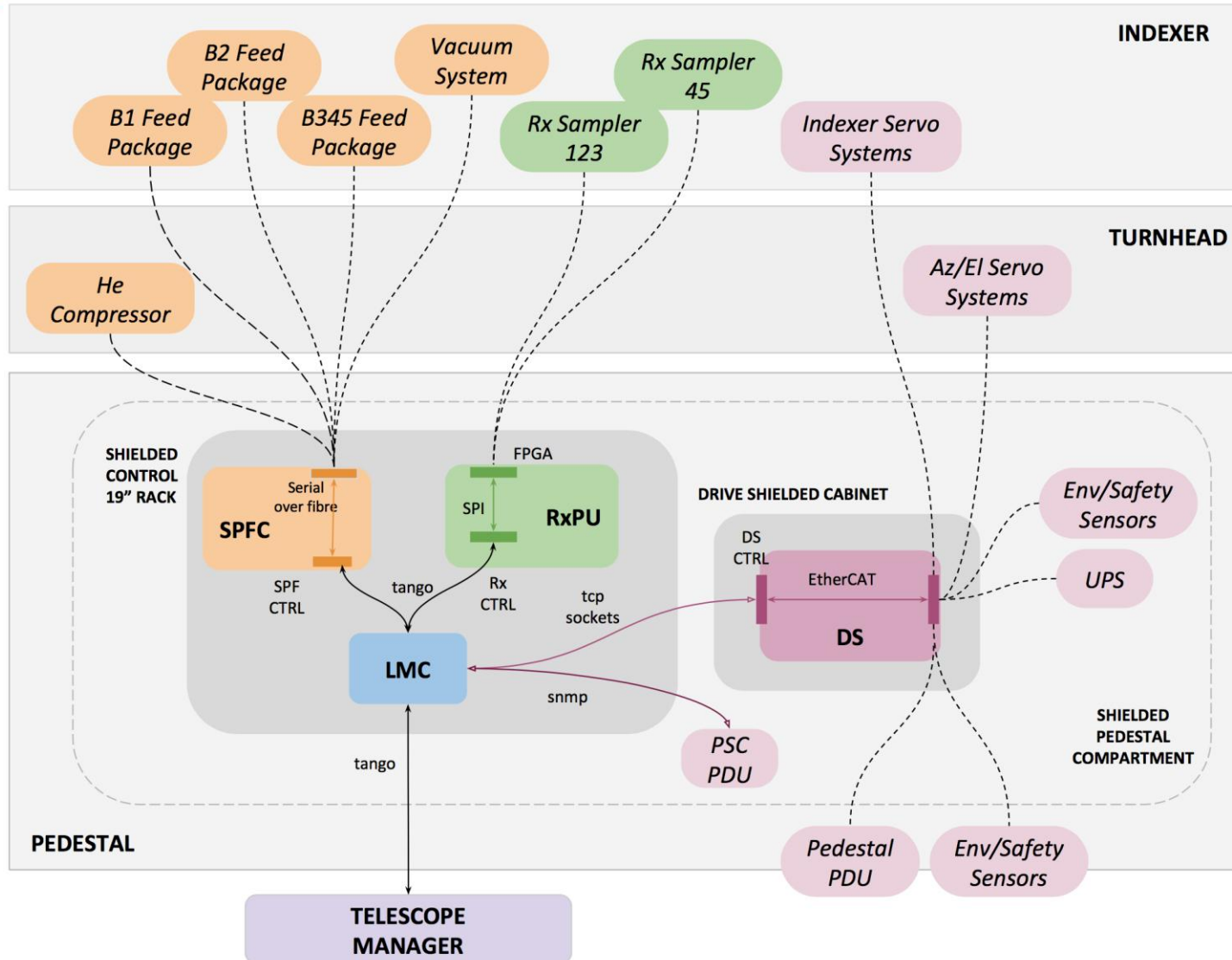
# LMC Overview

LMC consists of a software system for C&M of the DISH equipment to TM and a hardware computer hosting it.

