Outline

RADIOASTRONOMY

6 CFU = 48 hr (4 hr / week)

Summary

Bibliography

Final test

Some parts of radioastronomy science are dropped since they are included in fundamental courses, other subjetcs (e.g. Clusters of Galaxies, Gas Dynamics, ...) , are presented in a *"radioastronomicocentric" view*

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RADIOASTRONOMY..... WHY (1) ?

Interest in one ore more arguments discussed in the lectures
(better in more than one)
(best in all of them!)

Spotting something useful for thesis work.

Radio telescopes can be found everywhere

RADIOASTRONOMY..... WHY (2) ?

It's the timely opportunity to spend time doing radio astronomy!

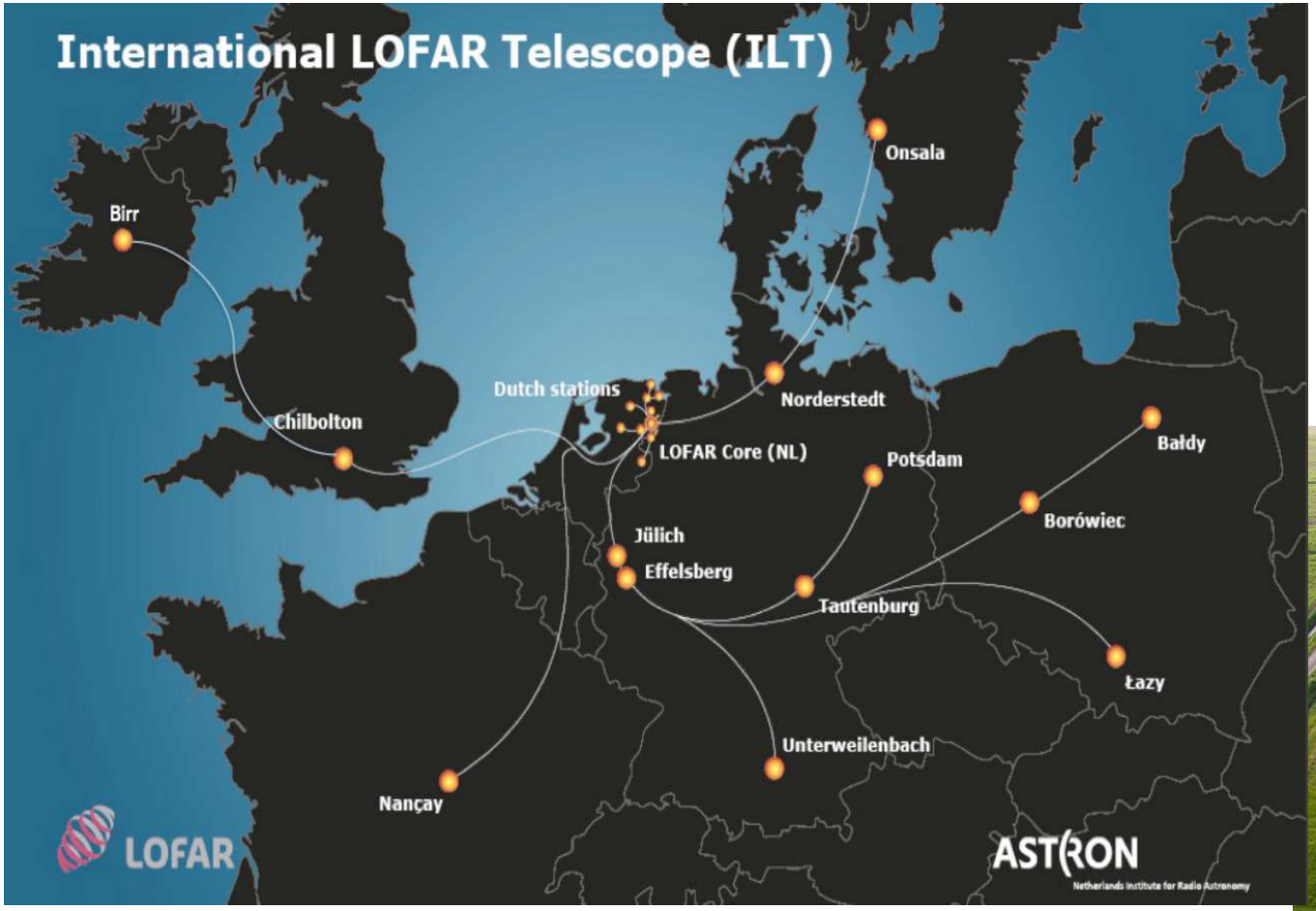
SKA, present and FUTURE

RADIOASTRONOMY..... WHY (3) ?

