Constraining magnetic fields in radio relics

A. Botteon[1,2], *G. Brunetti*[1], *D. Dallacasa*[1,2]

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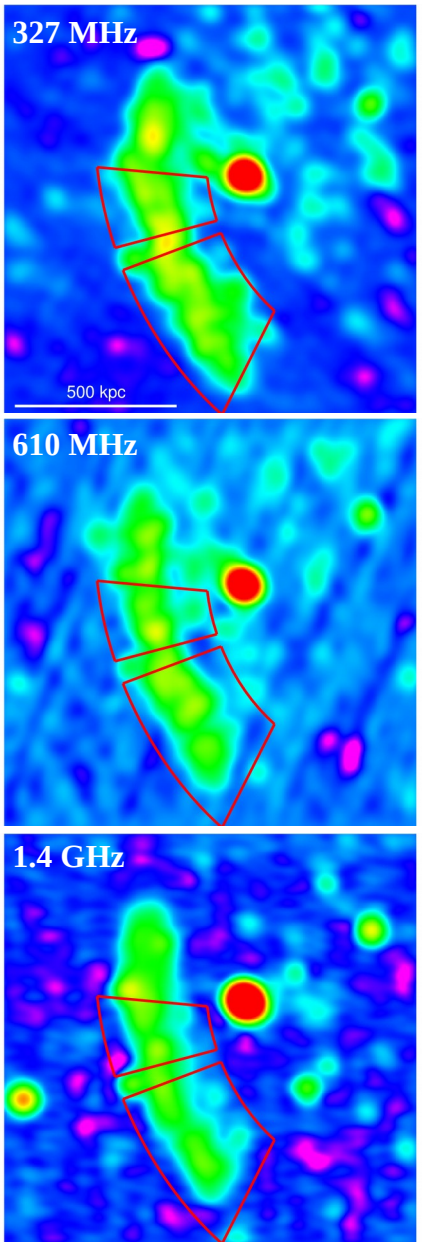
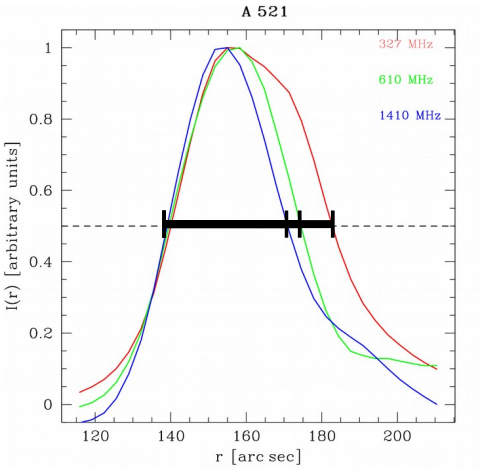
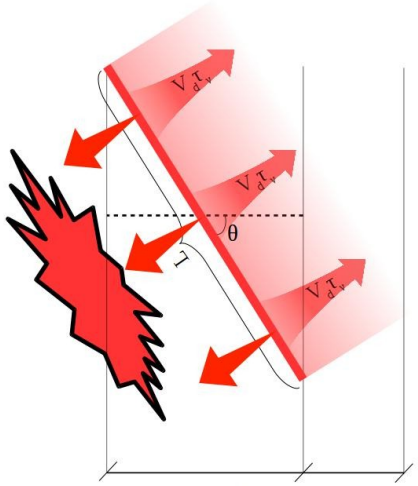


