

# Perspective for observations at high radio frequencies with the Italian facilities



UNIONE EUROPEA  
Fondo Sociale Europeo  
Fondo Europeo di Sviluppo Regionale



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**Fifth Workshop on Millimetre Astronomy in Italy - Bologna June 12-14, 2023**

# PON Project - Enhancement of the Sardinia Radio Telescope for the study of the Universe at high radio frequencies



INAF- Osservatorio  
Astronomico di Cagliari

INAF- Istituto di  
Radioastronomia di  
Bologna

INAF – Osservatorio  
Astrofisico di Arcetri

INAF – Osservatorio  
Astrofisico di Catania



Ministero dell'Istruzione dell'Università e della Ricerca  
*Dipartimento per la Formazione Superiore e per la Ricerca*  
Direzione Generale per il coordinamento, la promozione e la valorizzazione della ricerca  
PON Ricerca e Innovazione 2014-2020  
(CCI: 2014IT16M2OP005)

Call for proposals for grants aimed to enhance research infrastructures located in Southern Italy, issued by the Ministry of University and Research in 2018



SRT



VLBI

Upgrade at high frequencies of the Medicina and Noto antennas that operate, along with the SRT, within the Very Long Baseline Interferometry network.

# Enhancement of the Sardinia Radio Telescope for the study of the Universe at high radio frequencies

Work Packages	Description (PI)	Allocated Budget (Euro)
WP1	Multi-Beam Receiver (CARUSO) in W-Band for SRT A. Navarrini	2.850.000
WP2	Multi-Beam Cryogenic receiver in Q Band for SRT A. Orfei	1.035.000
WP3	Millimetre camera for SRT M. Murgia	2.700.000
WP4	Simultaneous compact tri-band receivers (K,Q,W-bands) for the 3 INAF radio telescopes P. Bolli	3.000.000
WP5	Metrology System for SRT S. Poppi	2.300.000
WP6	Backends for SRT G. Comoretto	1.555.000
WP7	Integration A. Orlati	2.498.000
WP8	HPC and storage systems for the archival and the use of the SRT data A. Possenti	1.400.000
WP9	Upgrade of laboratories for the development of microwave technologies T. Pisanu	1.345.000

