COLLABORATION IN SCIENCE
Radioastronomy in Italy - Science Highlights

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Scientific Directorate

V.N. Karazin Kharkiv National University – INAF
Bilateral Workshop on Astrophysics

22-23 March 2018 (Roma)

COLLABORATION IN SCIENCE
Radioastronomy in Italy - Science Highlights

- Scientific Research
  (Galactic and Extragalactic)
- Technological Reaserch
  (Design and fabrication of radio instrumentation)
- Managment of the Italian radioastronomical facilities

Istituto di Radioastronomia

Osservatorio Astrofisico di Arcetri

Osservatorio Astronomico di Cagliari

Osservatorio Astrofisico di Catania

REFERENCE INSTITUTES FOR RADIOASTRONOMICAL STUDIES IN ITALY

COLLABORATION IN SCIENCE
Radioastronomy in Italy - Science Highlights

- Extragalactic radioastronomy (AGN, galaxies, clusters of galaxies)

- Our Galaxy (stars and star formation)

- Molecular lines and continuum emission in star forming regions

- High Energy Astrophysics and Neutron Stars

- Interstellar medium

- Extragalactic radioastronomy (AGN, galaxies, clusters of galaxies, HI, Masers)

- Radio emission in stellar objects and stellar evolution

COLLABORATION IN SCIENCE
Radioastronomy in Italy - Science Highlights

Single-dish Antennas (SRT-Medicina Noto)

VLBI

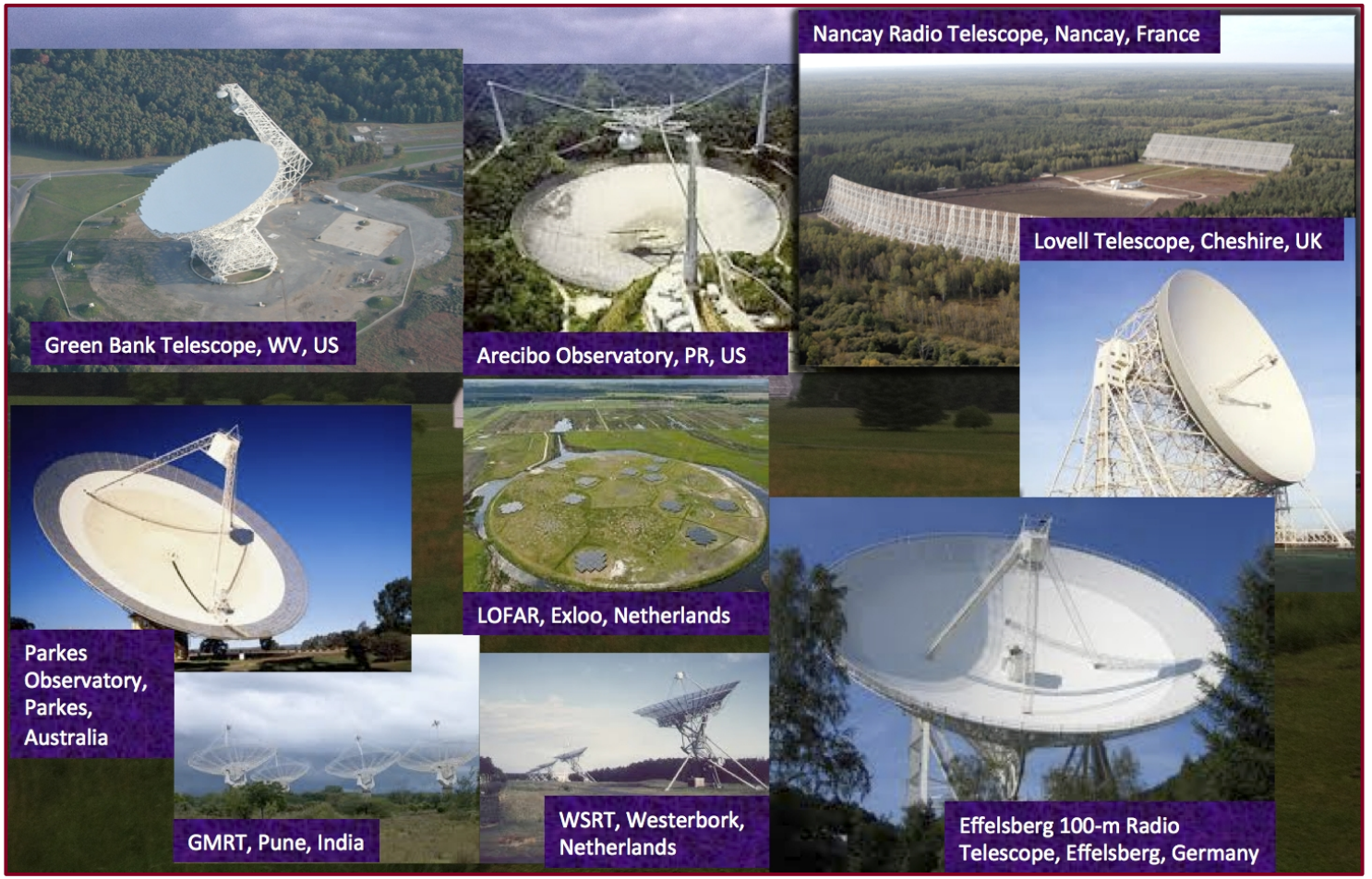
Precursors Pathfinders SKA (low frequency)

Precursors Pathfinders SKA (high frequency)

Big-data in radioastronomy

SKA

ALMA and mm astronomy



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SINGLE-DISH ANTENNAS

INAF operates three single dish radio telescope facilities for use by the scientific community: two 32-m single dish antennas located in Medicina and Noto (Sicily) and the Sardinia Radio Telescope a 64-m antenna located near Cagliari (Sardinia)

