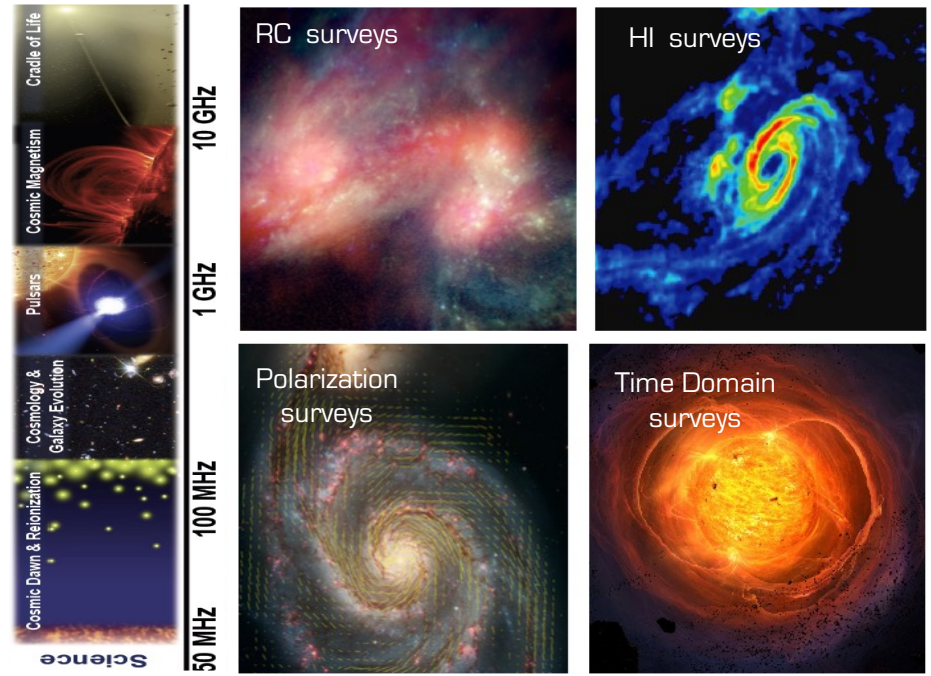


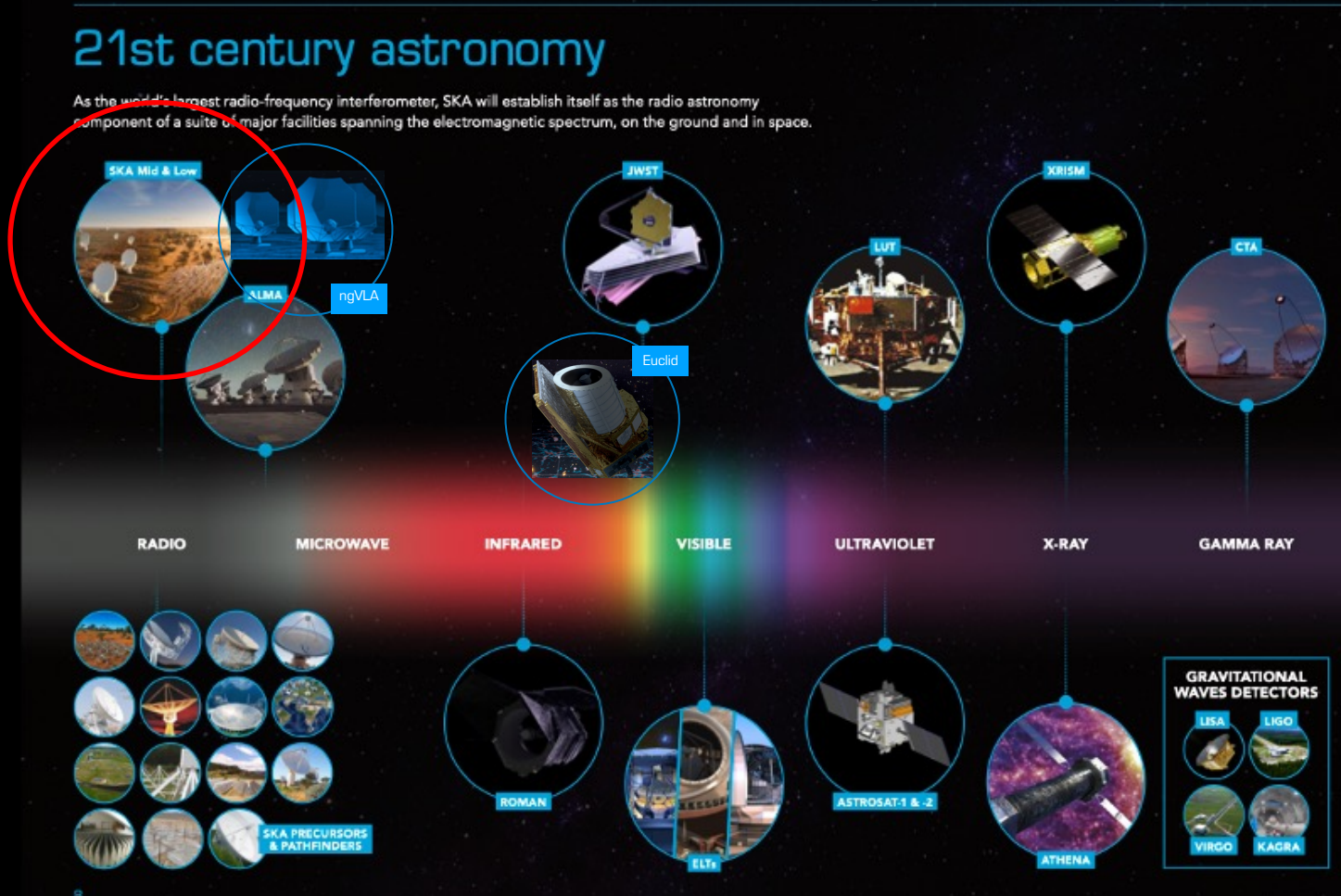
The SKA Observatory

Isabella Prandoni – INAF - IRA

Giornate RSN1, 9 February. 2026

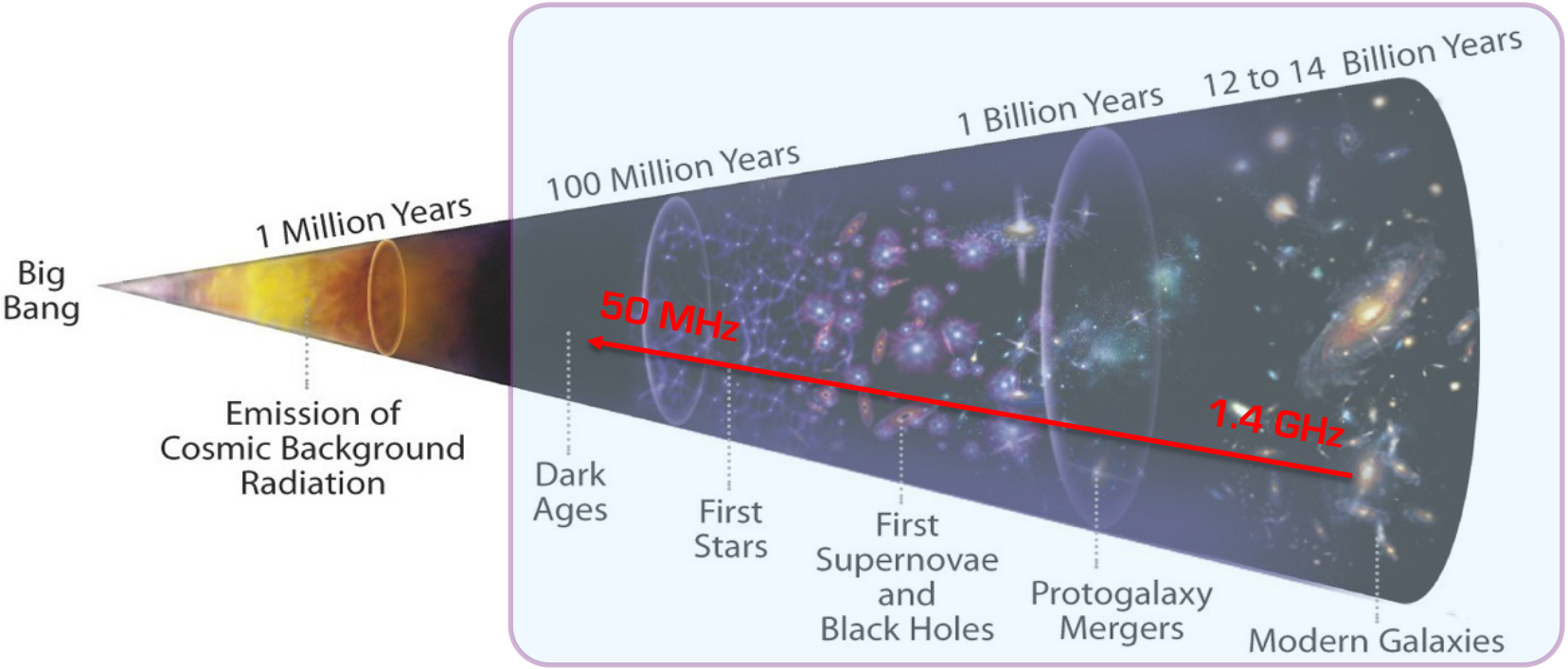
SKAO

A unique suite of astronomical facilities



Adapted from SKAO image