$$\Phi_\nu = V_d \tau_\nu(B)$$

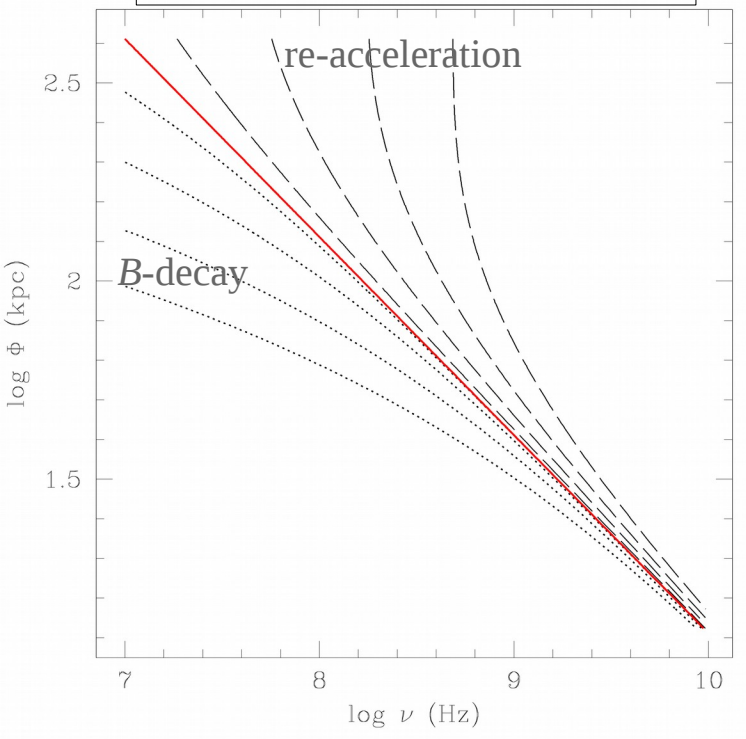


Broadening of the ***thickness*** **Φ** (=FWHM) of the relic at low ν



$$\Phi_\nu = L\cos\theta + V_d \tau_\nu \sin\theta$$

Predicted thickness (θ = 90°)



Simplest scenario: aging of accelerated electrons downstream due to ***IC+synchrotron***

$$\tau_\nu \propto \frac{B^{1/2}}{B^2 + B_{CMB}^2} \times [\nu(1+z)]^{-1/2}$$

$$\Phi_\nu \propto \nu^{-1/2}$$

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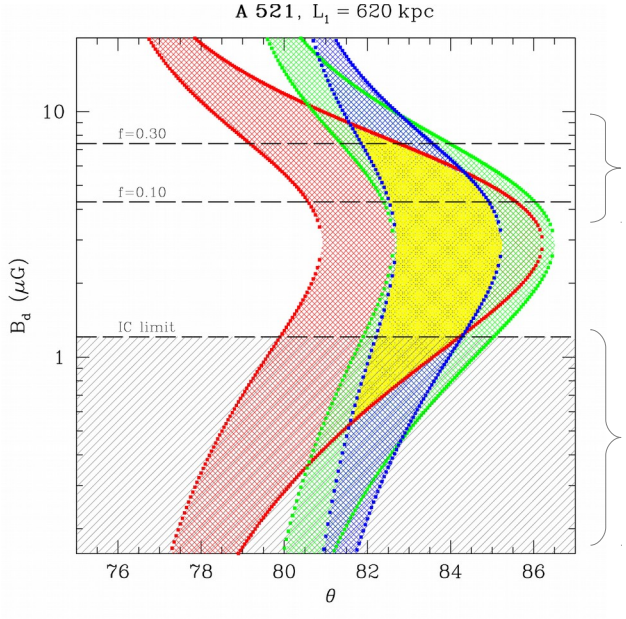


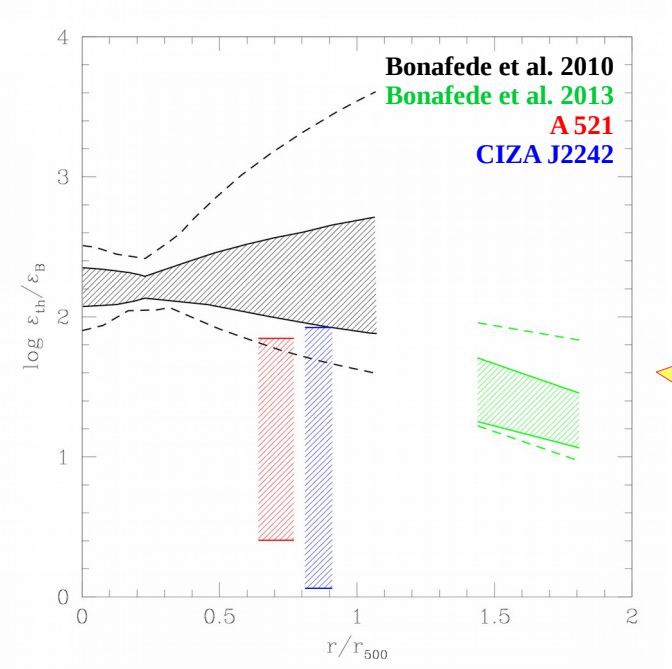
Energy arguments on the ICM

Lack of IC emission

New constraints on *B* in:
Abell 521
CIZA J2242 (the **"Sausage"**)