- The LMC PC is in the pedestal, in a 19" shielded rack inside a shielded compartment
- SPF, SPFRx, DS controllers and network switch (SaDT) are hosted in the same rack



# Dish M&C system





# SKA DISH: SAM Activities: The FEED INDEXER



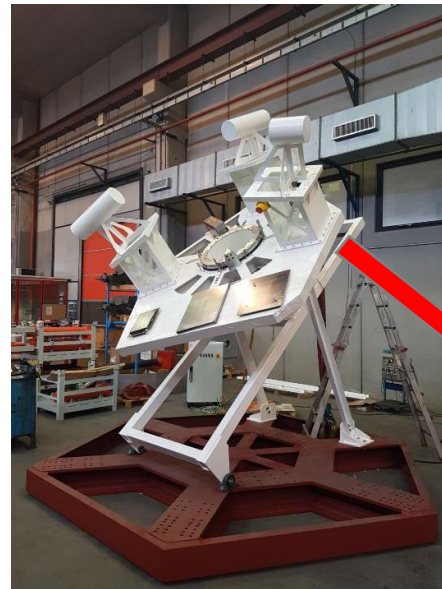
**Dish Structure Team:** China, Germany,  
SouthAfrica, Italy

**SKA1 total Value:** around 700 M€  
**«DISH» SKA1 Value:** around 160 M€

## Relevant Dates

Kick Off – September 2013  
PDR – March 2016  
DDR – December 2016  
TRR Feed Indexer – December 2017  
CDR – Planned for 24 November 2018

**Investments Made by SAM:** around 2,5 M€  
**Economic Return:** from the first industrial  
(SKA1, first 133 antennas): 8-10 M€, from the  
phase 2 around 150 M€



«SKA-P prototype, feed indexer and  
antenna structure (Shijiazhuang, China)





# FEED INDEXER SKA-MPI prototype – South Africa



The product realized by the Italian Consortium SAM allows the switch between the radio bands, from **350 MHz to 15.3 GHz**, with an accuracy of **0.04 mm**, on a diameter of **3 m**. The automation is based on an electrical system with an high precision encoder and a «anti backlash» torque control software, which allows to move a weight of **1900 kg** (receivers and electronic equipment included) in few seconds.