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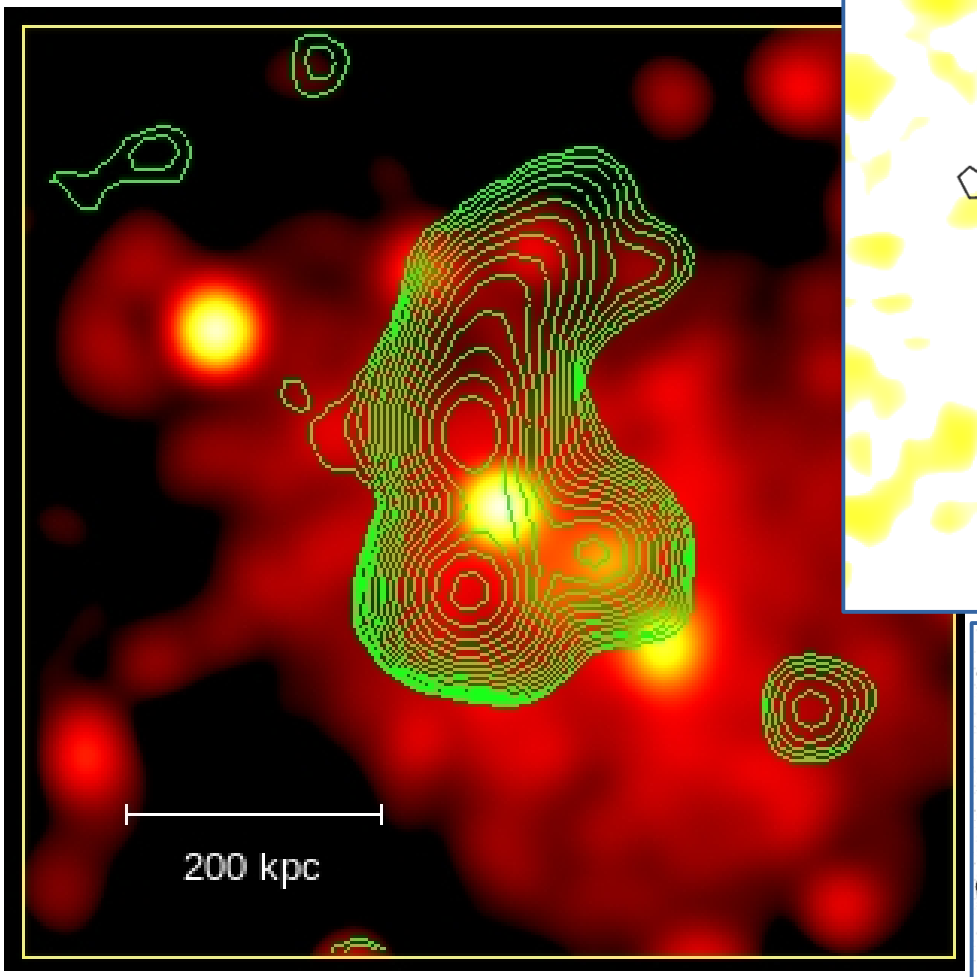
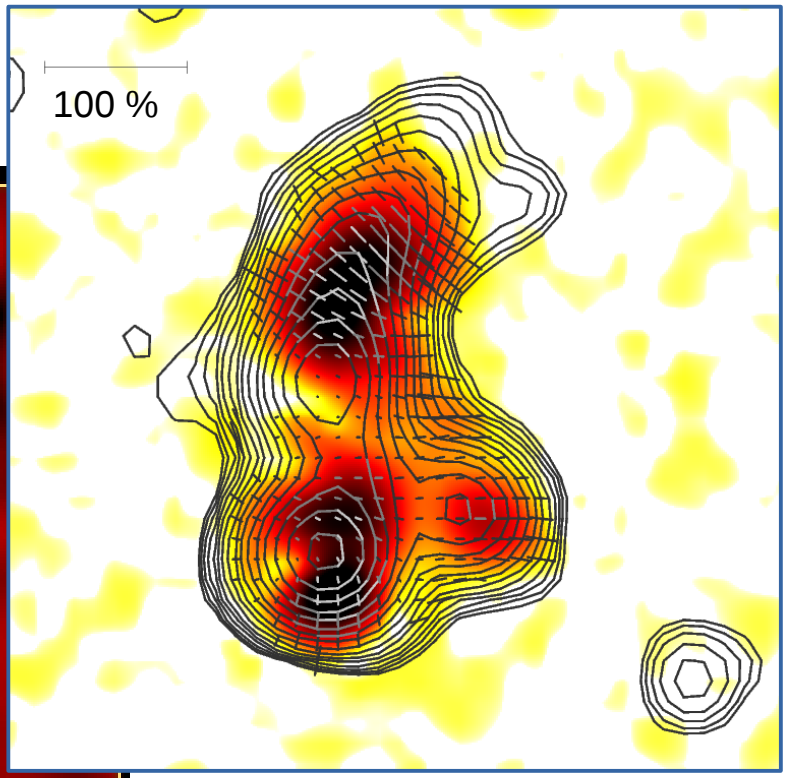
SINGLE-DISH ANTENNAS

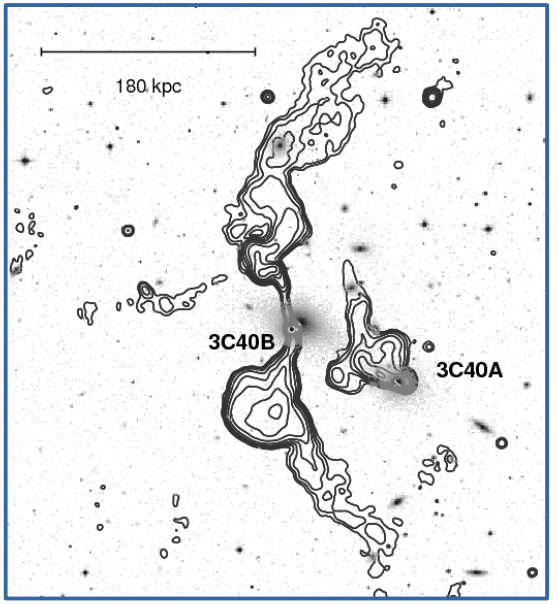
We detected polarization for both sources with a global fractional polarization of ~9%



SRT, 6.6 GHz
FWHM=2.9'
σI=1 mJy/Beam

Govoni et al. (2017)





VLA 1.4 GHz
FWHM=19''
σI=0.34 mJy/Beam

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VERY LONG BASELINE INTERFEROMETRY

In the VLBI technique, the data of an antenna are correlated with data from other antennas that recorded the same radio signal, to produce the resulting image. The resolution increase be increasing the distance between antennas. The INAF antennas take part of the VLBI global network.