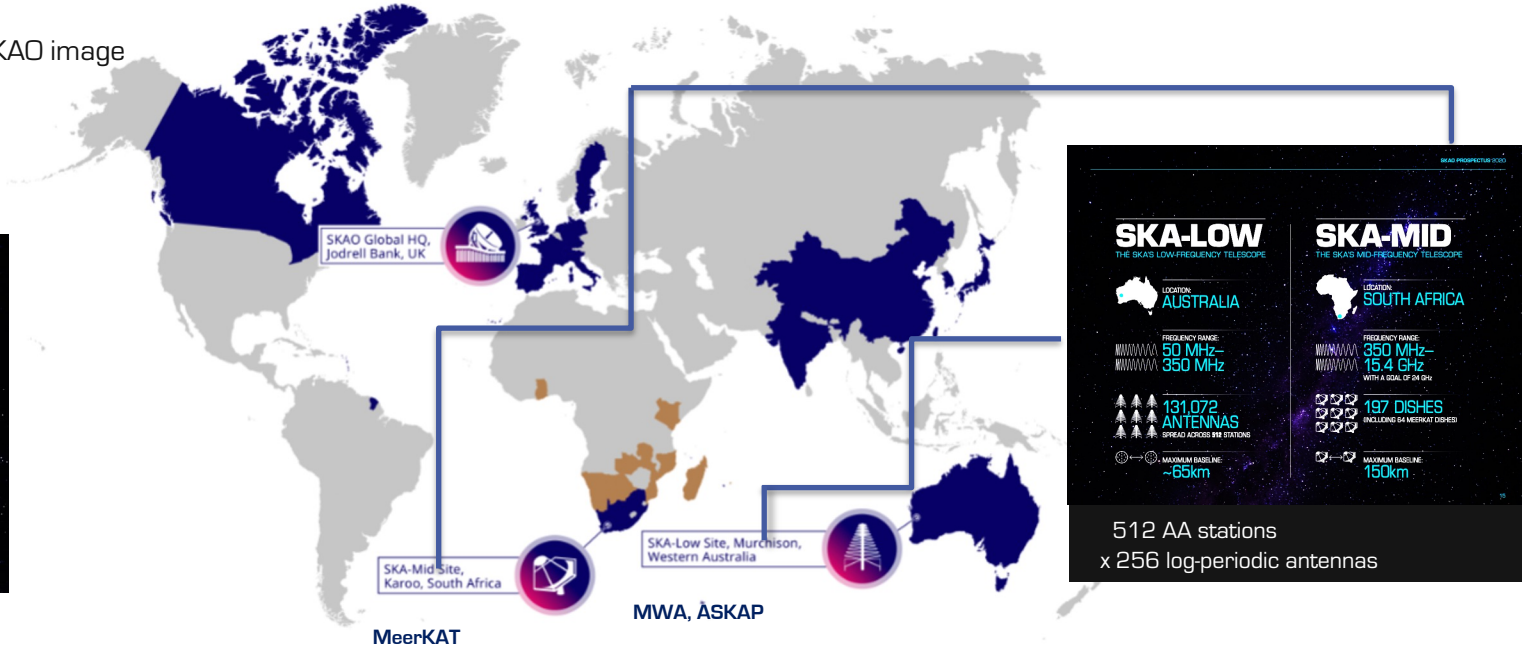
The SKA Concept



Tracing the history of the Universe and of its constituents through Hydrogen
Mapping Hydrogen through cosmic time and on a wide range of scales
Super-sensitivity over wide range of frequencies and spatial resolutions