Atacama Large Millimiter Array

- Formation of stars and planetary systems
- Gas (& cold dust) properties,
- Chemical composition,
- Gas properties in distant galaxies, etc.

RADIOASTRONOMY..... WHY (4) ?



- Continuum synchrotron emission (radio galaxies, normal galaxies, SNR, diffuse galactic & extragalactic sources) [surveys]
- Cosmic Magnetism
- Transients
- EoR

1. Radiotelescopes: single dishes & interferometers, present and future

(Useful pathway to the RadioAstronomy Lab)

2. Recap of radiative processes: plasma & magnetic fields
3. Gas in the ISM: (various properties & the rotation curve in spirals)
4. Molecules, ISM and YSO: ingredients & processes involved in SFR
5. Radio stars: general properties & the sun, solar flares
6. Supernovae & SNR: where, how many, lifetime, census
7. Pulsars: properties, distribution, mechanism & relativistic probes
8. Microquasars: similarites to AGN, GRB
9. The Milky Way and SgrA*: a nearby SMBH with (a lot of) anomalies
10. Radio emission in galaxies: powerful radio source genesis & evolution
11. Clusters of galaxies: individual & diffuse radio sources
12. Faint populations & radio source counts: the radio view of Cosmology

1. Radiotelescopes: single dishes & interferometers, present and future

(Useful pathway to the RadioAstronomy Lab)

2. Recap of radiative processes: plasma & magnetic fields

3. Gas in the ISM:
4. Molecules, ISM and YSO:

} Physics of atomic/molecular gas aka "COLD" Universe

5. Radio stars:
6. Supernovae & SNR:
7. Pulsars:
8. Microquasars:

} Physics of a variety of mainly non–thermal processes (and acceleration of particles)