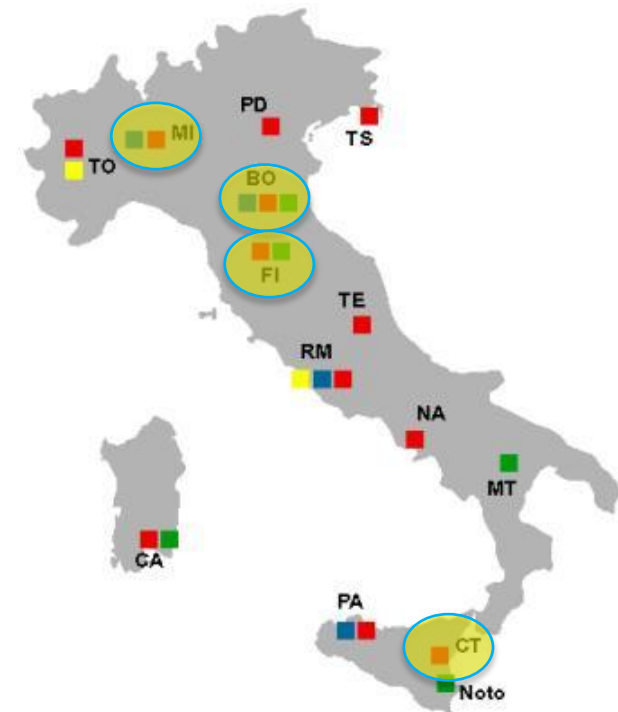
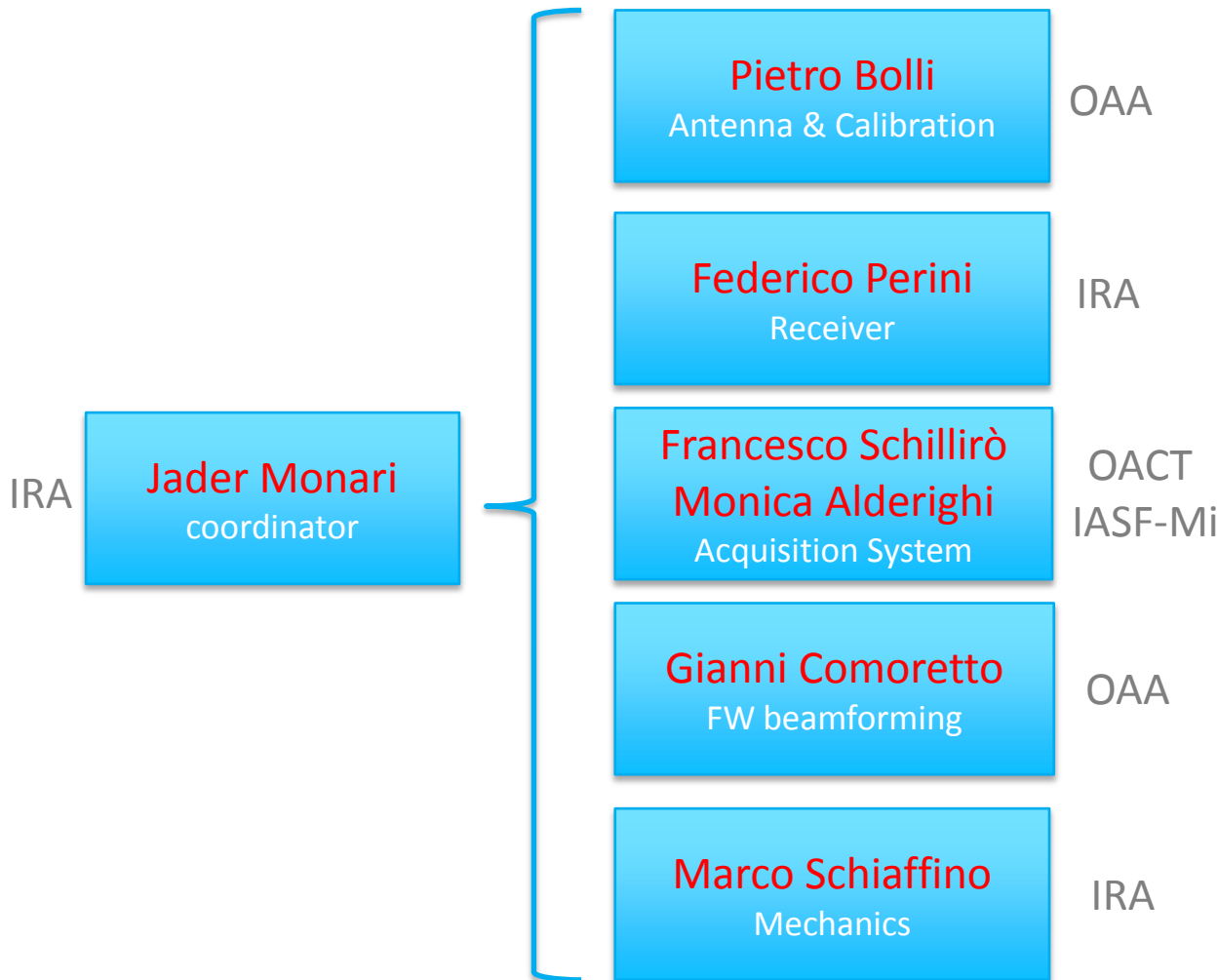