**Total (Euro) 18.683.000**

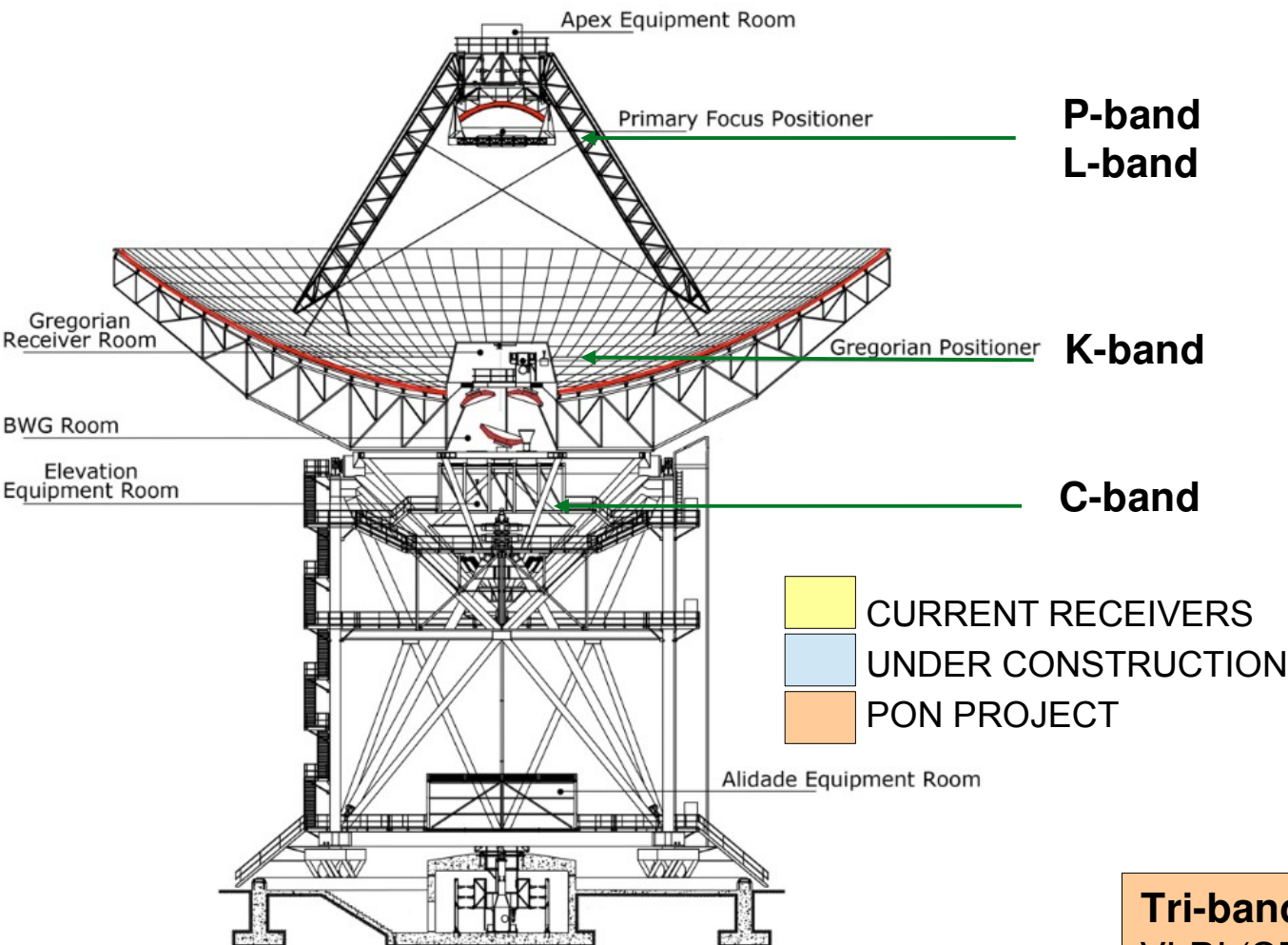


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## GREGORIAN RECEIVERS ROOM



**Tri-band K/Q/W**  
VLBI (SRT, Medicina, Noto)  
18-26, 35-50, 86-116 GHz

**Millimeter Camera**  
80-116 GHz

**P-band**  
305-425 MHz

**L-band**  
1.3-1.8 GHz