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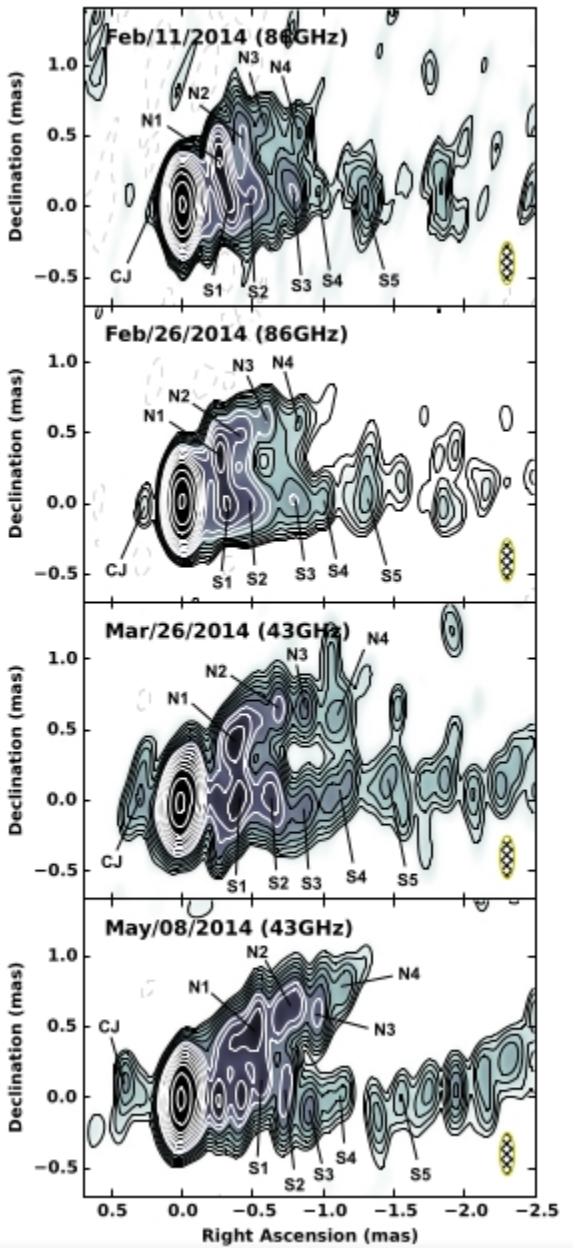

Accreting supermassive black holes at the center of active galaxies produce powerful relativistic jets that are observed as a collimated beam of plasma, often propagating beyond the host galaxies.

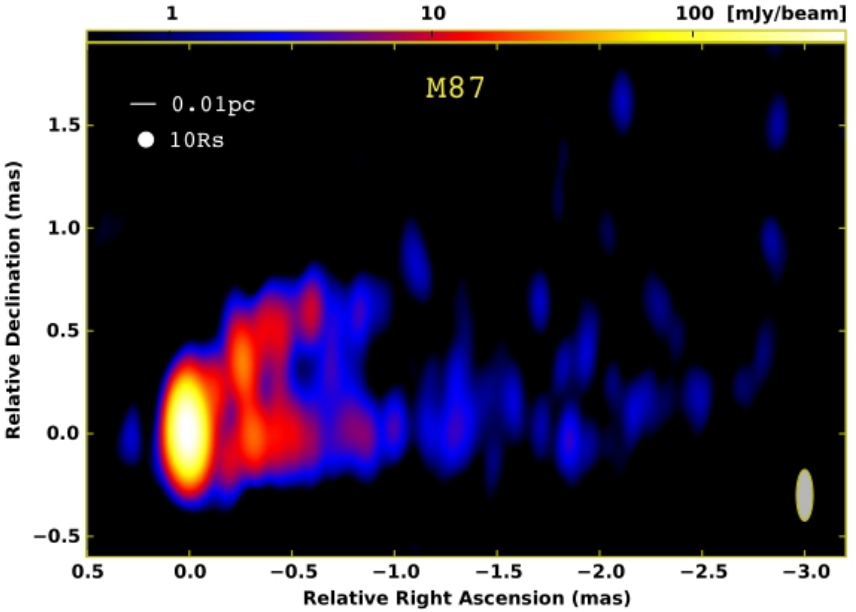

Figure 3. VLBA+GBT 86 GHz false-color total intensity image of the M87 jet. The image is produced by combining the visibility data over the two epochs on 2014 February 11 and 26. The restoring beam (0.25 mas × 0.08 mas at PA 0°) is shown in the bottom-right corner of the image. The peak intensity is 500 mJy beam^{-1} and the off-source rms noise level is 0.28 mJy beam^{-1}, where the resulting dynamic range is greater than 1500 to 1.

Hada et al. (2016)

VLBA+GBT 86 GHz
FWHM=0.25X0.08 mas

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ATACAMA LARGE MILLIMITER ARRAY (ALMA)

INAF- Istituto di Radioastronomia host the Italian node of the European ALMA Regional Centre (ARC) and is one of the seven nodes that constitute the European network that provides technical and scientific support to ALMA users:

- Proposal preparation and submission
- Optimising the observing strategy
- Reducing interferometric data with CASA
- Polarimetry
- mm-VLBI with ALMA

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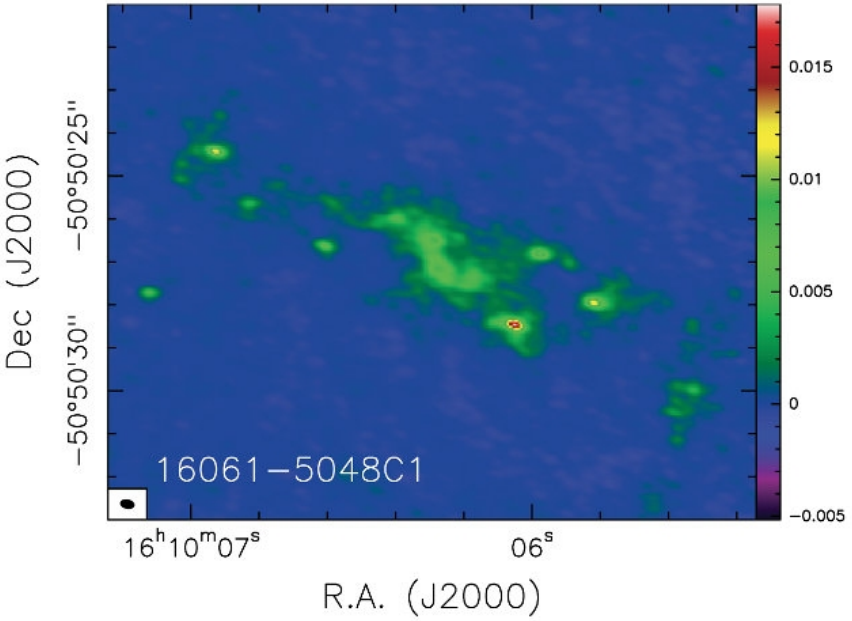
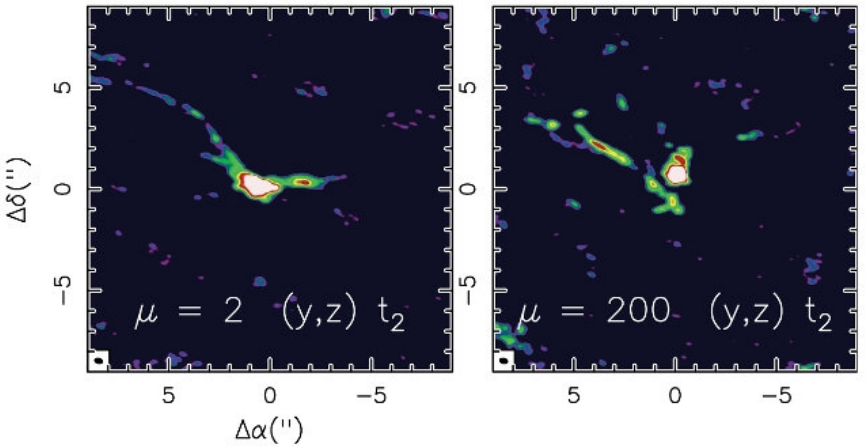
ATACAMA LARGE MILLIMITER ARRAY (ALMA)