# First SKA Dish



First radio telescope

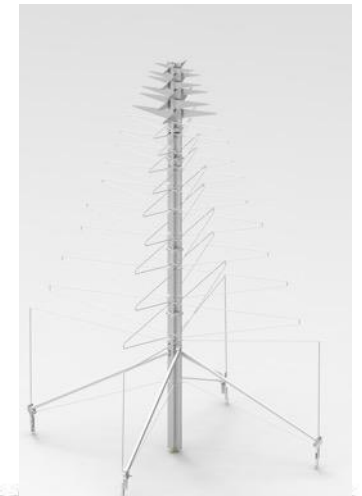
# INAF - LFAA technical group



# Main Past/Current Activities



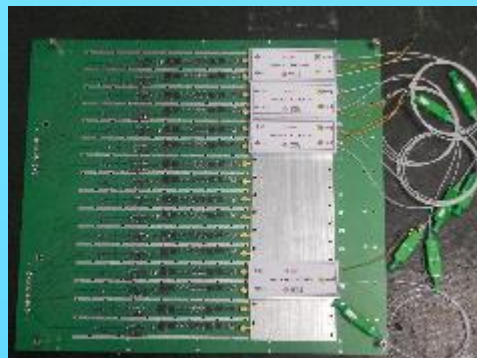
- Vivaldi and SKALA4AL design
- RFoF technology (standard, WDM, VCSEL, POF)
- Hexacopter test bench, Pattern measurement/Calibration for Vivaldi/SKALA, Mini MAD, MAD-1,2,3, LOFAR, AAVS0.5UK
- iTPM assembly (PREADU PRE-analogue board and ADU (Analogue Digital Unit))



# Generations PREADU & ADU



PREADU 1.0  
(standard 1310nm)



PREADU 2.0  
WDM  
1310/1550nm  
1270/1330nm



PREADU 2.1 (AAVS1)  
Optical integrated  
Receiver chain



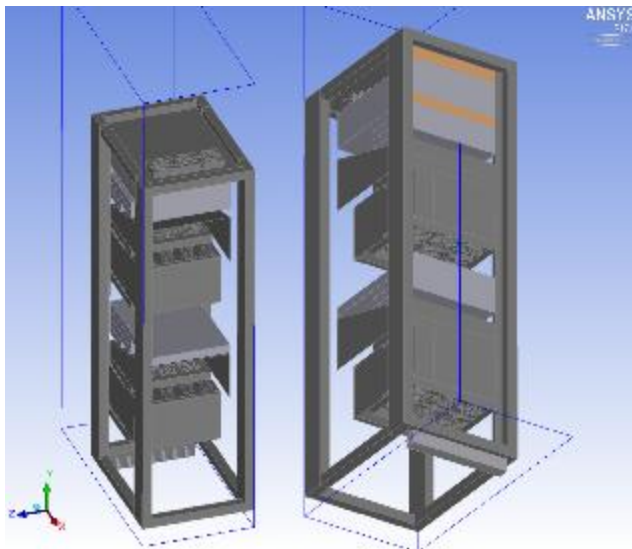
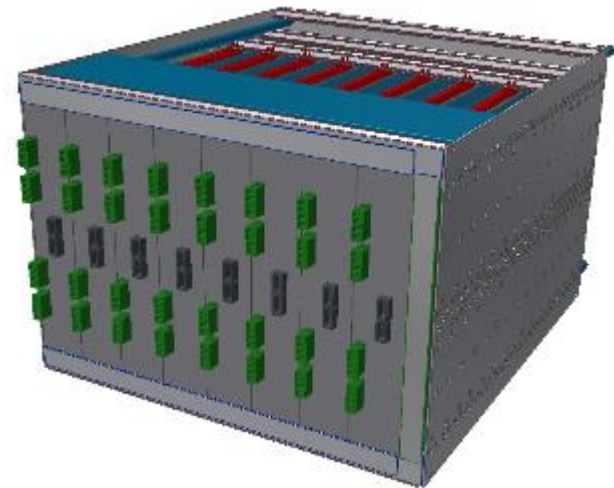
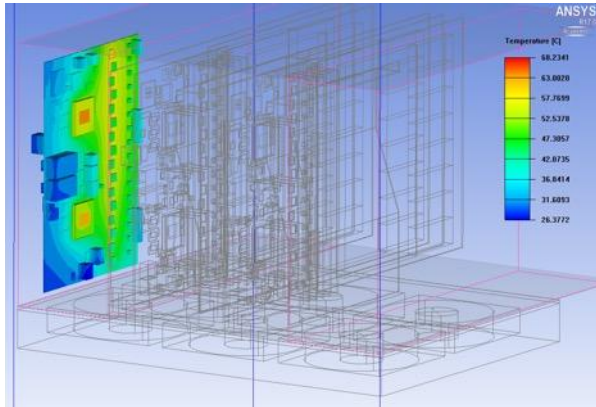
ADU 1.0  
(test board)