**C-band**  
5.7-7.7 GHz

**K-band multibeam**  
18-26.5 GHz

**Frequency**

**S-band**  
3.0-4.5 GHz

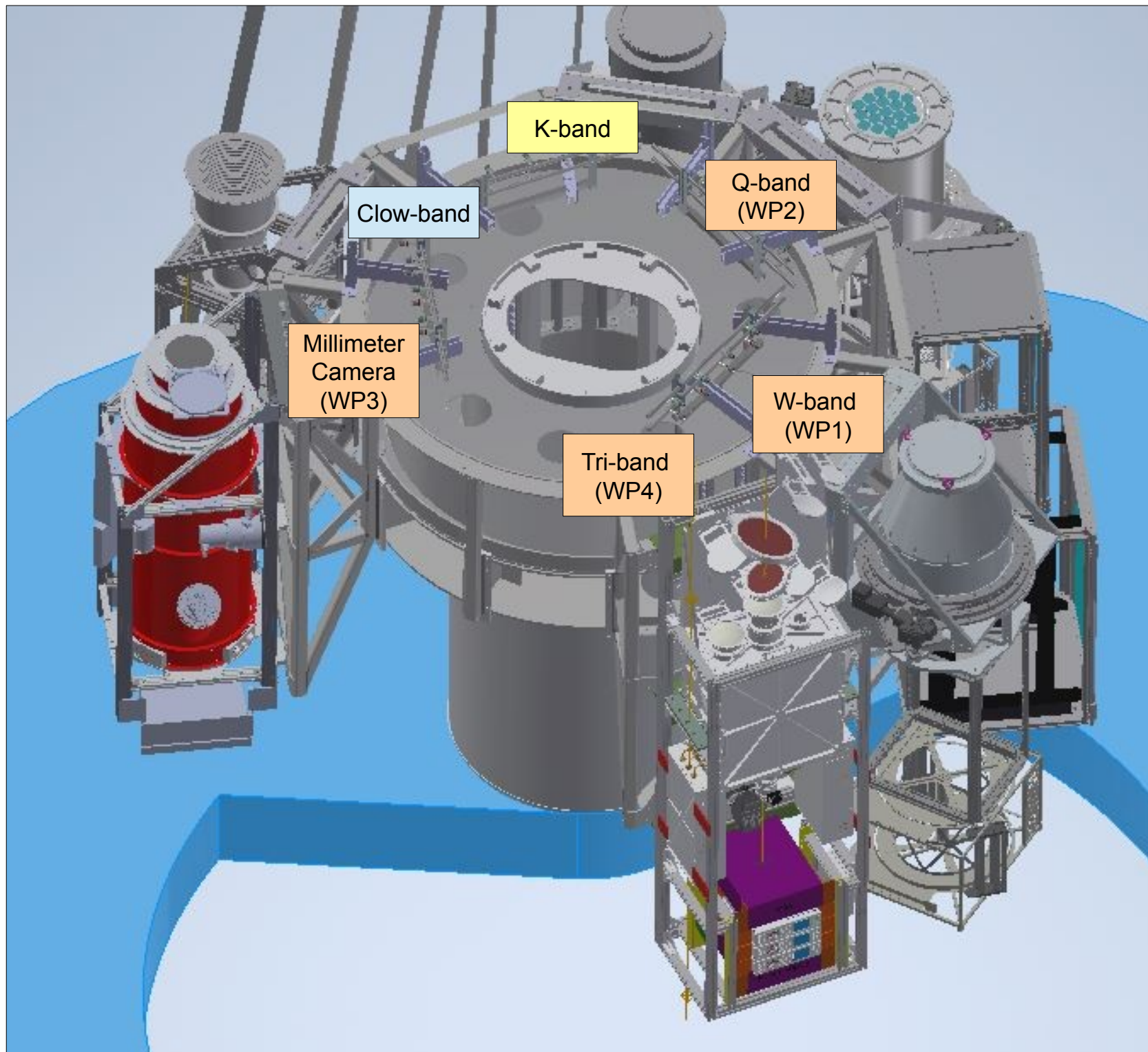
**Clow-band**  
4.2-5.6 GHz

**Q-band**  
multibeam  
33-50 GHz

**W-band**  
multibeam  
75-116 GHz

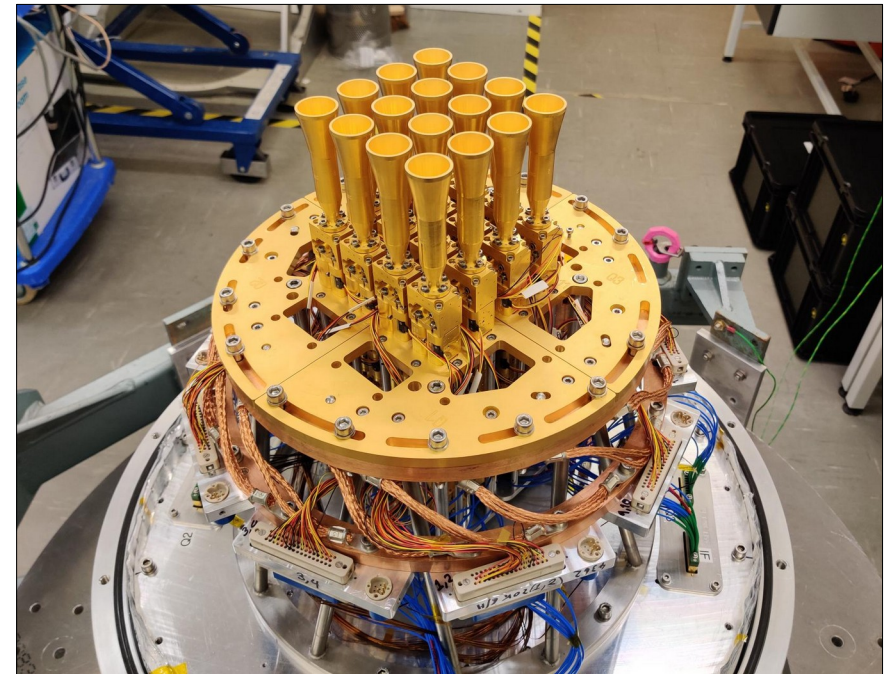
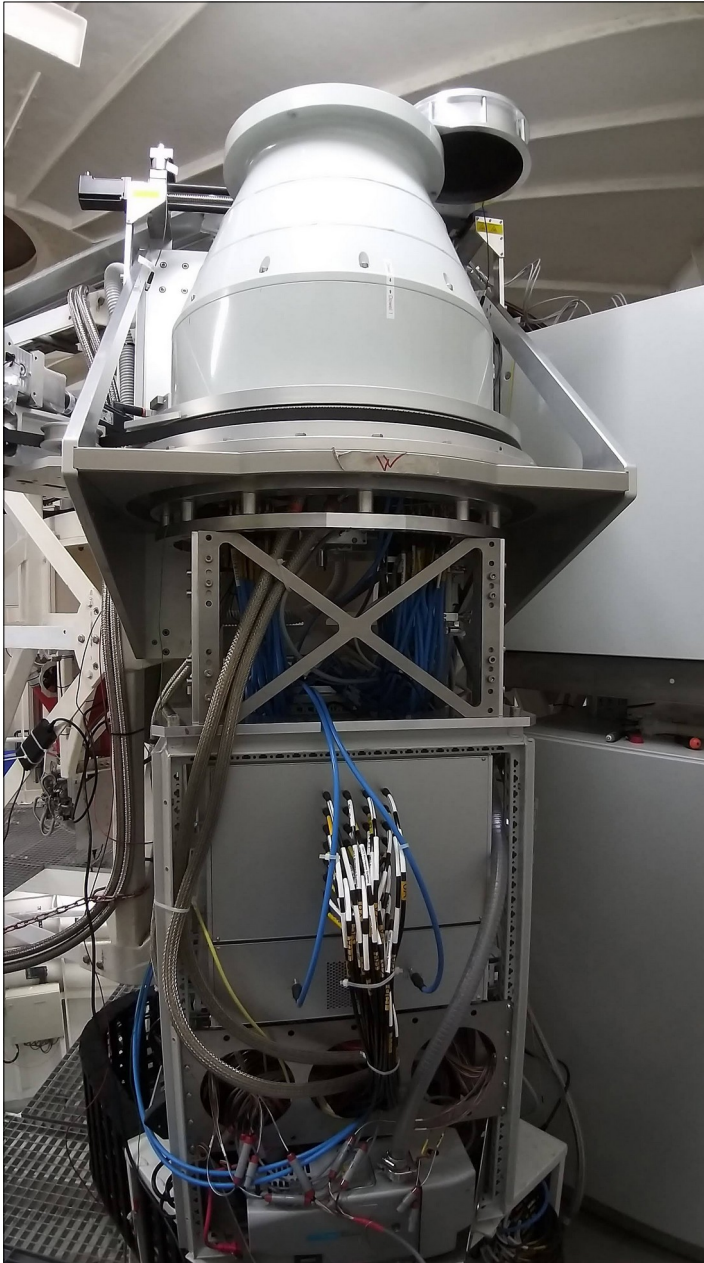