The SKA Observatory in a nutshell

Adapted from SKAO image



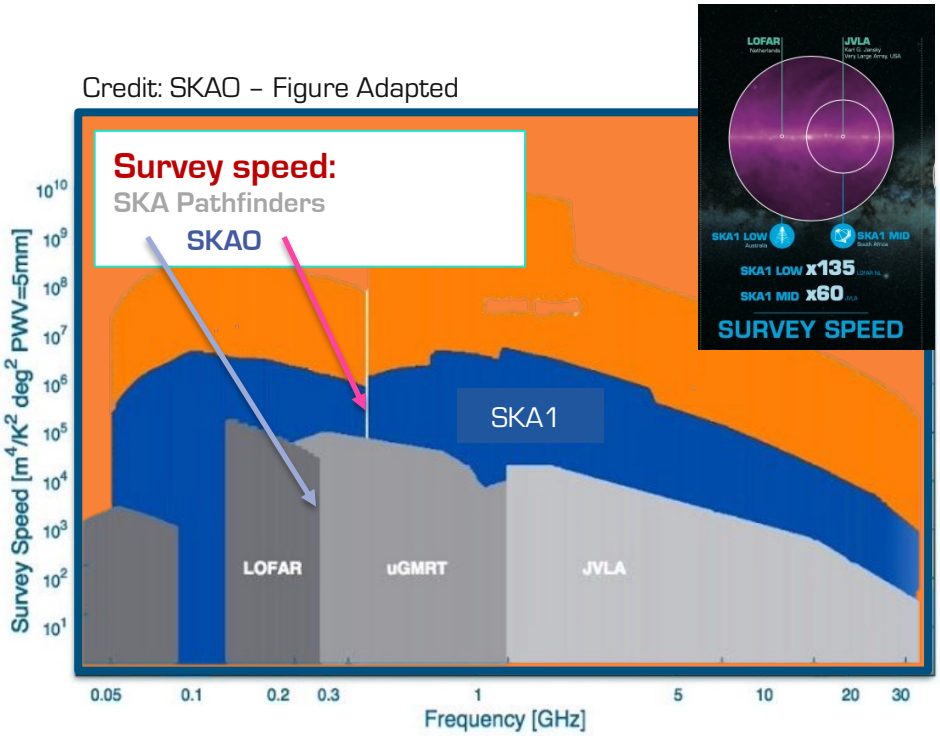
SKAO Partnership - includes SKAO Member States* and SKAO Observers (as of Nov 2024)

African Partner Countries

Full members (Updated end 2025): Aus, Canada, China, Germany, India, ITA, NL, Portugal, RSA, Spain, Sweden, Switzerland, UK
France, Japan, South Korea on the path to join

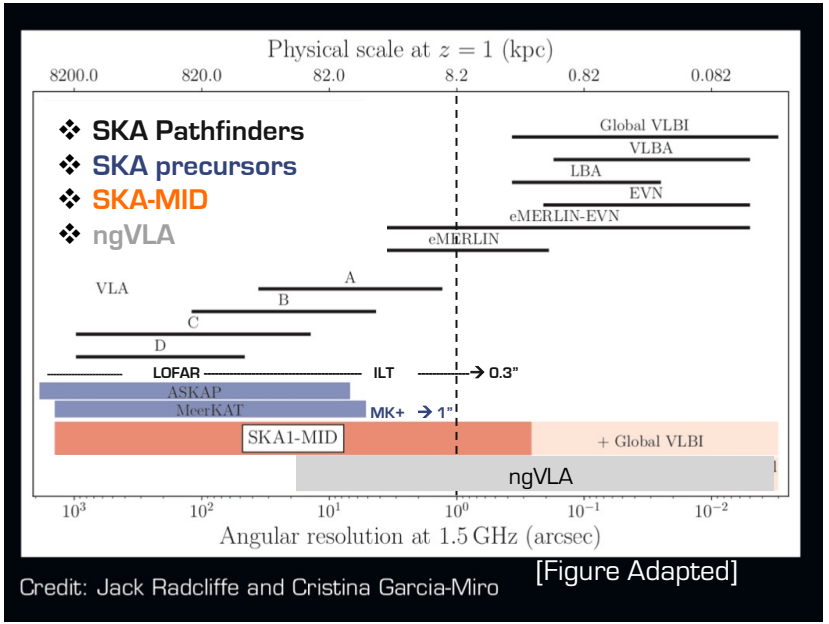
SKAO: A Multi-Resolution Survey Infrastructure

Credit: SKAO – Figure Adapted



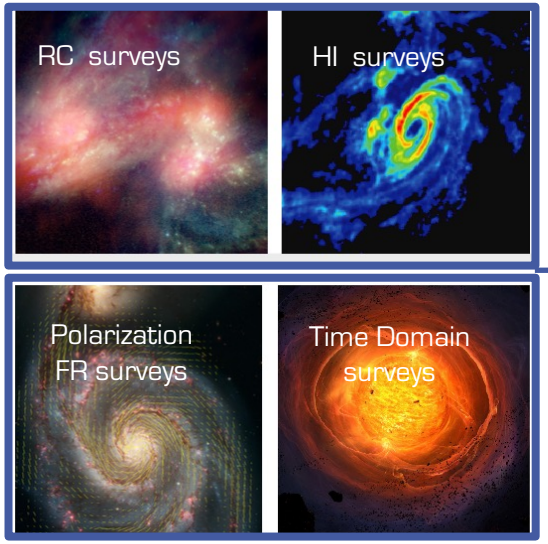
50 MHz ← Frequency range → 15(24) GHz

1000 arcsec ← Angular resolution → 0.01 arcsec

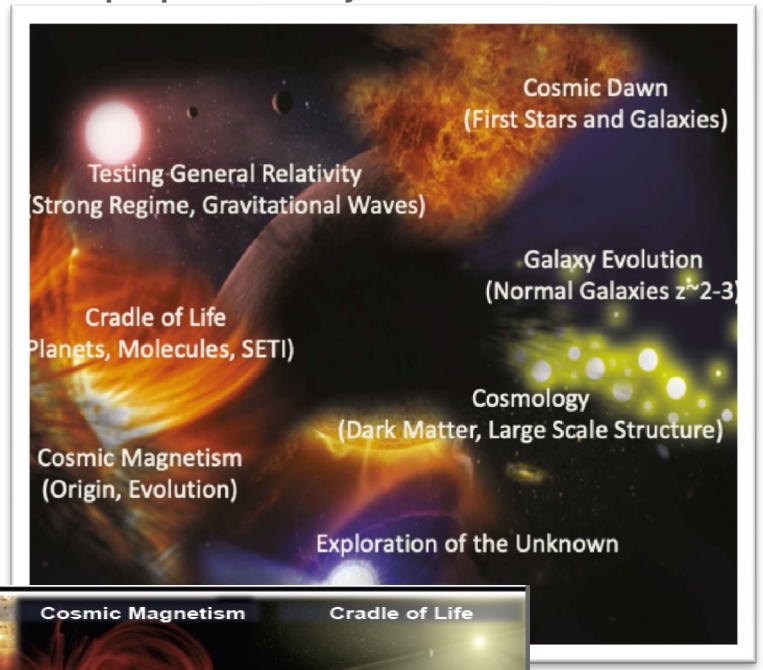


Credit: Jack Radcliffe and Cristina Garcia-Miro [Figure Adapted]