ADU 1.1-1.2  
(AAVS1)



# Mechanical works

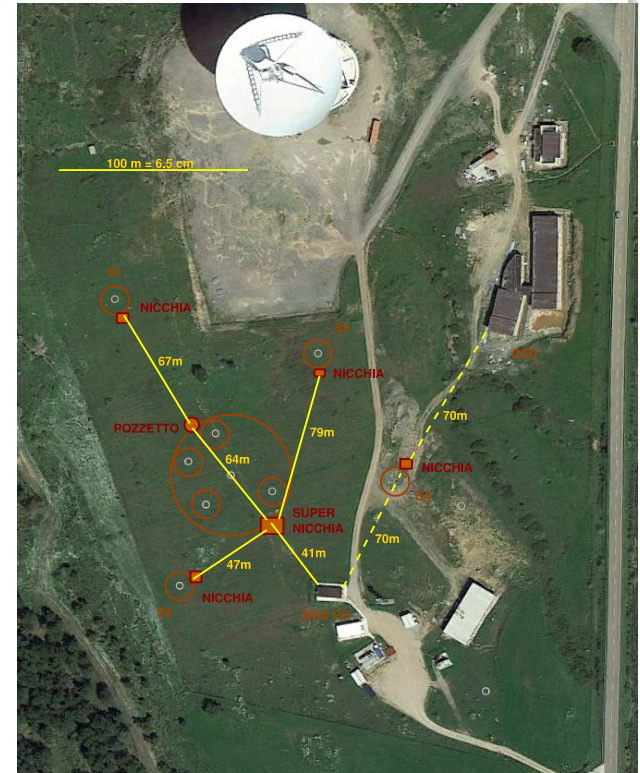
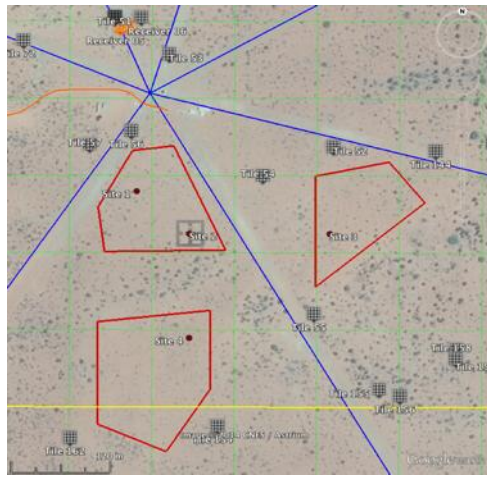