**ARRANGEMENT OF  
RECEIVERS AT THE  
SRT GREGORIAN  
RECEIVERS ROOM**



## W.P.1- Multi-beam cryogenic receiver (CARUSO) in W Band for SRT

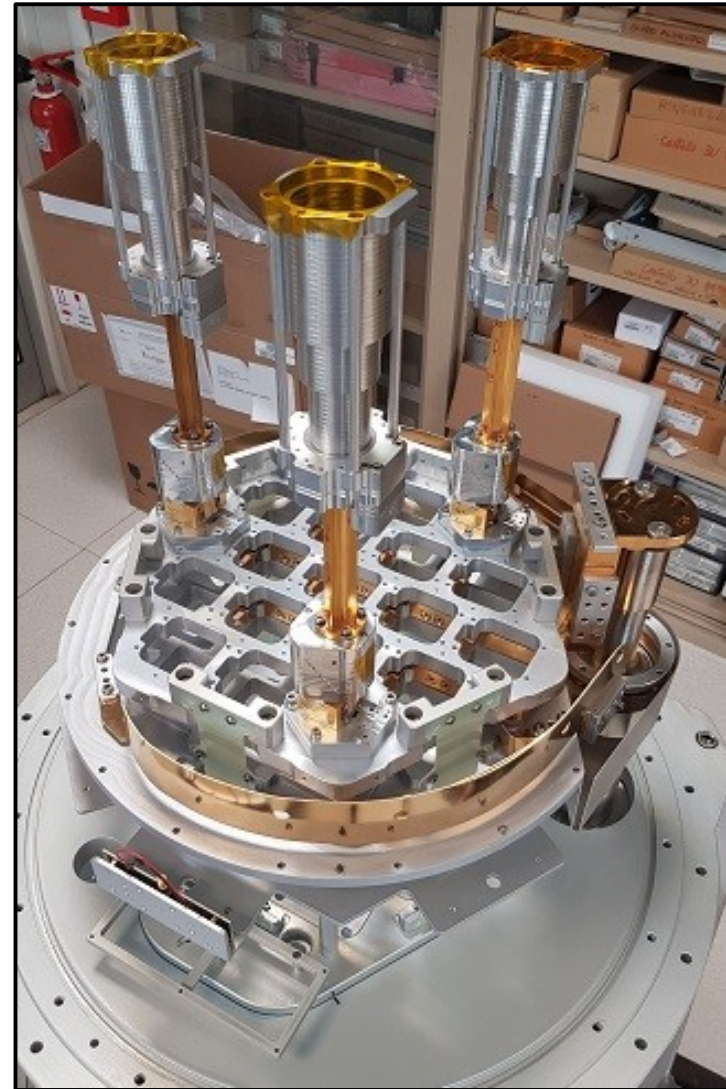
Supply - **UK Research and Innovation (UKRI)** - of a cryogenic receiver operating in the 75-116 GHz frequency band and composed of 16 double circular polarization beams. This receiver is fundamental for the detection of complex organic molecules through polarimetric studies of galactic and extragalactic sources





## W.P.2- Multi-beam cryogenic receive in Q Band for SRT

Development of a cryogenic receiver operating in the 33-50 GHz frequency band and composed of 19 double circular polarization beams. This receiver is ideal for surveying large areas of the sky in radio continuum emission and in broadband spectro-polarimetry. Receiver fully designed and developed at **INAF**



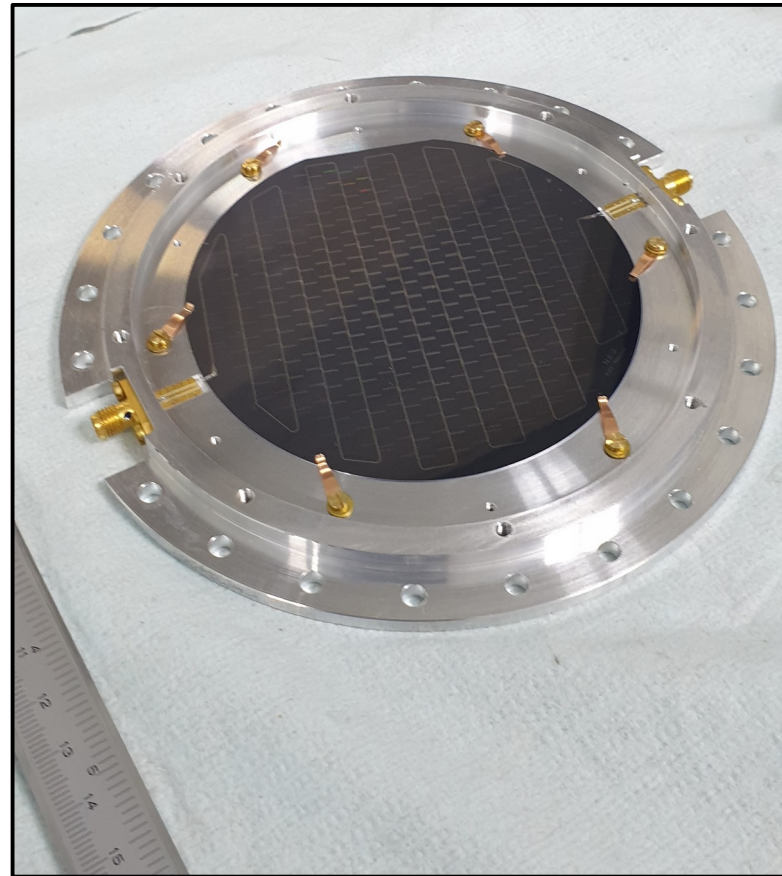


## W.P.3- Millimetre camera (MISTRAL) for SRT

Supply - **Università La Sapienza Roma (Italy)** - of a millimeter chamber operating in the 80-116 GHz frequency band composed of an array of about 408 independent detectors (pixels) that simultaneously sample a wide field of view. This will be suitable for the observation of extensive and diffused emission with low surface brightness.