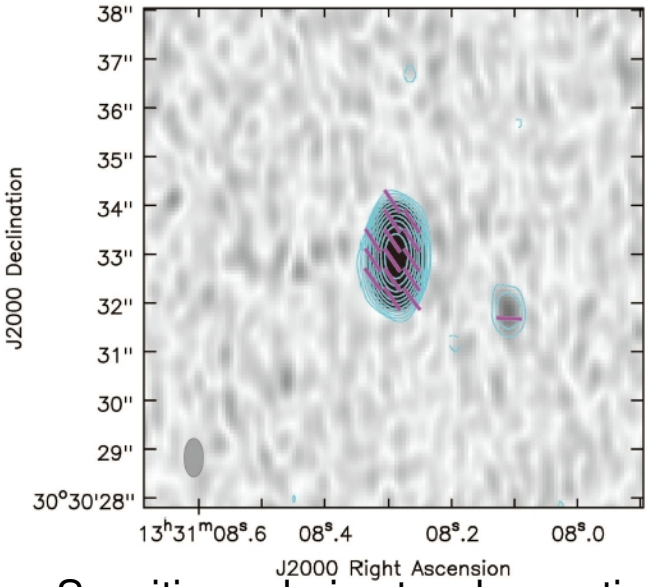
The earliest stage of star-formation observed in a molecular cloud. Fontani et al. (2016)



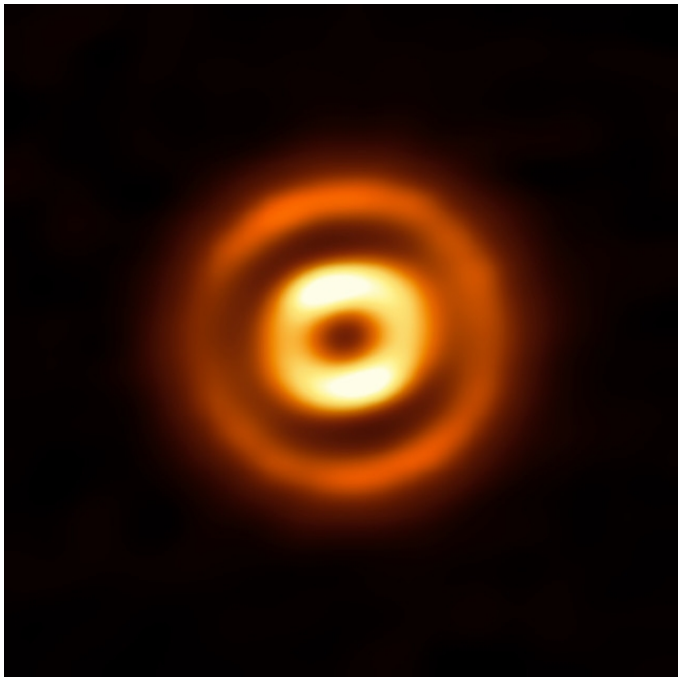


Two planets in formation discovered in the HD 169142 system Fedele et al. (2017)

Nagai et al. (2016)



Sensitive polarimetry observations of 3C286



Single-dish Antennas (SRT-Medicina-Noto)

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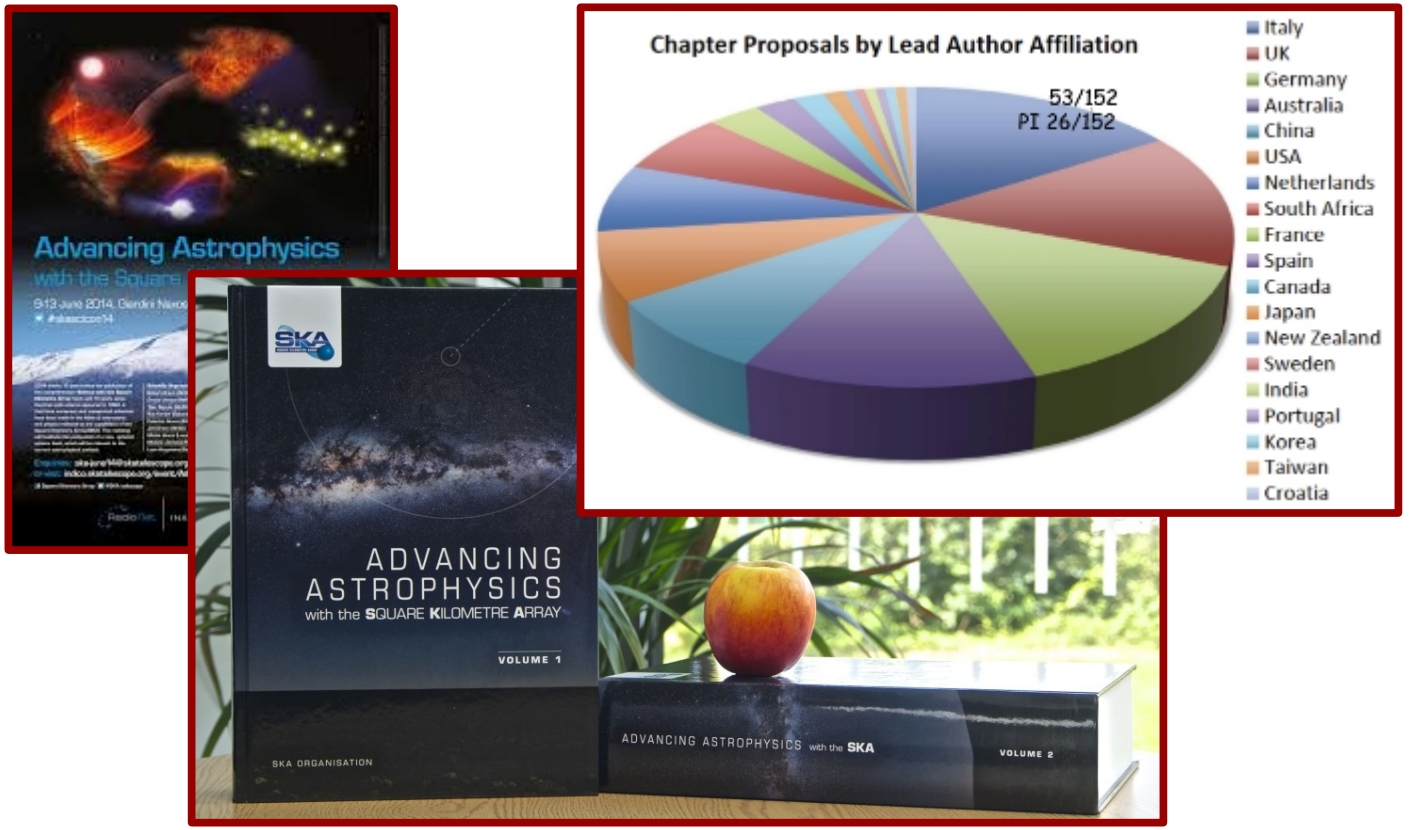
SKA