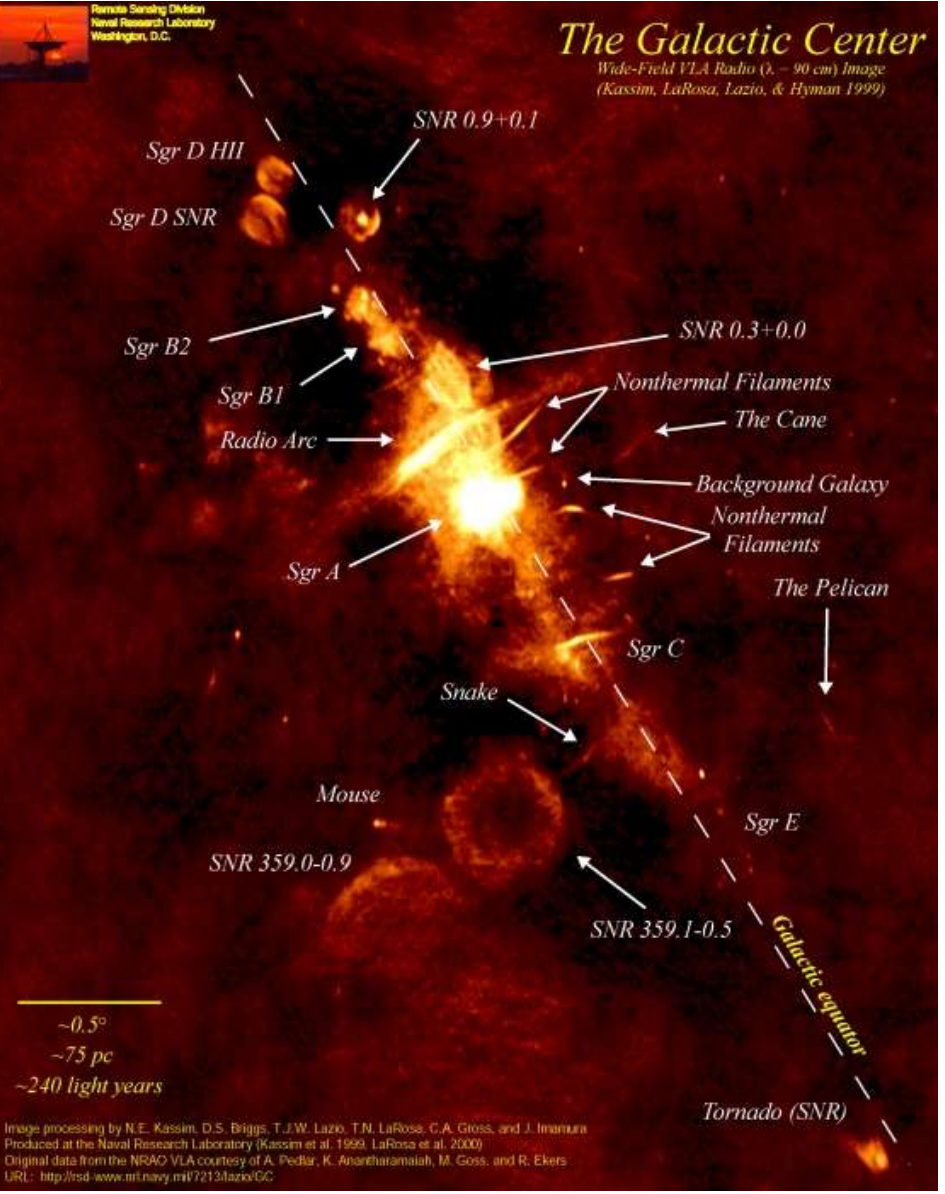
9. The Milky Way and SgrA*:

} Physics of unexpected entities and phenomena where they should not be

10. Radio emission in galaxies:
11. Clusters of galaxies:

} Physics of magnetized non–thermal plasma within a thermal plasma

12. Faint populations & radio source counts: SF and AGNs across cosmic time

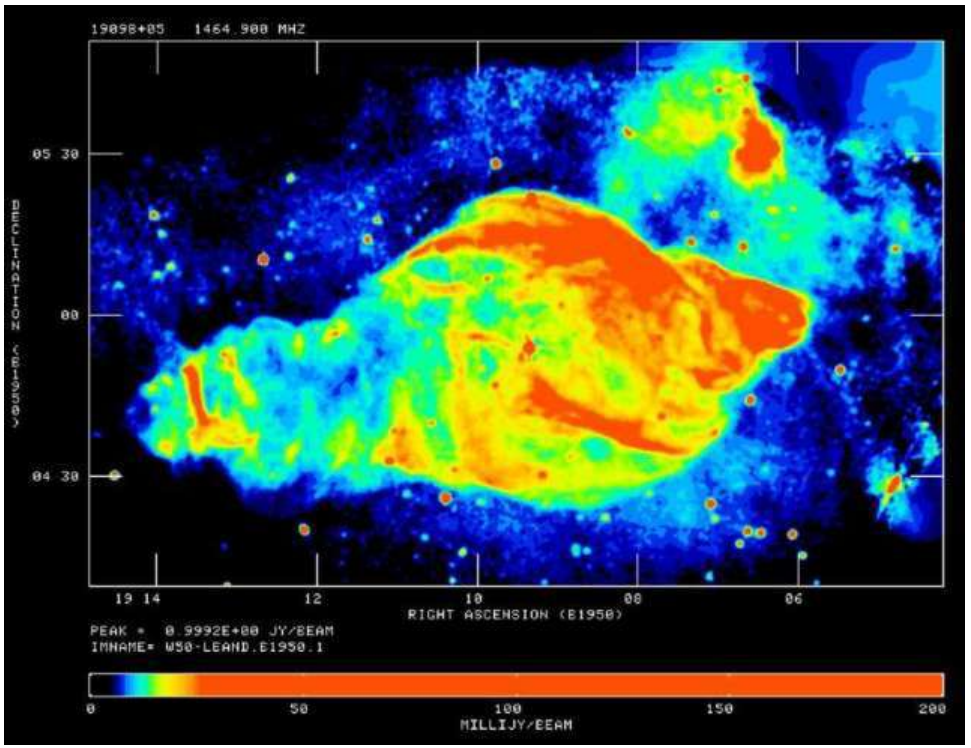


Slides available at (in continuous evolution)