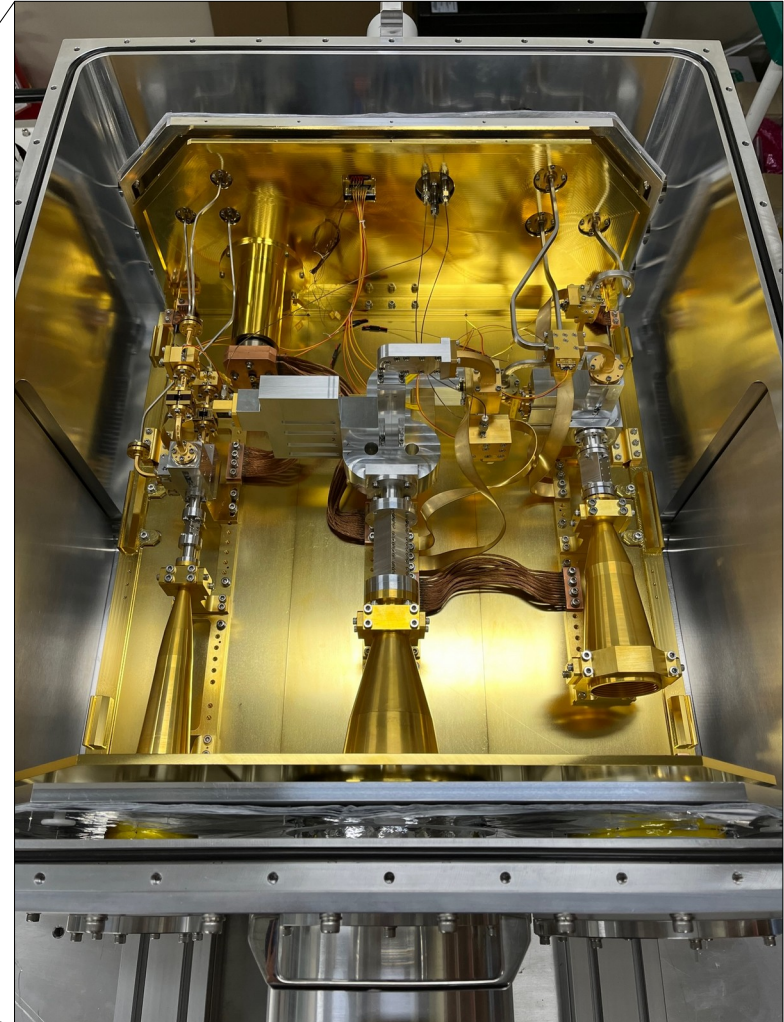
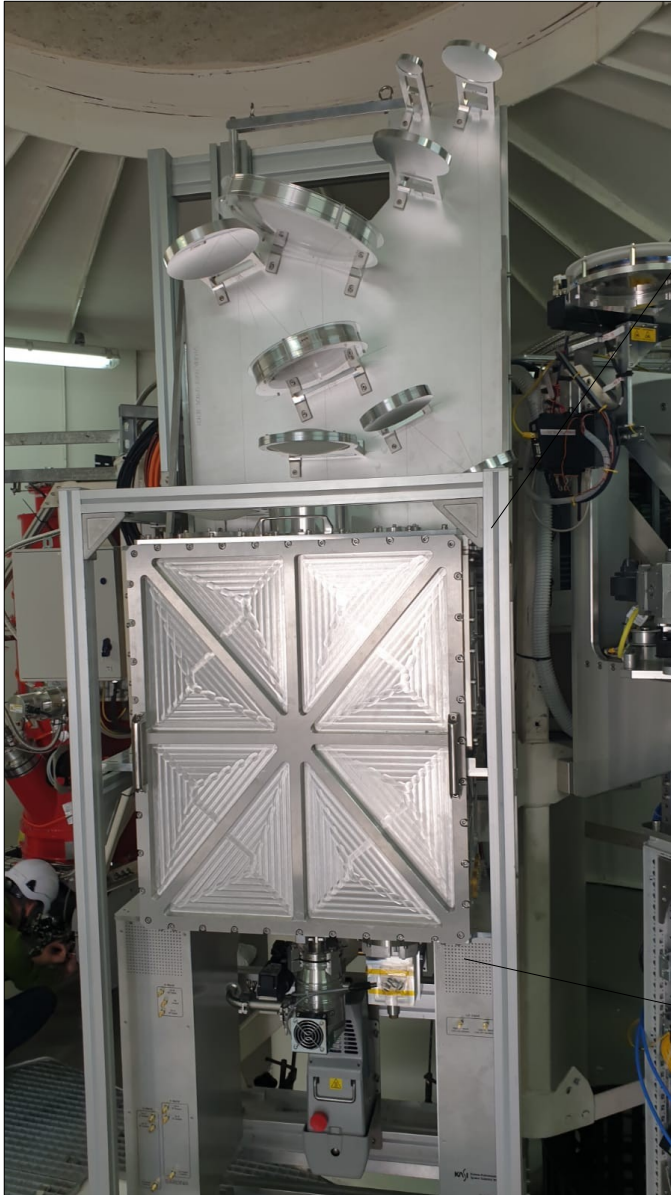
Photo – La Sapienza





## W.P.4- Simultaneous Tri-band (K,Q,W-bands) receiving system for the three INAF radio telescopes (SRT, Medicina, Noto)

Supply - **Korea Astronomy and Space Science Institute (KASI)** - of three compact and simultaneous three-band (18-26, 35-50, 86-116 GHz) microwave-receiving systems for the three Italian radio telescopes.