ALMA ed astronomia millimetrica

PRECURSORS/PATHFINDERS SKA AT LOW/HIGH FREQUENCY



SKA precursor telescopes are prototypes designed primarily as engineering testbeds for the future SKA to test and refine technologies and to anticipate potential challenges.

Precursors (telescopes located on the SKA sites): MeerKAT, HERA ASKAP, MWA

Pathfinders (instruments located elsewhere in the world and who contribute to the design and research around the SKA): LOFAR,APERTIF,GMRT,LWA

Their size makes them world-class science instruments and they will already greatly contribute to the science fields covered by the SKA.

Single-dish Antennas (SRT-Medicina-Noto)

VLBI

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Precursors Pathfinders SKA (high frequency)

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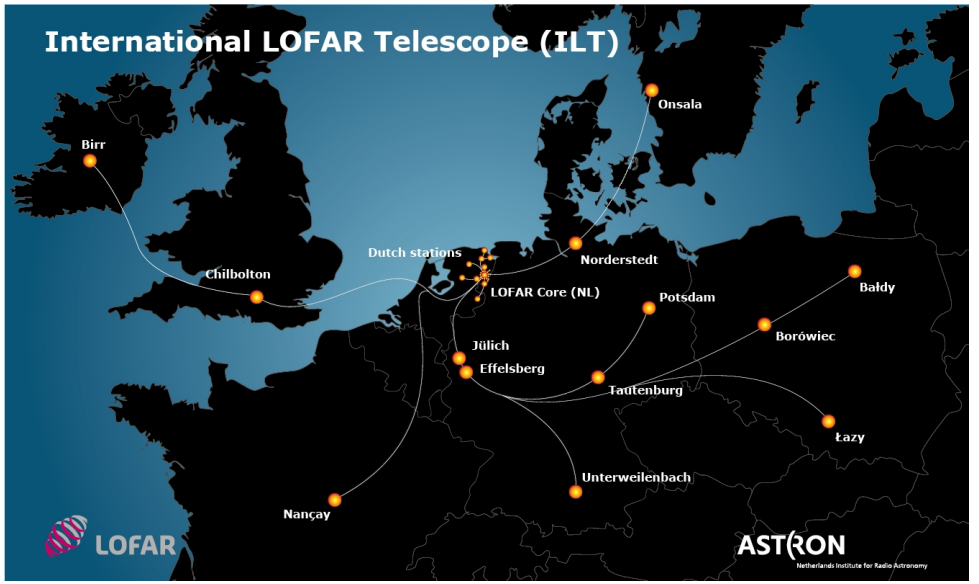
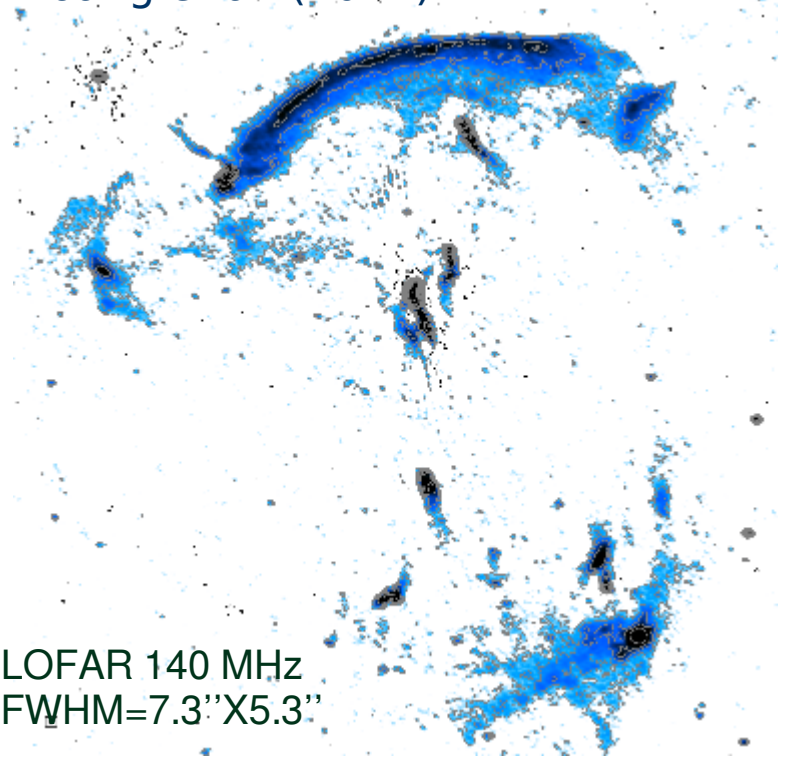
PRECURSORS/PATHFINDERS SKA AT LOW FREQUENCY