http://www.ira.inaf.it/~ddallaca/Radioastronomy.html

A few (2-5) [review] papers are given for each section

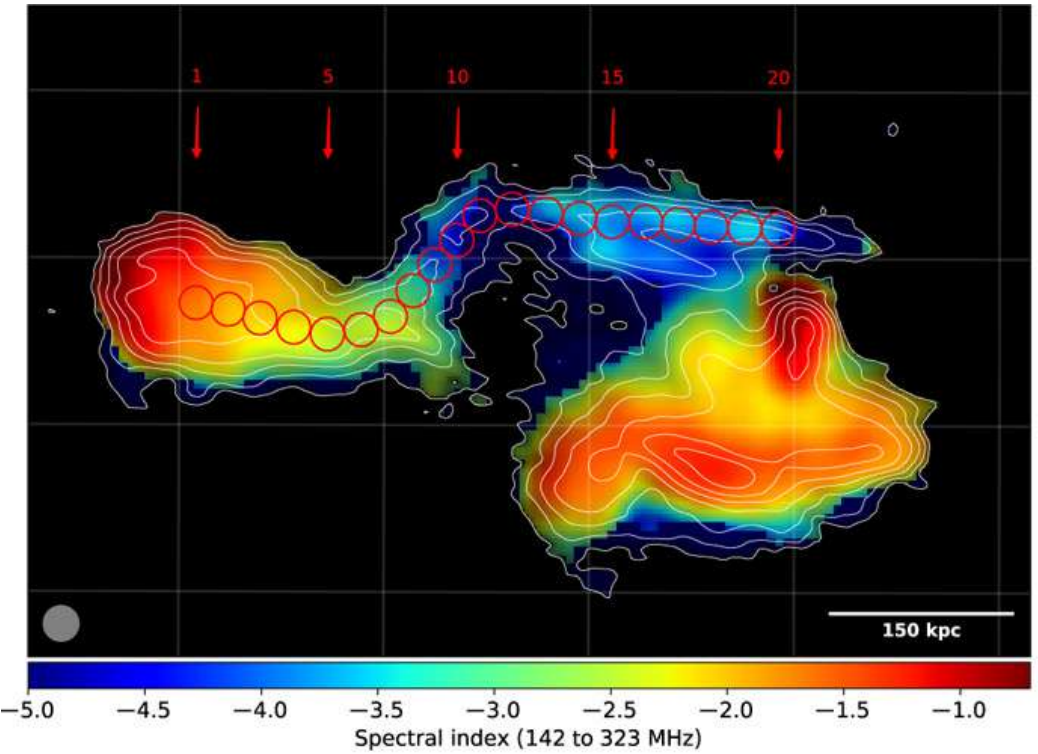
Textbooks (indications on sections/chapters)