The SKAO Science Case



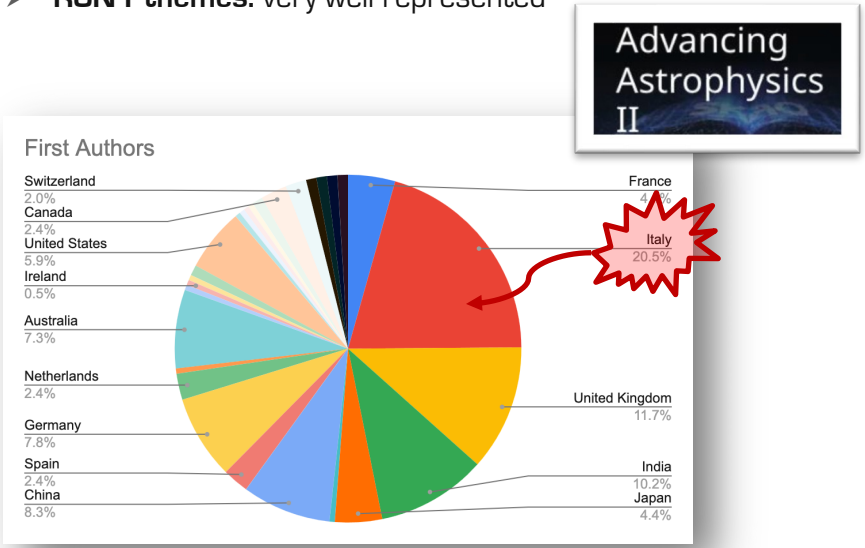
Multi-purpose Facility

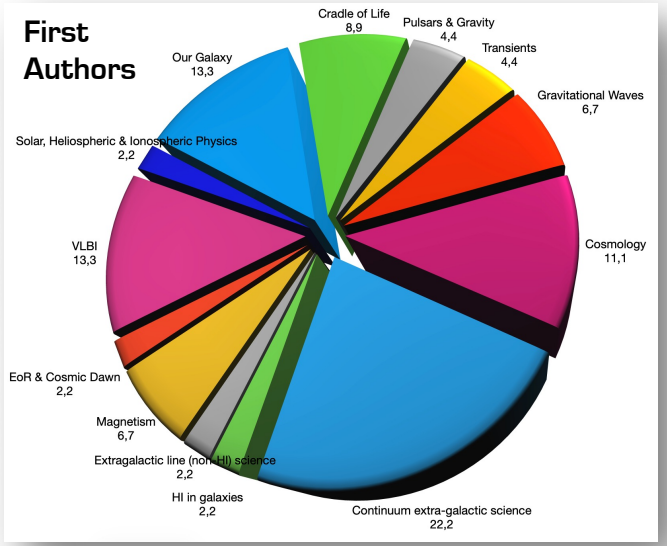


The SKAO Science Case: IT Contribution

Several initiatives to engage Italian Community and build a SKA-oriented leadership

- **219 IT members** (11.2%) distributed over 14 Science WGs
- **5 IT chairs (+5 ex-chairs) + 22 IT members with Coordination Roles in 11 SWG**
- SKA Science Book **2015** - 135 chapters: **41% with IT co-authors** (56) – **15% with IT first authors** (20)
- SKA Science Book **2026** – Italy first contributor: **20% of chapters with IT first authors**
- **RSN1 themes:** very well represented





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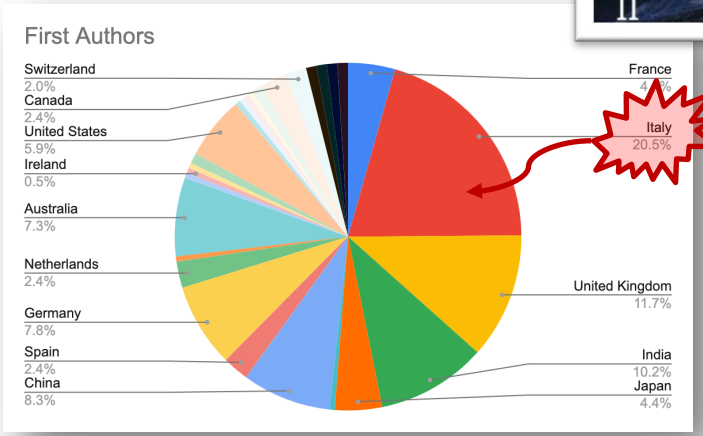
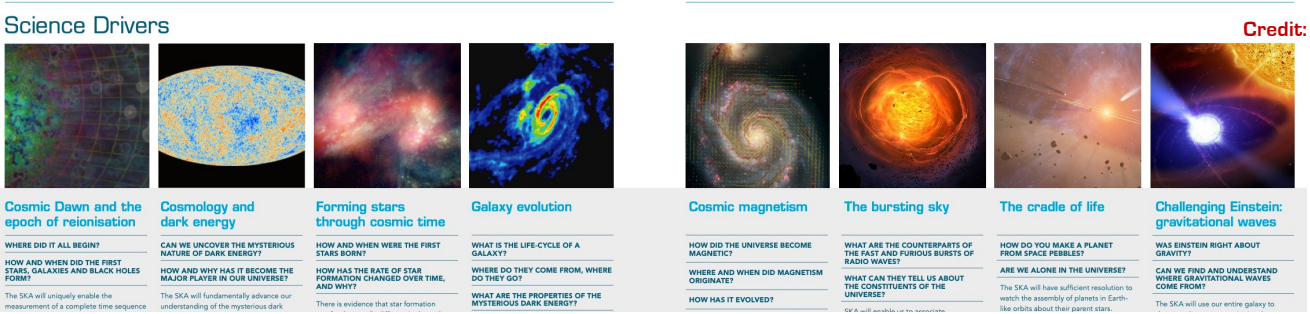


<u>INAF involvement in LOFAR and MK</u>

- **Italy-led SKA precursors KSP/PI-projects**
- **ERC/FIS grants** to SKA-related projects
  - **ERC (2015-2025)**: 7 grants (all on RSN1 themes)
  - **FIS (2024-2025)**: 4 Grants (3 on RSN1 themes)