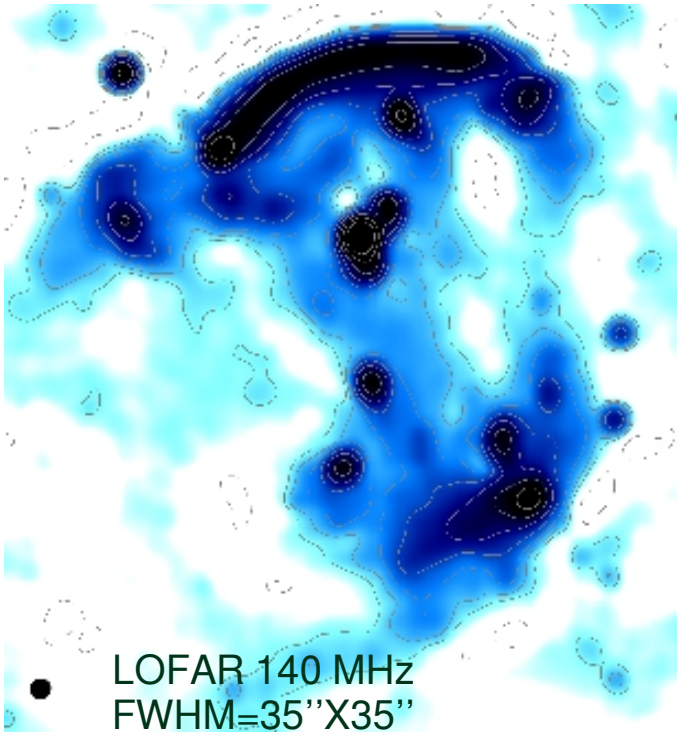


Hoang et al. (2017)



LOFAR 140 MHz
FWHM=7.3''X5.3''

CIZA J2242.8+5301



LOFAR 140 MHz
FWHM=35''X35''

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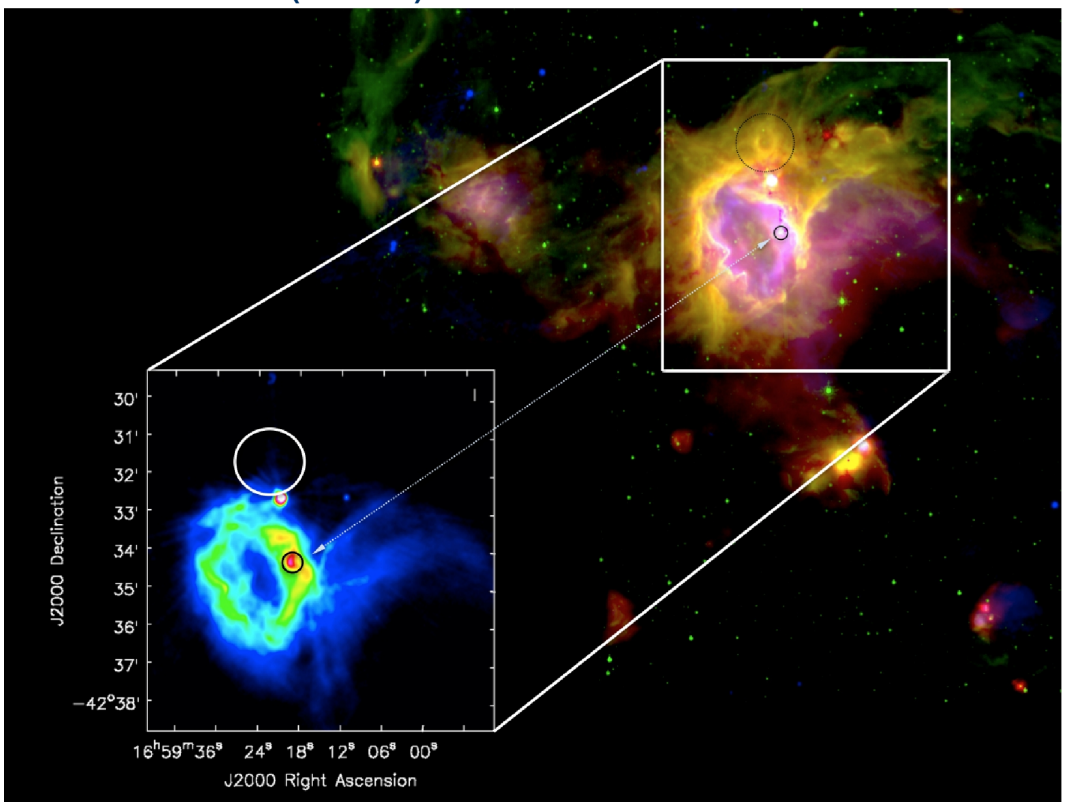
PRECURSORS/PATHFINDERS SKA AT HIGH FREQUENCY

Umana et al. (2015)



Radio emission has been detected in a broad variety of stellar objects from all stages of stellar Evolution

Blue=SCORPIO
Green=Spitzer (8microm)
Red=Hershell (70microm)

Stellar cluster associated with multiple bubbles. Bubbles are usually associated with hot young stars in massive star formation regions. However, some bubbles are related to massive evolved stars (like SNRs)

SCORPIO (Stellar Continuum Originatiing from Radio Physics In Ourgalaxy)
Deep survey at 1.4 GHz with ATCA resolution=10'' sensitivity=30microJy
FoV 2degX2deg in the galactic plane in the direction of the Scorpio constellation

EMU all SkySurvey ASKAP at 1.4 GHz
sensibilità di 10 microJy/beam resolution=10''

SCORPIO → pathfinder of EMU (ATCA, Parkes e ASKAP) 320 hours

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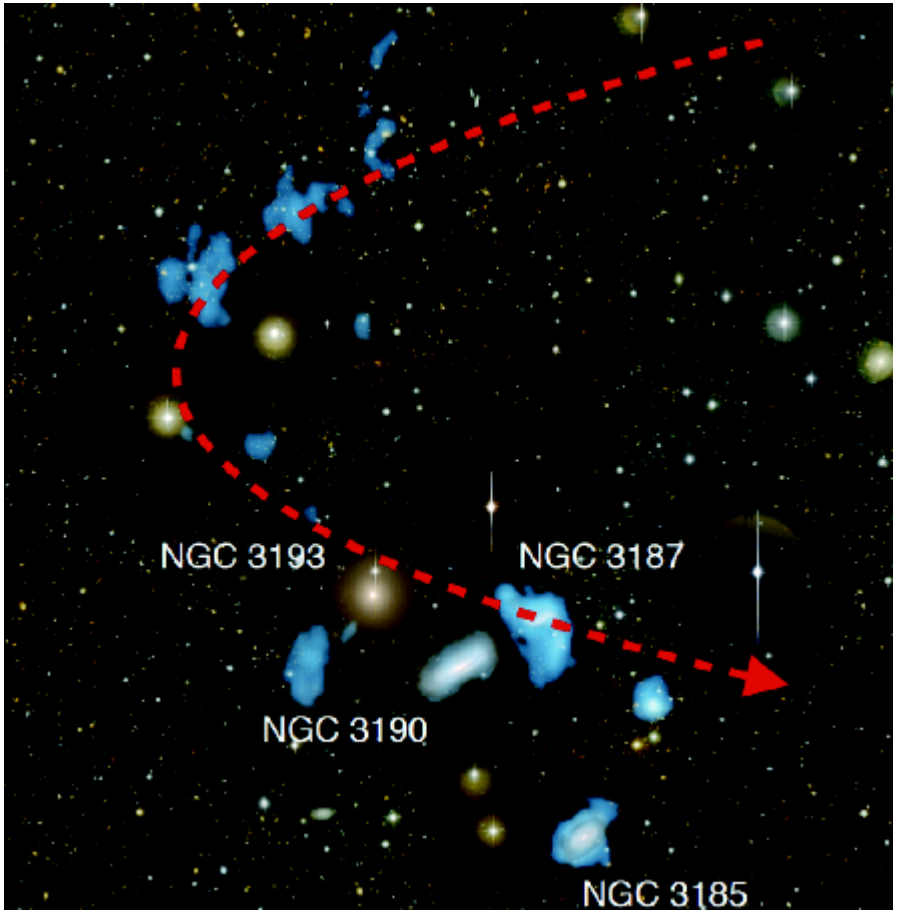
PRECURSORS/PATHFINDERS SKA AT HIGH FREQUENCY