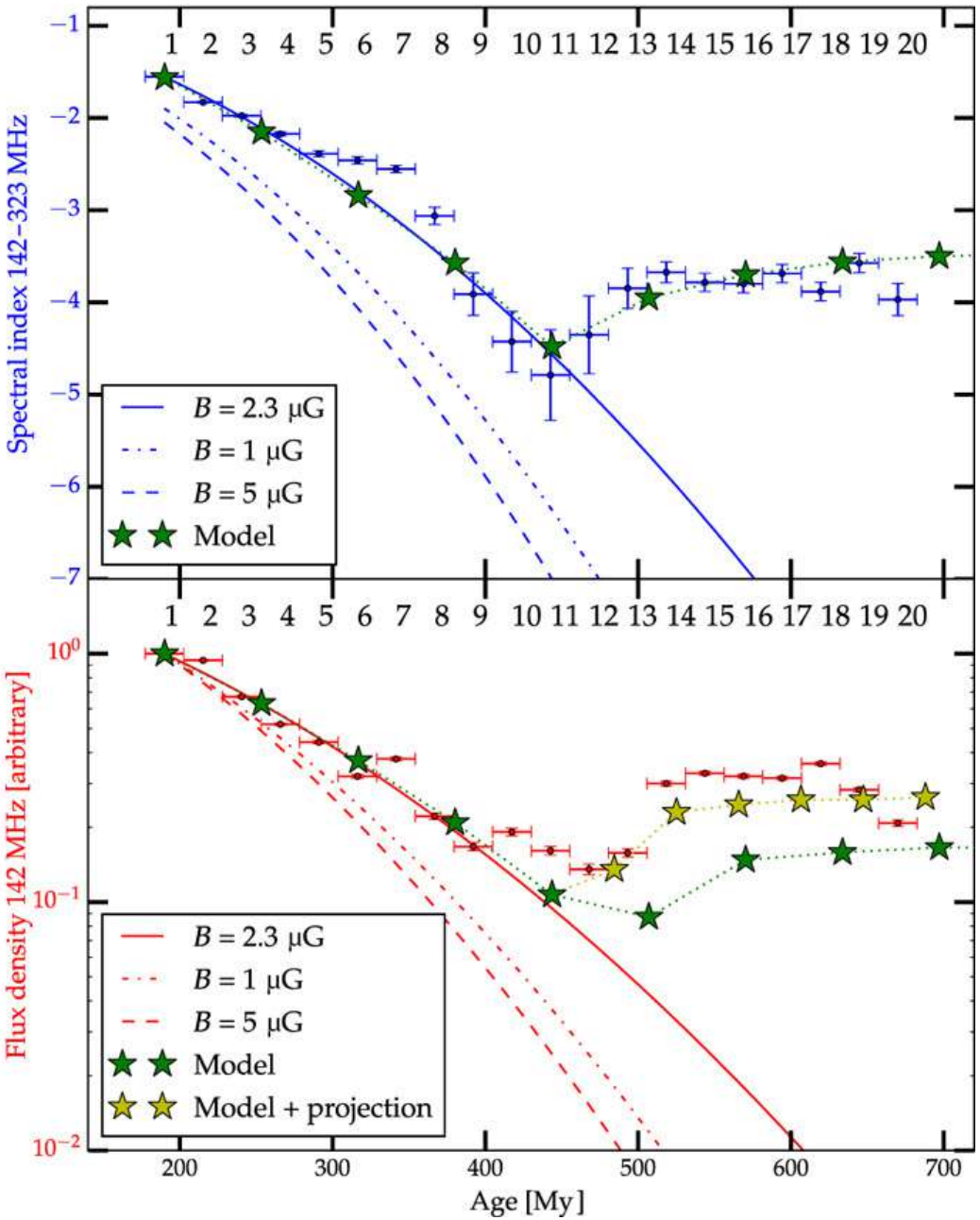


Exam:

- "Official" schedule on almaesami + other dates can be agreed
- Approximate duration: 45'
- First question: discussion of a (review) paper/topic chosen by the canditate
- Two additional questions (randomly) chosen (by me) among the remaining 11 items.

➔ "New" Physical process(es) & connections with other observables (e.g. X-rays) (e.g. GreETs & radio Phoenices)