SKAO: Science Drivers



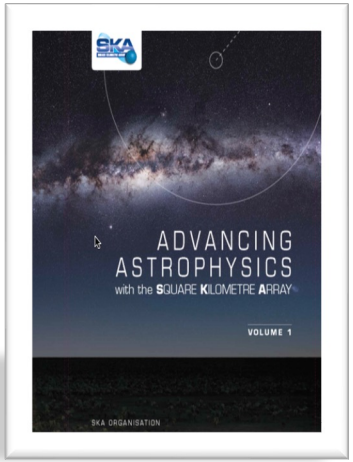
Credit: SKAO

Relevant to RSN1

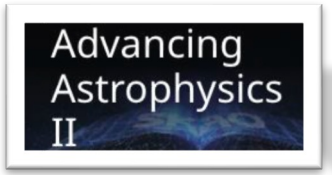
2015

135 Chapters

2 Volumes



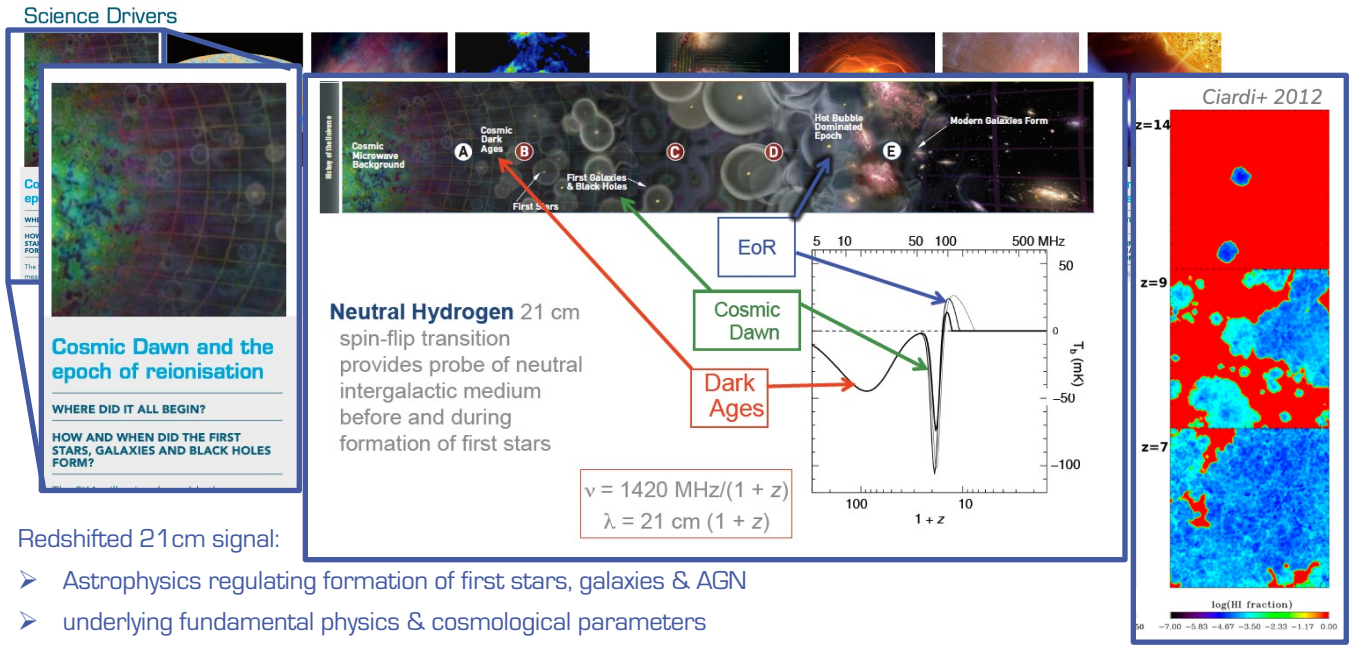
2026



See also reviews/talks on:

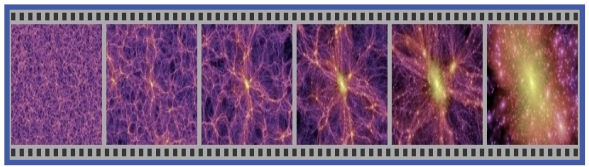
- Galaxy clusters: Andrea Botteon; Francesca Loi
- Cosmology: Vincenzo Cardone; Massimo Meneghetti
- HI role in galaxy assembly in nearby Universe: Antonino Marasco

Cosmic Dawn & Epoch of Reionization



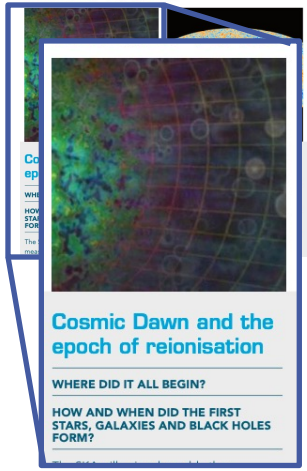
Redshifted 21cm signal:

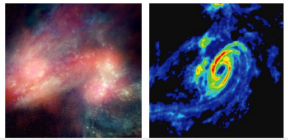
- Astrophysics regulating formation of first stars, galaxies & AGN
- underlying fundamental physics & cosmological parameters



Cosmic Dawn & Epoch of Reionization

Science Drivers

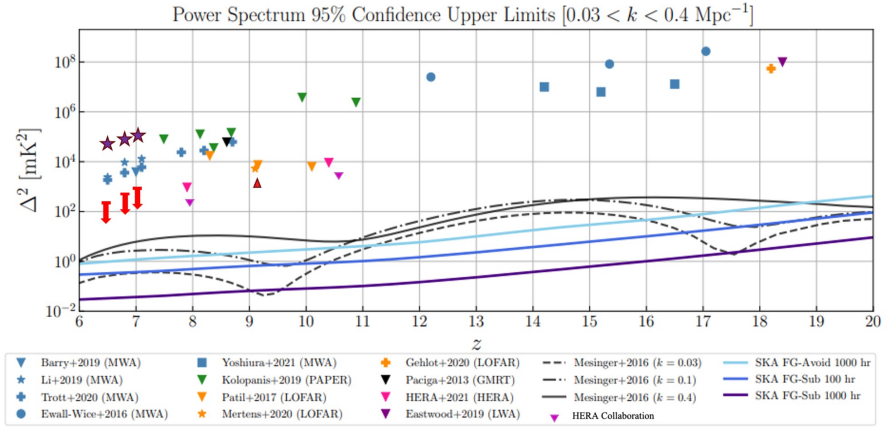




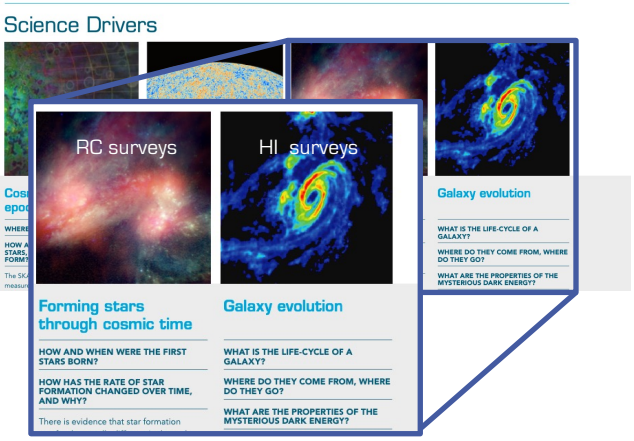
SKA objectives (CD and EoR):