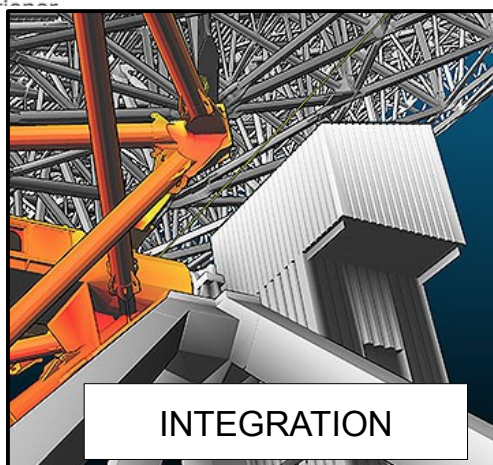
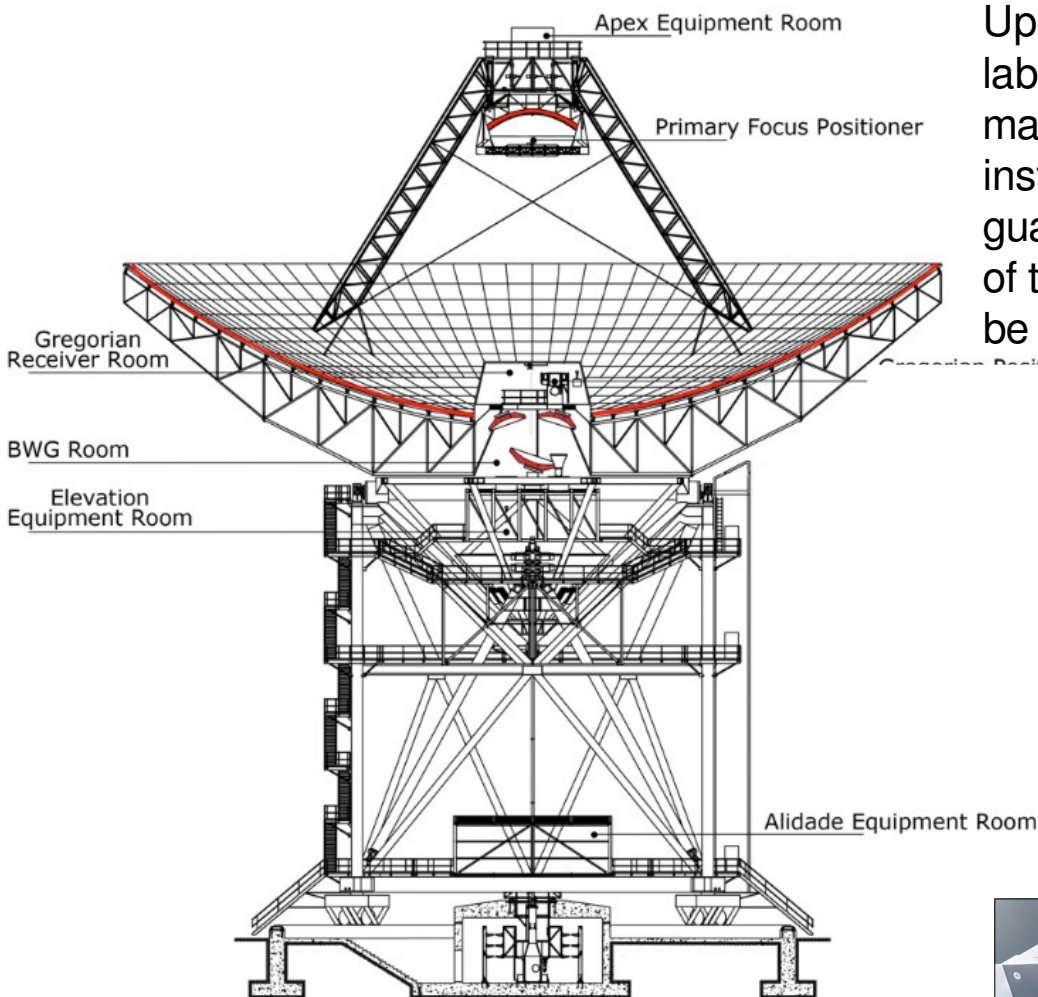


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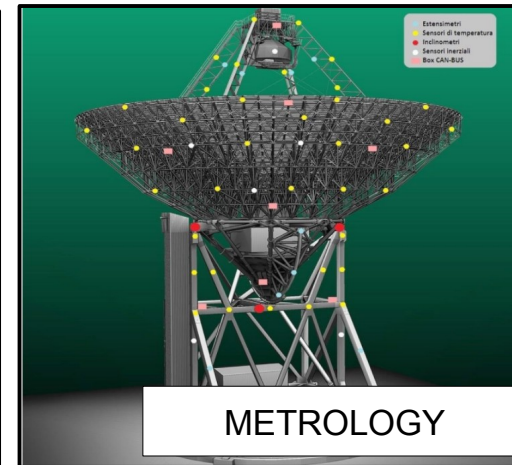


LABORATORIES

Upgrade of the laboratories to allow the maintenance of the new instruments. INAF must guarantee that the effects of the enhancement will be maintained for at least 10 years.



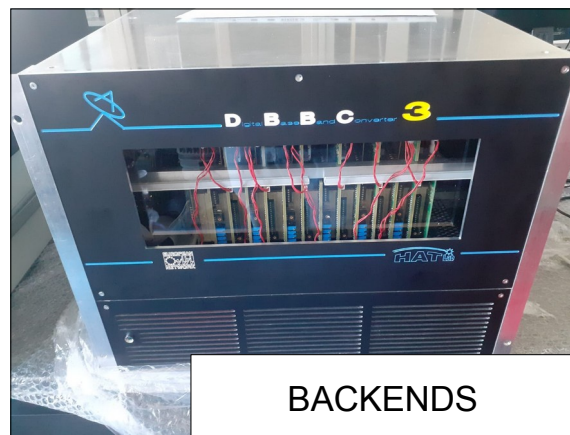
INTEGRATION



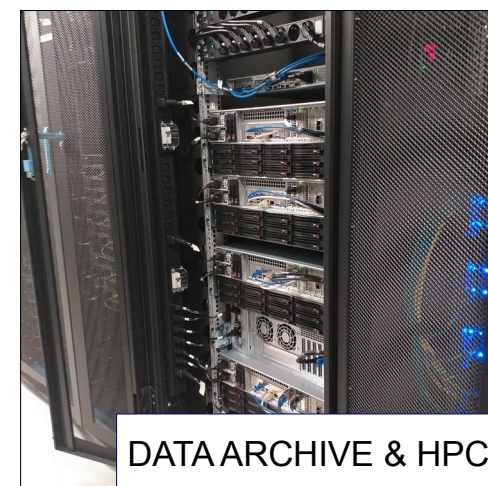
METROLOGY

### Budget distribution:

- 53% to new receivers (WP 1-4)
- 20% to back-end & HPC (WP 6,8)
- 20% to metrology and infrastructure (WP 5,7)
- 7% to new laboratories (WP 9)