Serra et al. (2013)



Neutral hydrogen (H I) emission overlaid on optical image of HCG 44.
The orbit of the stripped galaxy is shown by the red line.

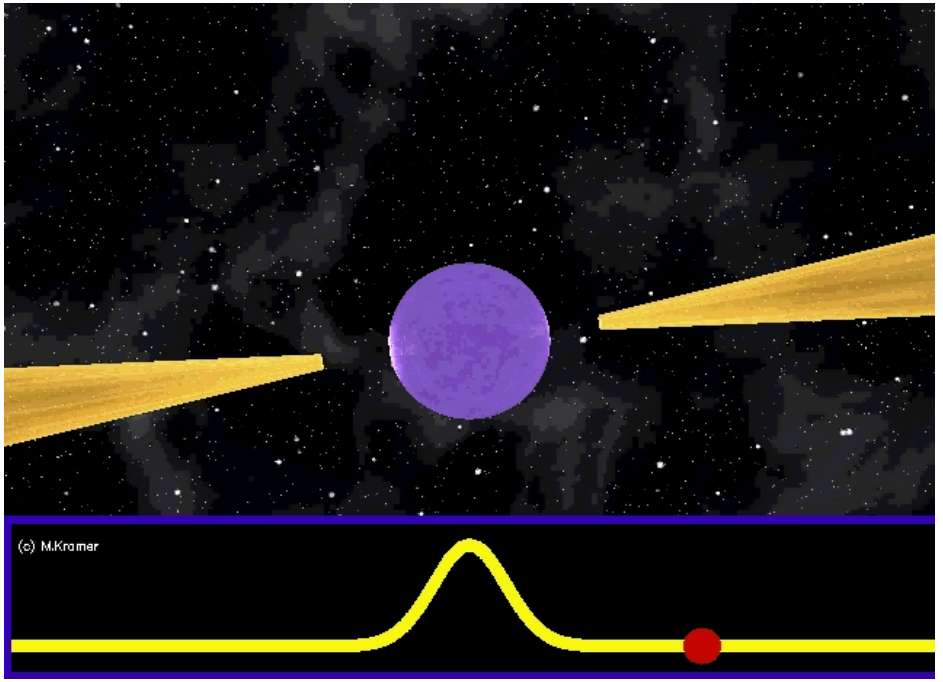
HI is the gas phase from which molecular clouds and new starts forms, and is therefore a key observable to understand galaxies

MeerKAT FORNAX survey → HI survey of the Fornax galaxy cluster

Deep survey at 1.4 GHz with MeerKAT resolution=10''
FoV 12 square deg

BIG-DATA IN RADIOASTRONOMY

Pulsars are highly magnetized and rapidly rotating neutron stars emitting a pulsed radio signal whose extreme characteristics make them excellent laboratories for a wide range of fundamental physics and astrophysics experiments.



Pulsars are unique laboratories for gravity theories.
See the case of the Double Pulsar (Burgay et al. 2003, Lyne et al. 2004)

Single-dish Antennas (SRT-Medicina-Noto)

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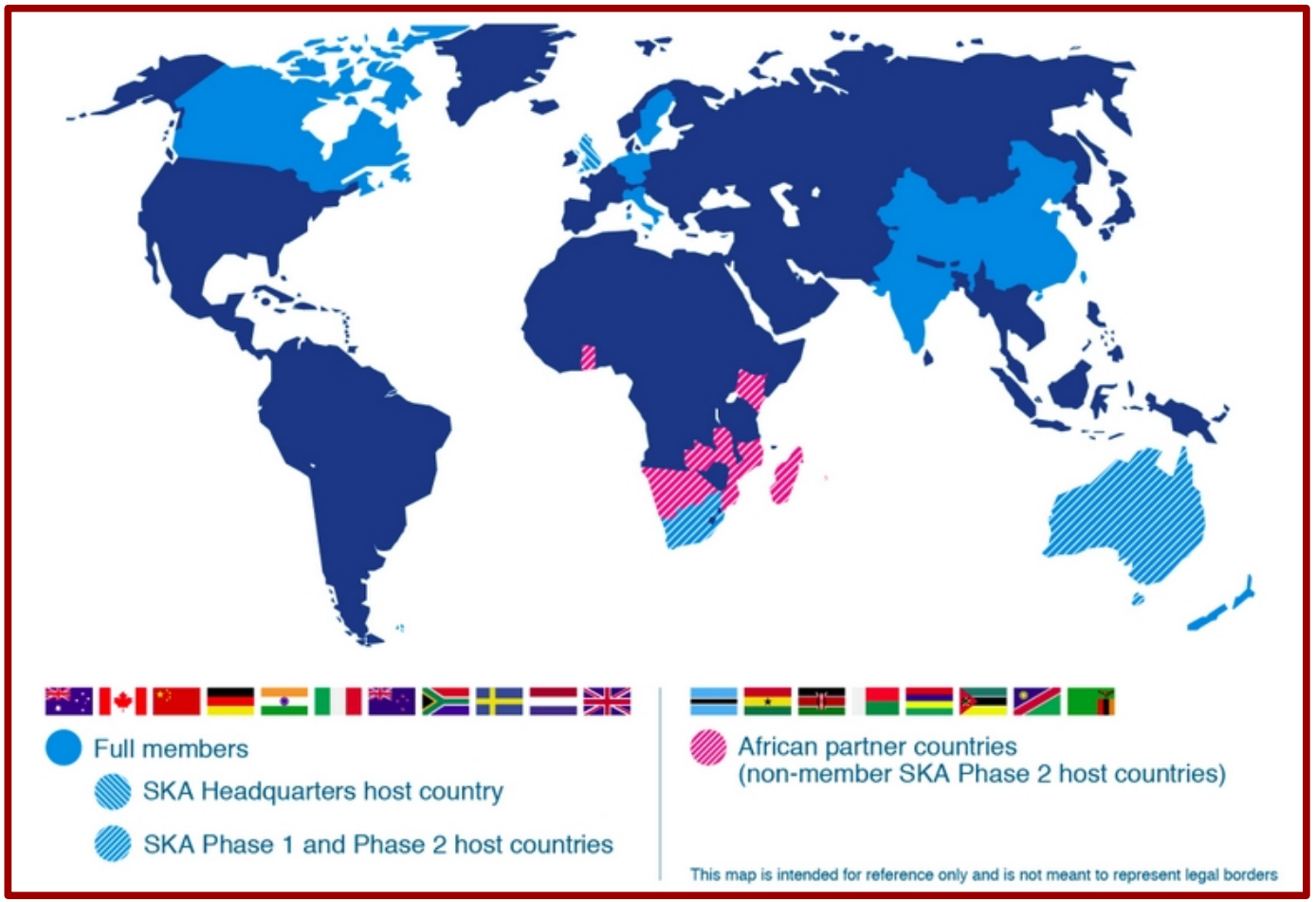
SKA (SQUARE KILOMETRE ARRAY)