Exploring the Universe with the world's largest radio telescope

# Verification systems (2014-2017)



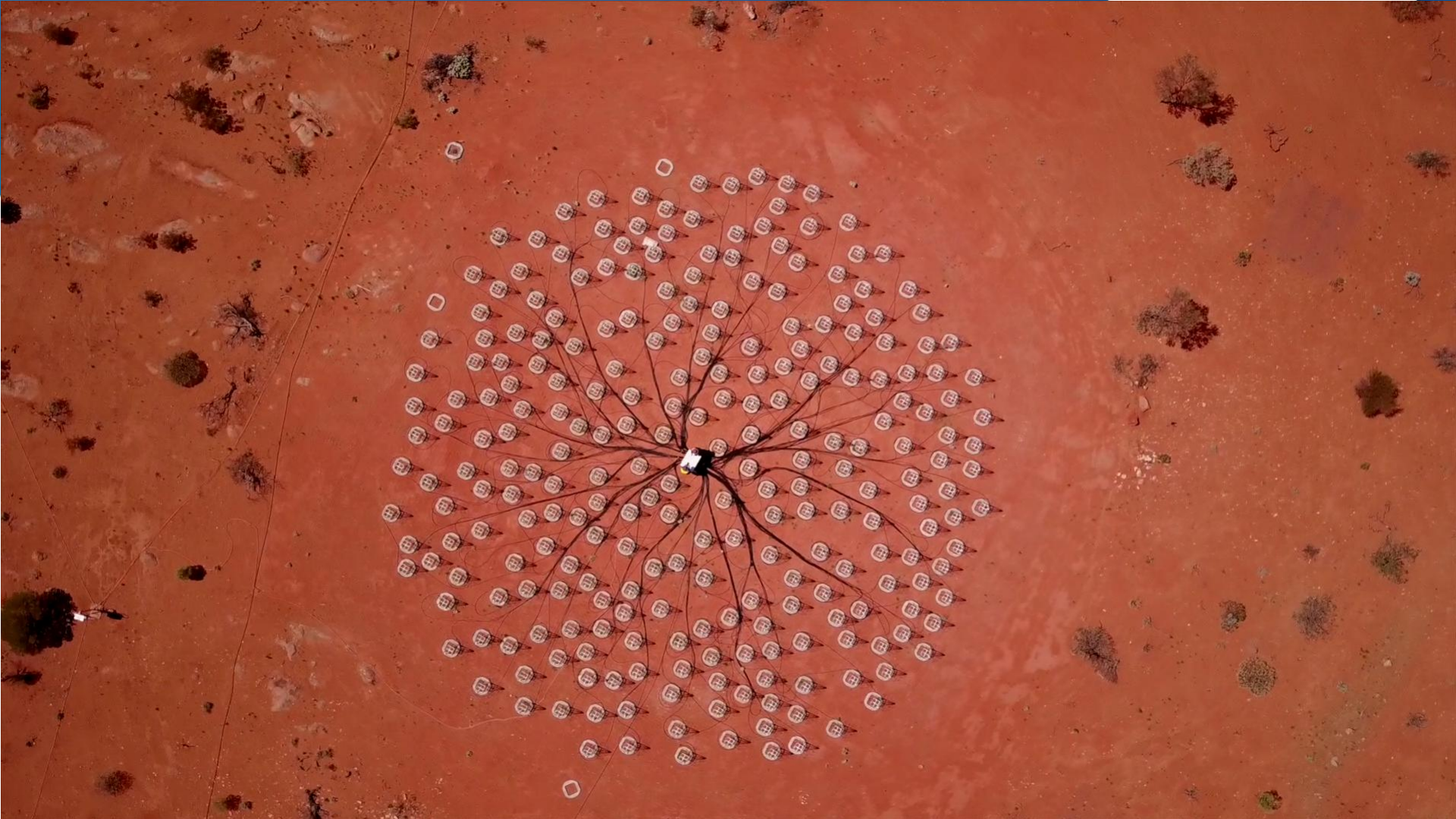
1. Pre-AAVS1 (16 SKALA Lord Bridge) – 2015/2016
2. MAD-BAD (16 Vivaldi Medicina) – 2014/2016
3. AAVS1 (256 SKALA MRO) -2016/2017
4. SAD (128 Vivaldi SRT) – 2015/2017/2018



# EDA 2.0



International  
Centre for  
Radio  
Astronomy  
Research



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