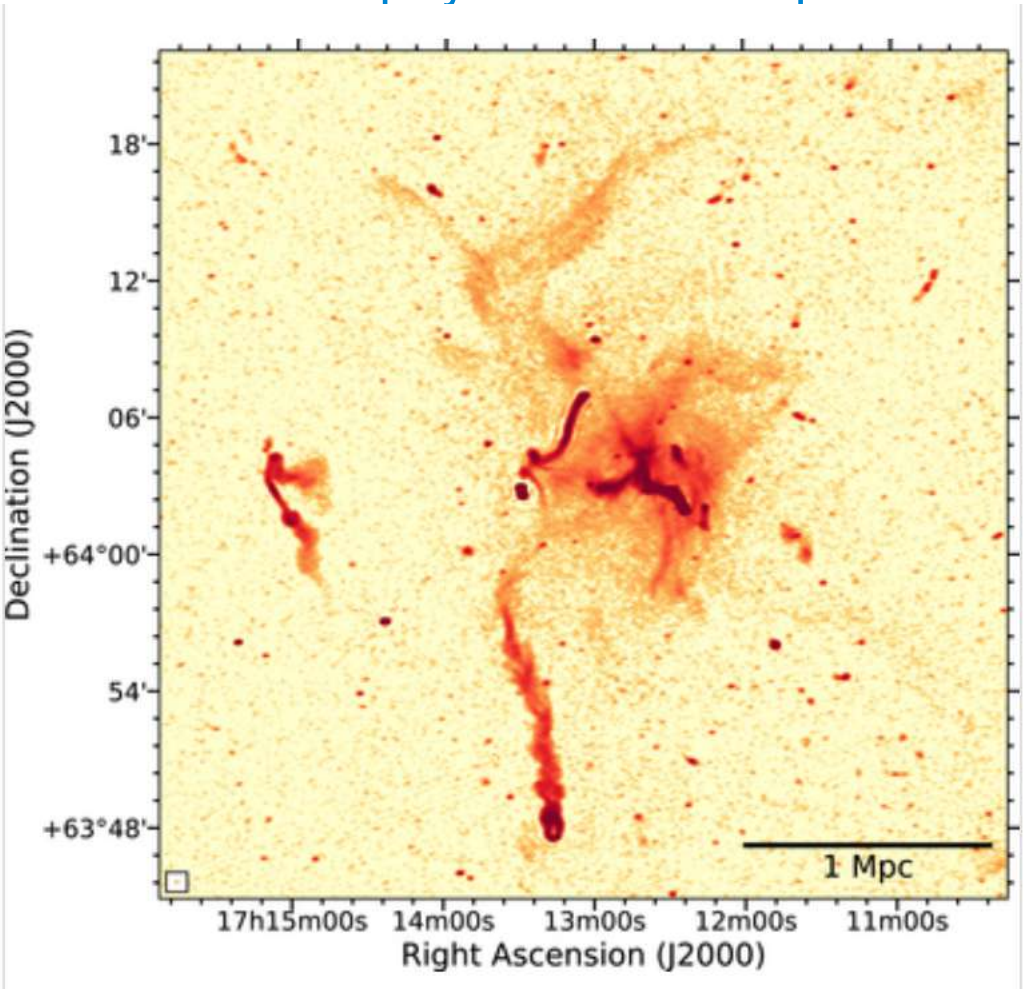


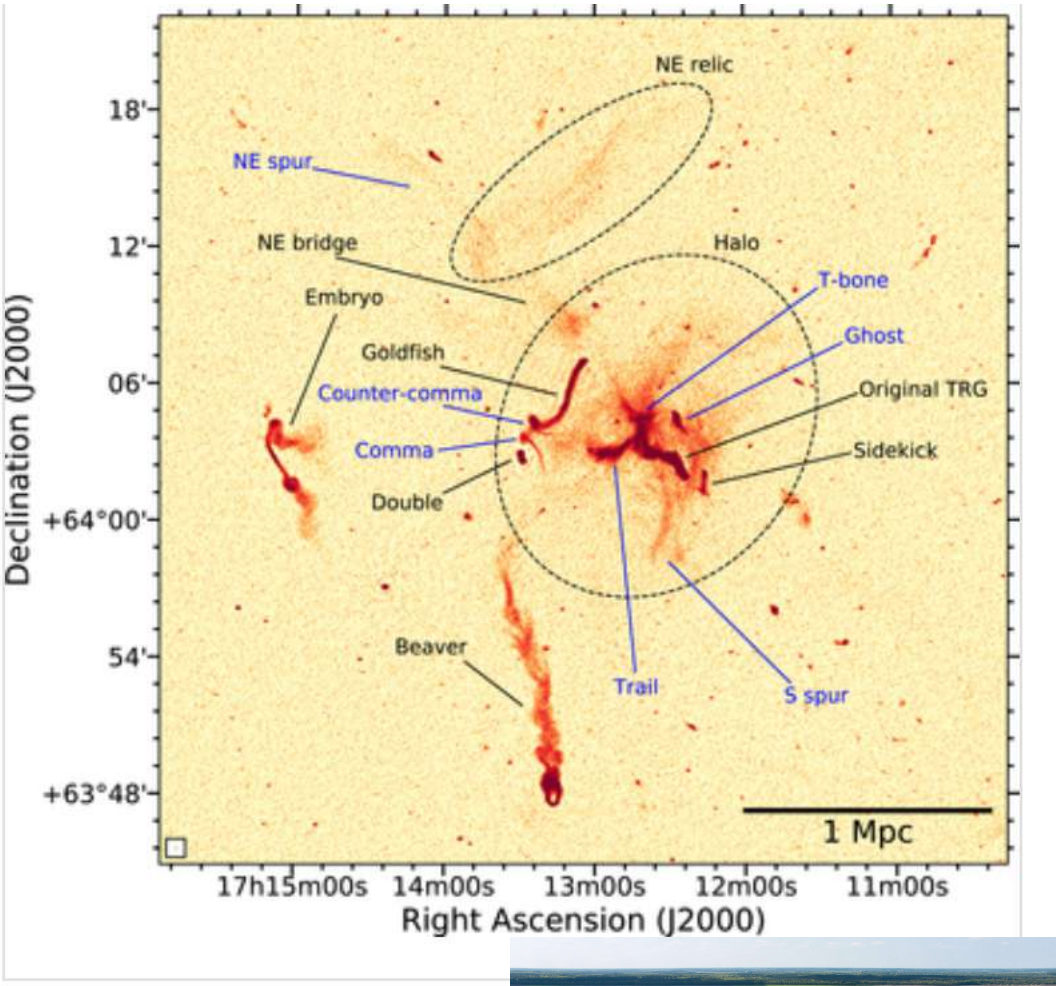


De Gasperin et al. *Science Advances* 04 Oct 2017

➔ "Discovery of new features"

Part of the physics can be explained, most of it still subject to many hypotheses





➔ Botteon + 2020, ApJ, 897, 93

"The beautiful mess in Abell 2255"

LOFAR SUPERTERP ⇨ Sometime in 2023?, a LOFAR 2.0 station will be deployed @ Medicina

The galactic centre: SgrA*

Moon size

The Galactic Center in Radio from MeerKAT

Image Credit: MeerKAT, SKA, SARAO

(Astronomical Picture of the day, 2018 August 22)

The picture shows an inaugural image of the MeerKAT array of 64 radio telescopes just completed in South Africa

South Africa's MeerKAT radiotelescope is the prototype for the Square Kilometre Array. Credit: South African Radio Astronomy Observ.

Possible Theses: [Bonafede, Dallacasa, Gitti, (Vazza)]

a) Clusters of Galaxies (Conventional Interferometry @ 0. 1 – a few GHz : LOFAR, GMRT, JVLA, MeerKAT, etc)

b) Radio Galaxies (idem@ 0. 1 – 10 GHz : LOFAR, GMRT, JVLA, MeerKAT, etc.)

c) Compact AGN (young) (Very Long Baseline Interferometry @ a few GHz)

d) Radio – γ-ray (X-ray) connection (idem)

Further:

e) Acceleration mechanisms, statistical studies, theoretical work (on the items above), etc.
+ a) and b) @DIFA and INAF – IRA in collaboration with staff and PhD students.

f,g) Pulsar studies in connection with Cagliari; Radio stars in connection with Catania; FRB @ northern cross + people in Cagliari.

i) molecules in the ISM (& star formation) in connection with Florence (+ Munich?)

Synergies with other courses

Active Galactic Nuclei and Supermassive Black Holes

Stellar Evolution

(Galaxy Formation and Evolution / Cosmology)

Astronomical Instrumentation

The Insterstellar medium

(Astroparticle physics)

(Astrophysical Fluid Dynamics)

Galaxy Clusters

High Energy Astrophysics

Magnetic Fields in Astrophysics