Radio relics probe *B* in cluster outskirts

$$\langle B \rangle (r) = \langle B_0 \rangle \left(\frac{n_e(r)}{n_0} \right)^{\eta}$$

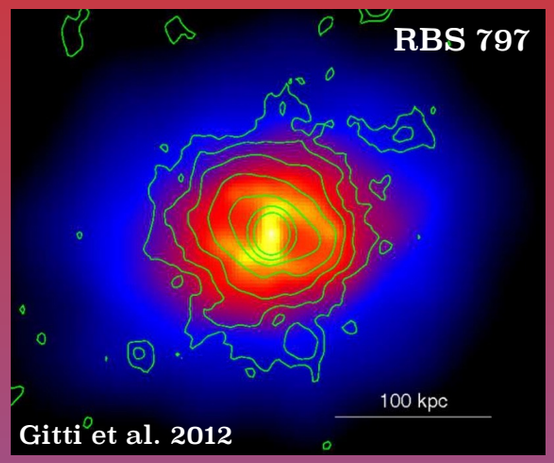


Evidence for larger magnetic fields
Do relics trace regions of strong amplification of magnetic fields?

ON THE CONNECTION BETWEEN RADIO MINI-HALOS AND GAS HEATING IN COOL-CORE CLUSTERS

Luca Bravi

- **Homogeneous analysis of *Chandra* data of the largest collection of mini-halo clusters currently known (~20 objects)**



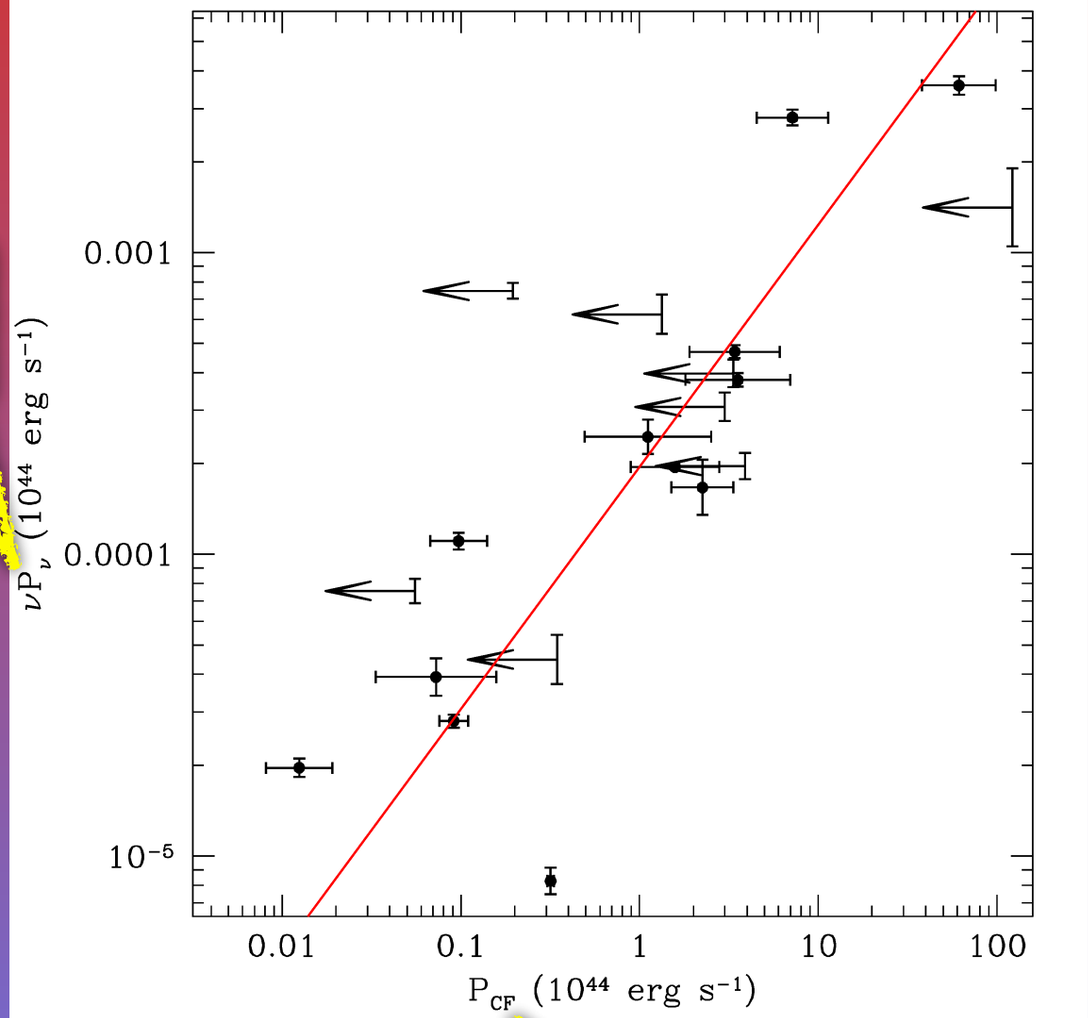
- **Correlation between mini-halo radio power (νP_ν) and cooling flow power (P_{CF}):**