1) Statistical Detection (Power spectrum vs z) z=5.5-27

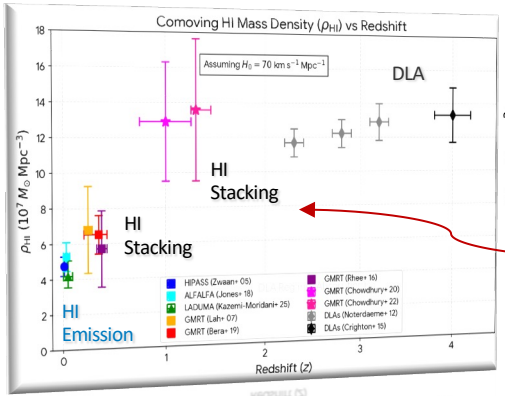
2) Imaging of IGM transition vs z (Tomography) z=5.5-15

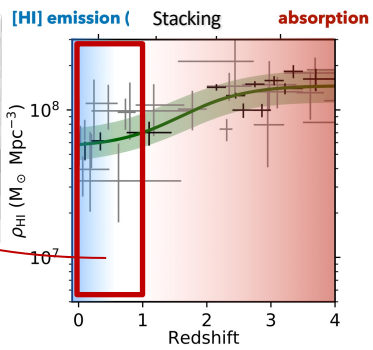


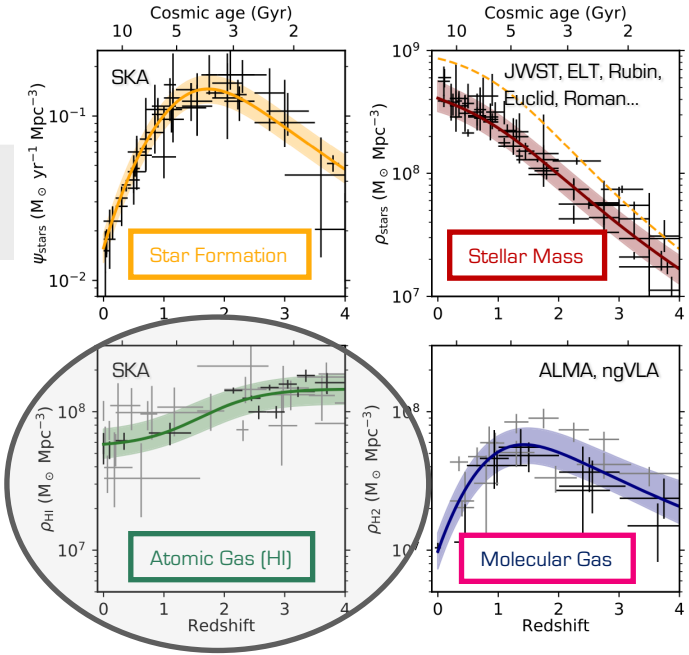
Galaxy Formation & Evolution



Based on MeerKAT and GMRT







Adapted from Walter+2020

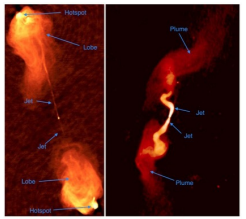
HI role in galaxy assembly beyond local Universe

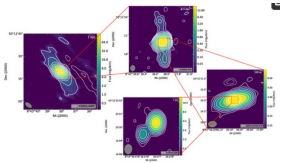
SFRD & role of AGN Feedback in galaxy evolution

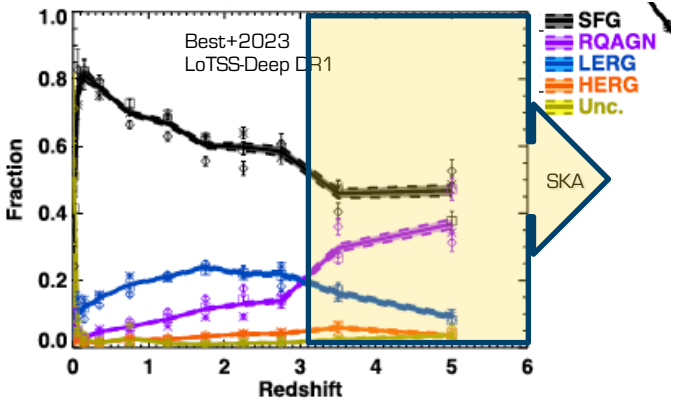
Deep radio continuum surveys:

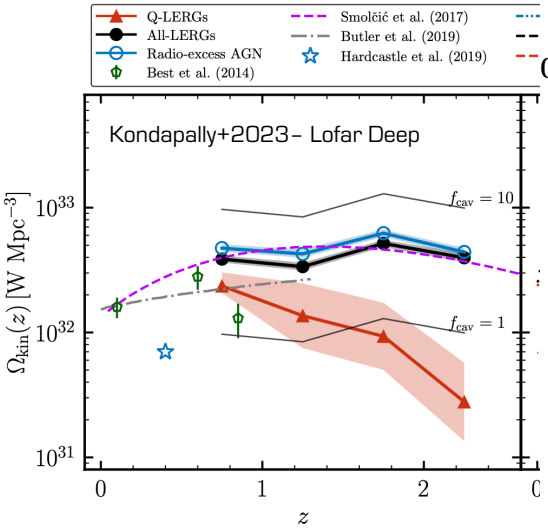
- Complete and unbiased census of SFG & AGN populations **down to RQ regime** up to high redshifts (unaffected by dust/gas)
- **Role of jetted AGN in galaxy evolution**

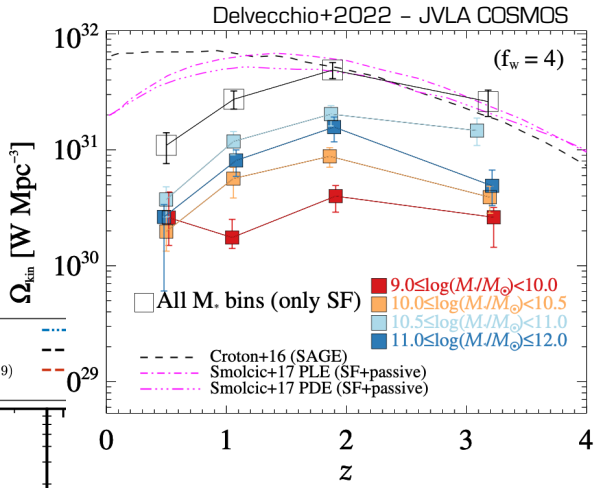
Is jet-induced feedback relevant in high-z SFG?