BACKENDS



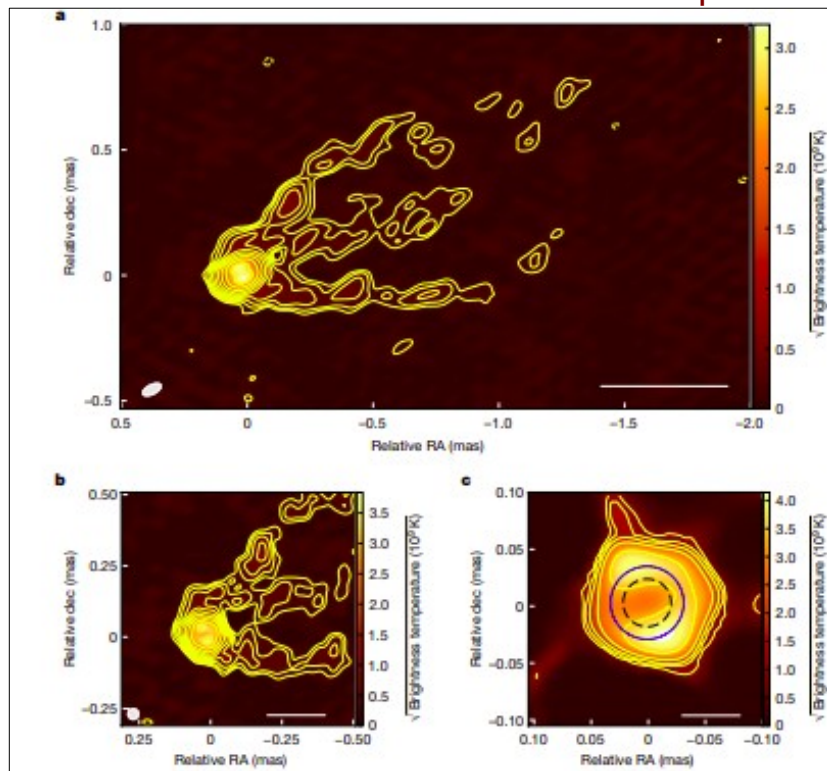
DATA ARCHIVE & HPC



# Key science cases accessible in the future

- Spectral line observations in molecular clouds and interstellar filaments
- Observations of molecular gas tracers in nearby galaxies;
- Spectral Energy Distribution (SED) of galaxies; **talk by SIMONE BIANCHI**
- Solar studies and Space Weather applications;
- Continuum and in spectro-polarimetry observations of galactic and extragalactic sources;
- Sunyaev-Zeldovich (SZ) effect in galaxy clusters;
- Magnetars; **talk by ANDREA POSSENTI**
- Active galactic nuclei;
- Global Millimeter VLBI observations.

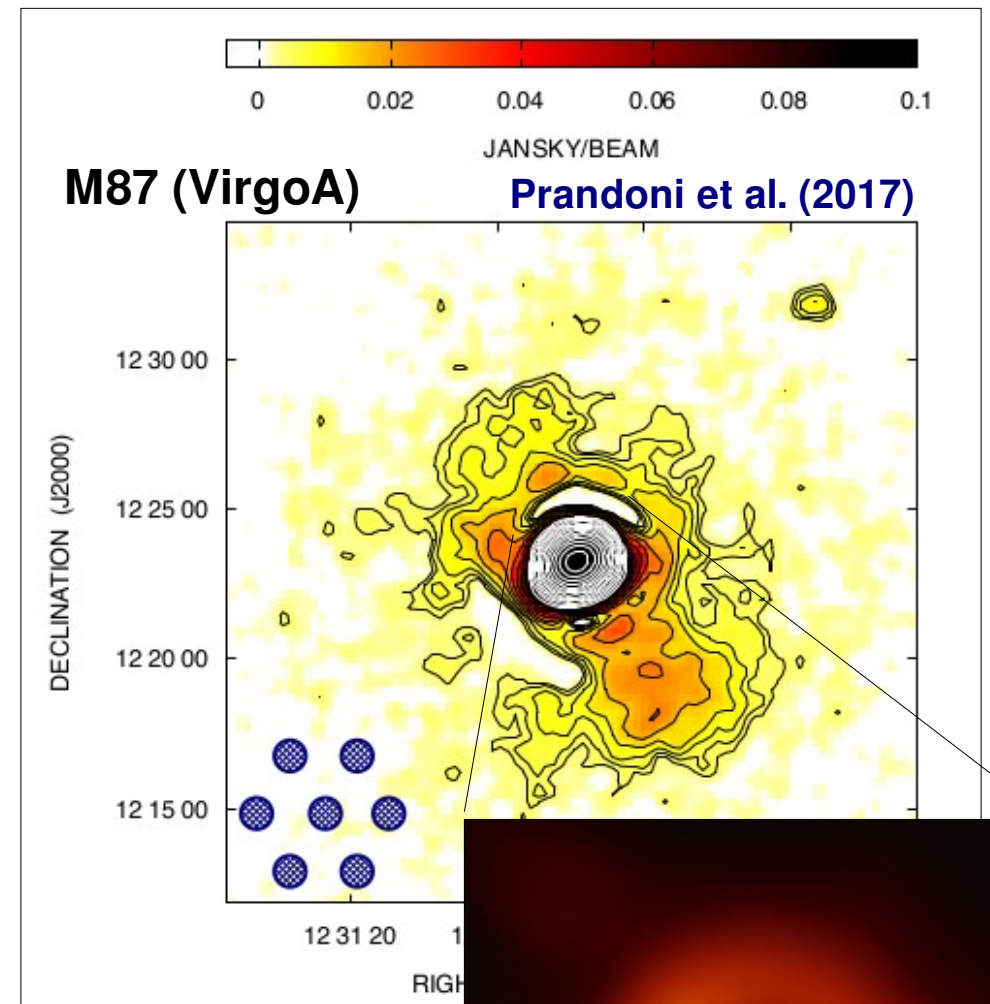
GMVA+ALMA+ GLT  
3.5 mm (86 GHz)  
Resolution 79 X 37  $\mu$ arcsec