- Pulsar
- Extragalactic Continuum
- Epoch of Reionization
- Our Galaxy
- Cosmic Magnetism



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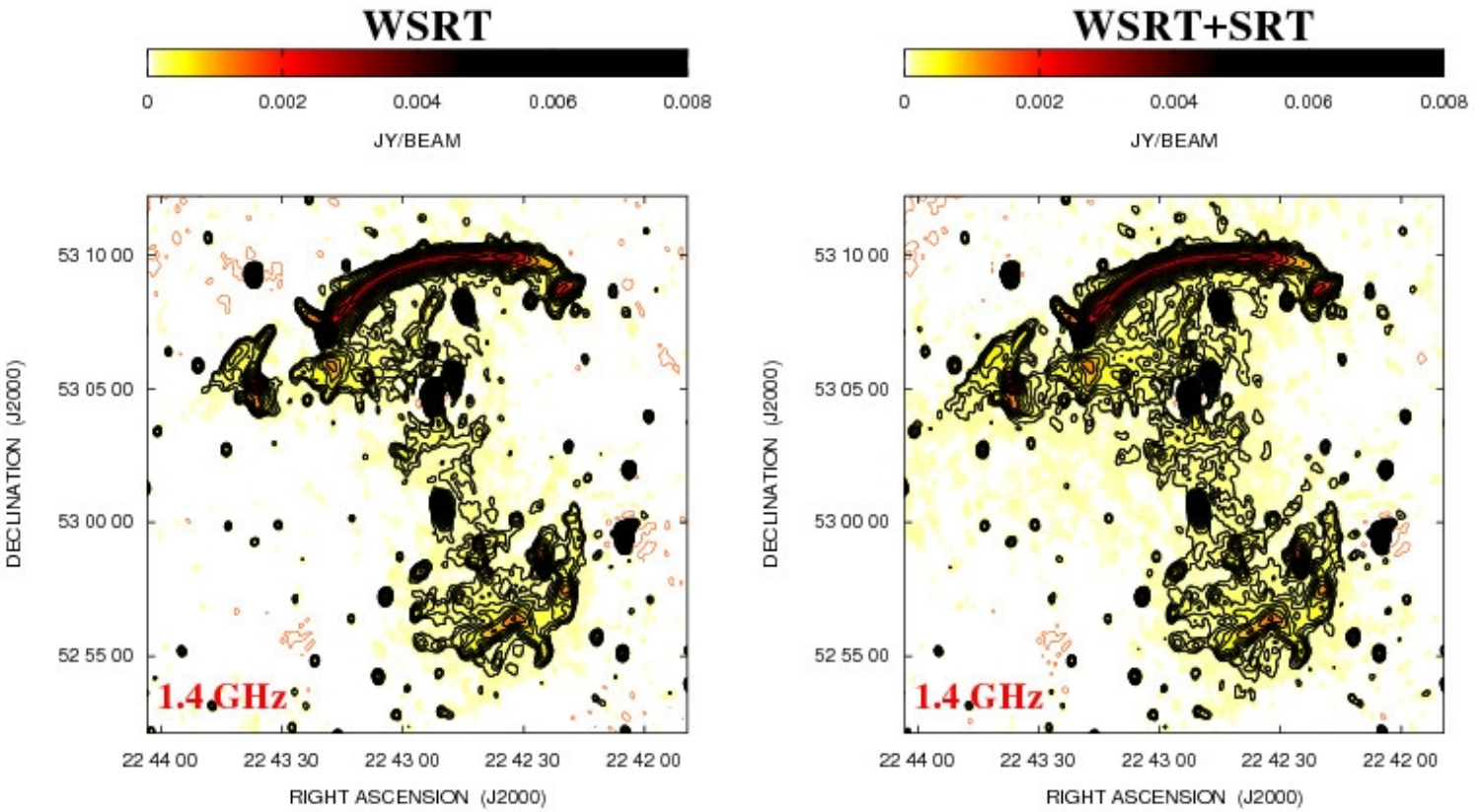
SKA (SQUARE KILOMETRE ARRAY)

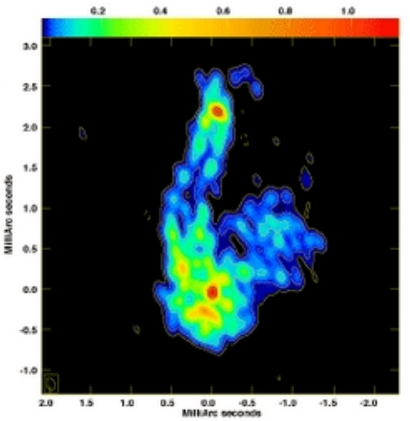
CIZA J2242.8+5301



Stroe et al. (2013)

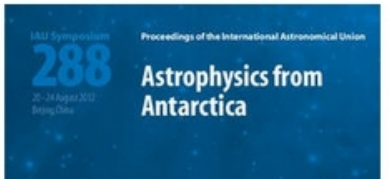
Loi et al. (2017)

1382 MHz, BW 156 MHz, SRT + WSRT
beam=21"x16" PA=0, rms 50 mJy/beam



Post Meeting

The proceedings of the IAUS342 "Perseus in Sicily: from black hole to cluster outskirts" will be published no more than 6 months after the celebration of the Symposium. IAU Symposium Proceedings are published in the IAU Proceedings' Series by the IAU Publisher, Cambridge University Press (CUP). The




THANK YOU!
Sergio Poppi