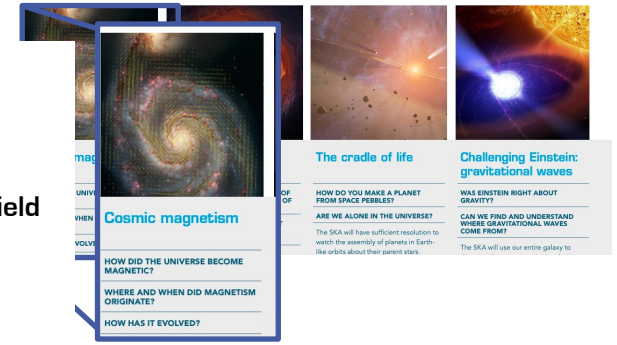






AGN kinetic power density
Vs
redshift

Magnetogenesis



Magnetic fields permeate the Universe, but poorly constrained

- How they grow and propagate (amplification mechanisms, role of CRs)?
- How they affect affect galaxy evolution?

Magnetic fields in filaments should carry memory of the initial field

SKA traces the magnetic fields through polarization / Rotation Measure (RM) grid surveys

Key requirement: Dense RM grid → better statistics

SKA ≈ 230-450 sources / deg^2

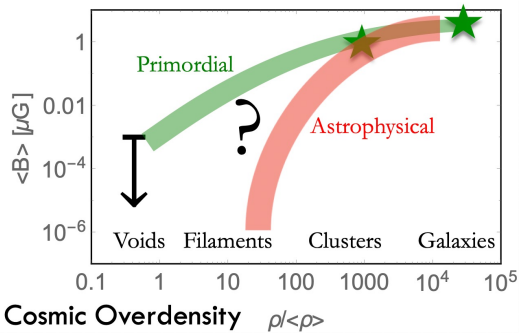
Upper limits from CMB temperature anisotropies:

B < few nG on Mpc scales

Lower limits from TeV γ-ray observations:

B > 10-7 nG on Mpc scale

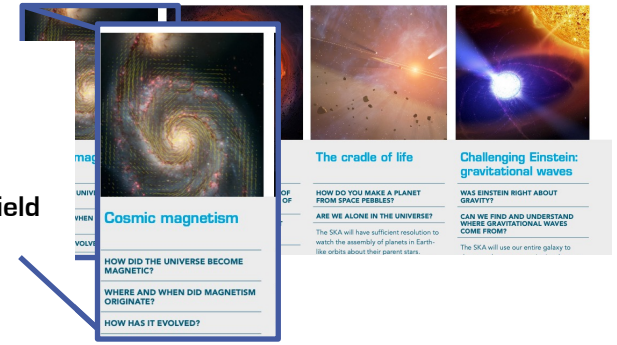
Courtesy O.Sullivan



A-Primordial Scenario: Turbulent amplification and compression of weak cosmological fields (seed 10^{-9} G)

B-Astrophysical Scenario: Magnetization by galactic winds and outflows powered by star formation feedback, SN, AGN (seed 10^{-11} G)

Magnetogenesis



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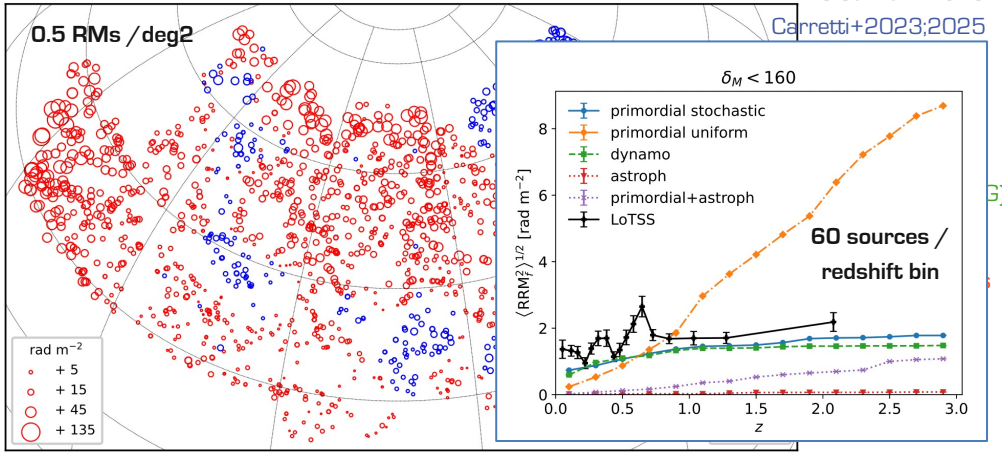
LoTSS
O'Sullivan+2023
Carretti+2023;2025