$$[\nu P_\nu]_{1.4GHz} \propto P_{CF}^{0.8}$$

- **Turbulent re-acceleration scenario:** particle acceleration (origin of mini-halo) and gas heating in cool-cores (solution of cooling flow problem) can be due to the dissipation of the same turbulence, provided that B > 0.5 μG in the mini-halo region

from radio data
Non-thermal mini-halos

$$\log(\nu P_\nu) = [(0.80 \pm 0.13) \cdot \log(P_{CF})] - (3.70 \pm 0.11)$$



from X-ray data
Thermal cool-cores

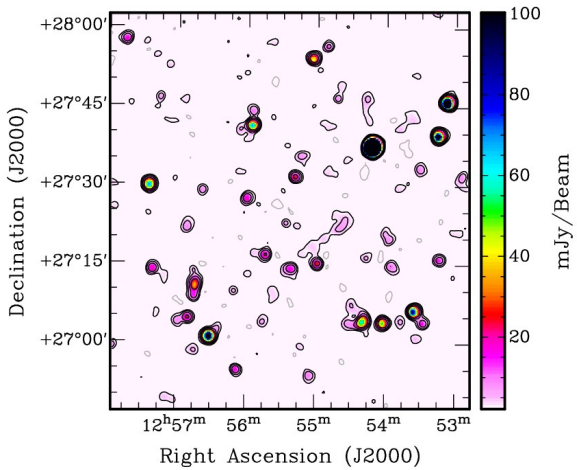
Bravi, Gitti, Brunetti 2015, MNRAS Letter, in press

COMBINING SURVEY DATA WITH SINGLE-DISH OBSERVATIONS

to produce images with high resolution and total-power information

Monica Trasatti, Uli Klein, Annalisa Bonafede, Gabriele Giovannini

The radio relic in the Coma cluster:

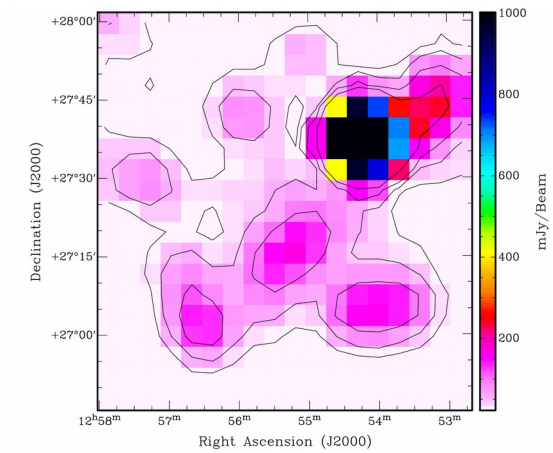


Interferometric image (NVSS)