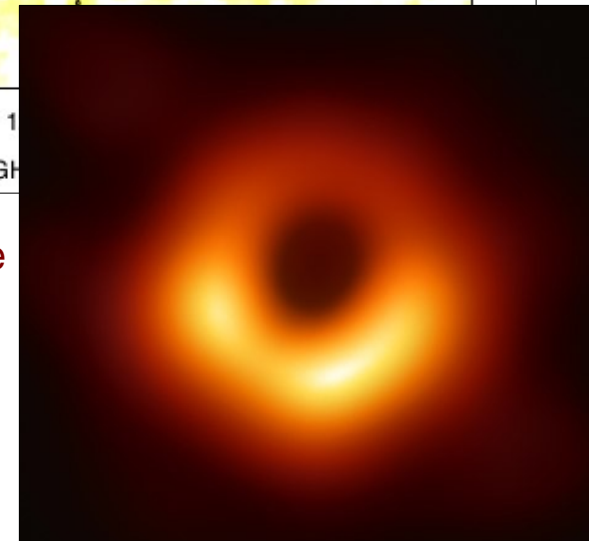
**Lui et al. (2023, Nature)**

*A ring-like accretion structure in M87 connecting its black hole and jet*

SRT  
19 GHz  
Resolution 57 arcsec



Event Horizon Telescope  
1.3 mm (230 GHz)  
Resolution 25  $\mu$ arcsec

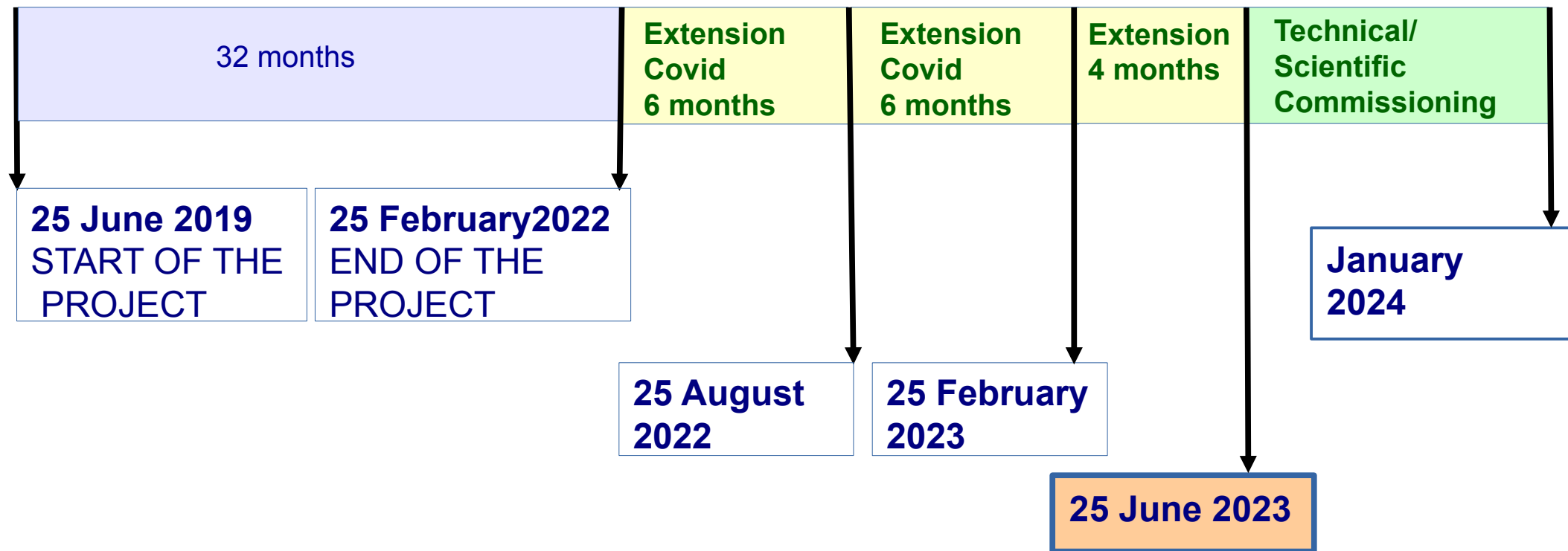


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**Framework:** Call for proposals for grants aimed to enhance research infrastructures located in Southern Italy, issued by the Ministry of University and Research in 2018

**Approved budget:** 18.700.000 Euro (15% outside Sardinia)

**Time-scale:** 32 months 25 June 2019 --> 25 February 2022 (+ 4 months of Extension)



## THANK YOU!!!!