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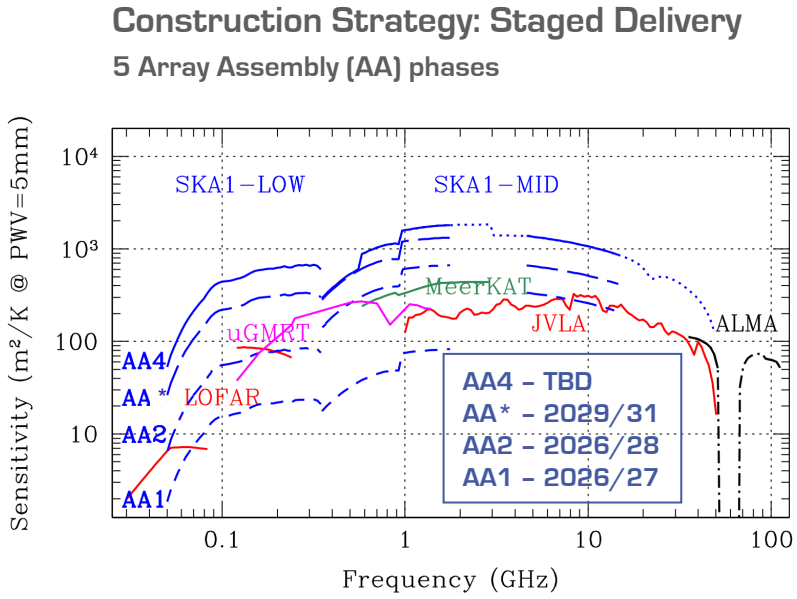
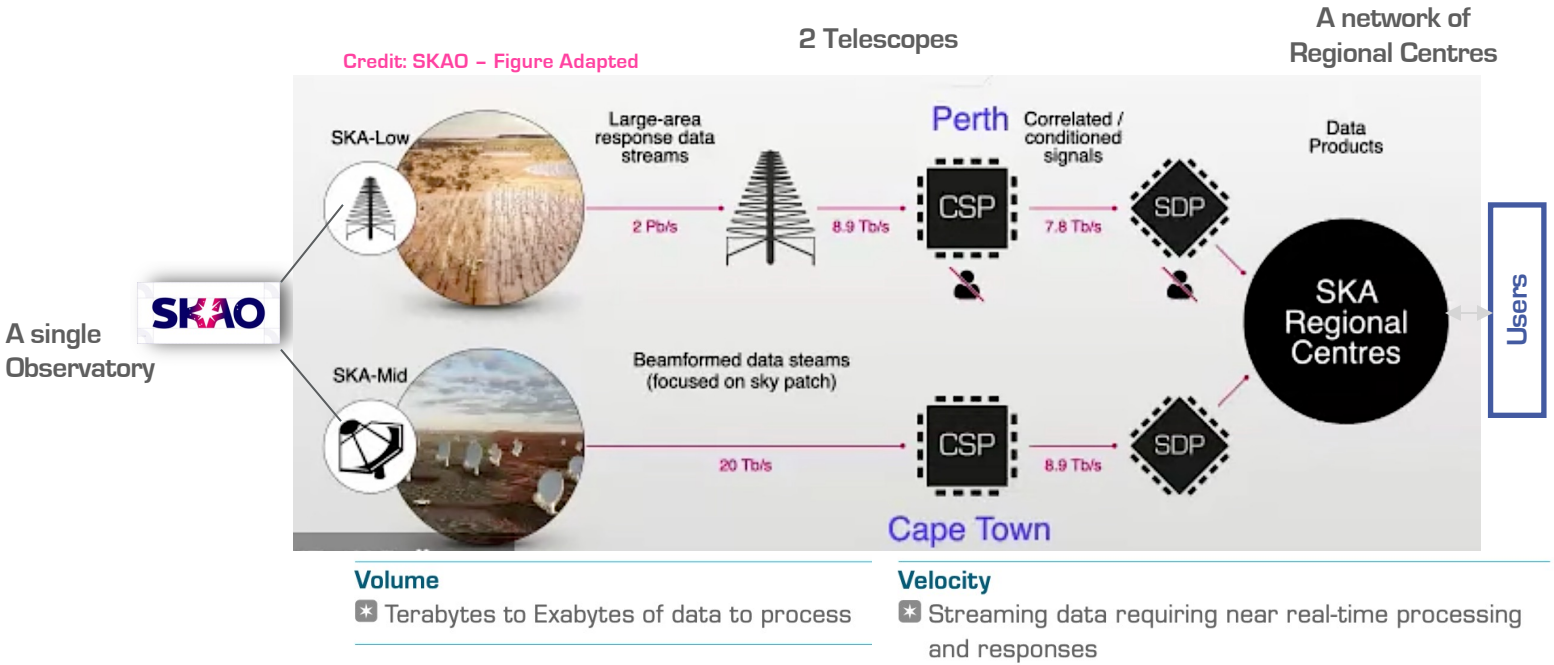
The SKAO Timeline



Milestone Event (earliest)		SKA-Mid	SKA-Low
AA0.5	4 dishes 4 stations	2026 Q2	2025 Q3
AA1	8 dishes 16 stations	2027 Q1	2026 Q1
AA2	64 dishes 68 stations	2029 Q1	2027 Q1
Science Verification begins		2029 Q2	2027 Q2
AA*	144 dishes 307 stations	2030 Q2	2028 Q2
Operations Readiness Review		2030 Q3	2028-Q3
Science Verification AA*		2031	2029
Cycle 0	**(Shared Risk)**	**2032**	**2030**
AA4 (Design Baseline)	197 dishes 512 stations	TBD	TBD

AA = Array Assembly Updated **June 2025** (Construction Report)

The SKAO Operational Model



Volume

- Terabytes to Exabytes of data to process

Velocity

- Streaming data requiring near real-time processing and responses

Only SKA Regional Centres will provide data access, data analysis, data archive, user support interfaces with user community

Italian node at Technopolo (Bologna)

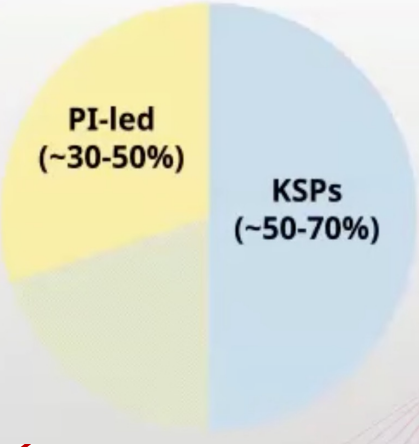
Telescope Access

Key Science Projects (KSPs)
- Large programs (>500 h ?) performed over multiple cycles
- PI & leadership team from SKA-member countries; co-Is from any country (latter may be limited)

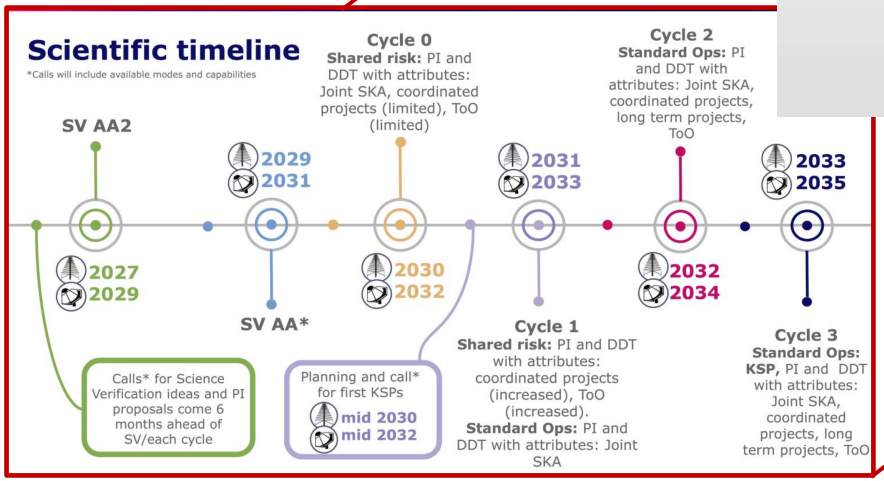
Principal Investigator (PI) Projects
- Small programs (<500 h ?) performed within a single cycle

Director-General's Discretionary Time
- Time allocated by the D-G outside of the normal TAC process

International time – fraction TBD



Credit: SKAO



Science driven, based on contribution level

Take home messages:

- Radio future is bright! SKA in behind the corner and SKA precursors are already transforming our understanding of the radio Universe
- SKA science drivers relevant to RSN1 – high degree of complementarity and synergy with other wavebands
- Italian community - high level of engagement and leadership
- Important to maintain and increase scientific leaderships into SKA Era