High resolution

Morphological properties

+

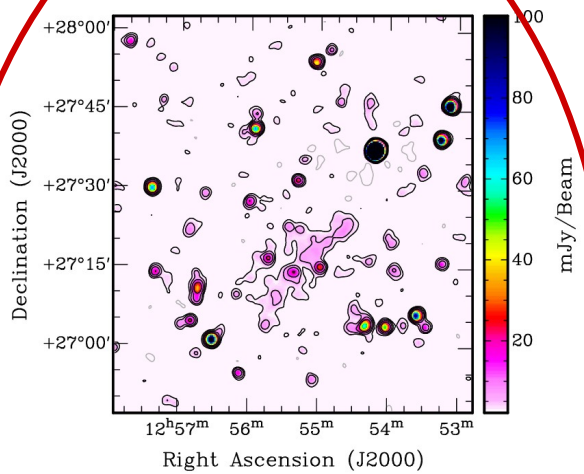


Single-dish image (Effelsberg)

Total-power information

Spectral properties

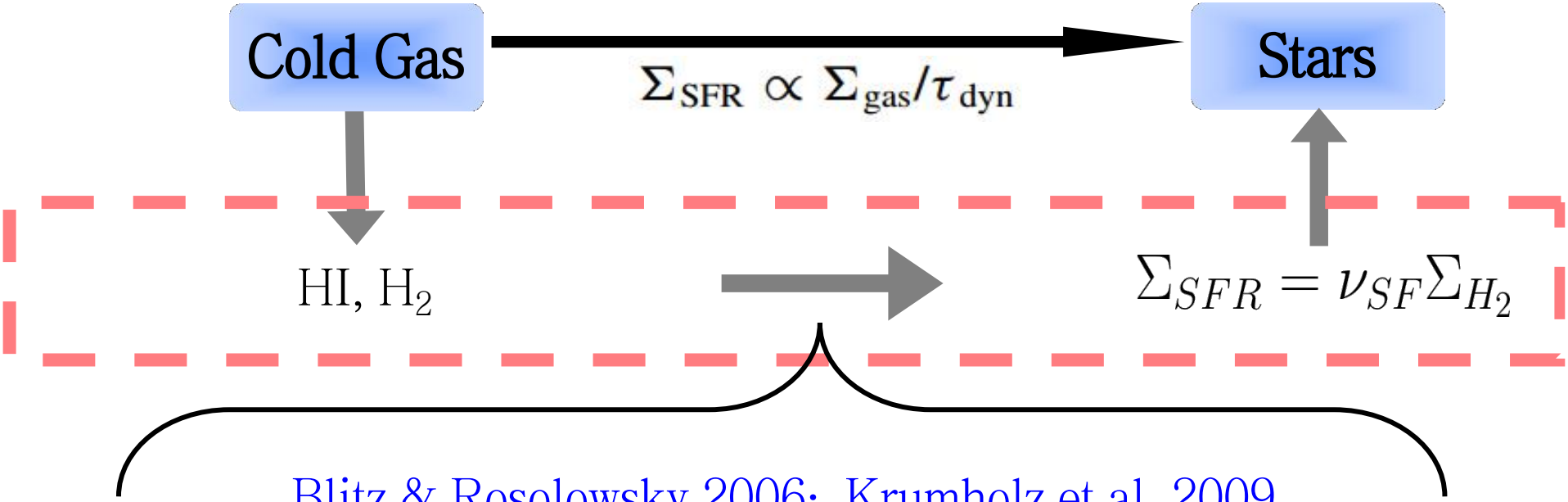
=



Combined image (NVSS+Effelsberg)

Morphological + spectral properties!

H_2–based star formation laws in semi–analytic galaxy formation model



Blitz & Rosolowsky 2006; Krumholz et al. 2009
Gnedin & Kravtsov 2011; Krumholz 2013

Lizhi Xie & Gabriella De Lucia
INAF–– Astronomical Observatory of Trieste

- **With H_2-based star formation laws, our model can statisticallly reproduce a number of observational measurements of galaxies at z=0.**
  - stellar mass function; luminosity function; HI mass function; H_2 mass function; correlation between HI, H_2 and stellar mass; black hole-stellar mass relation; metallicity-stellar mass relation; .....

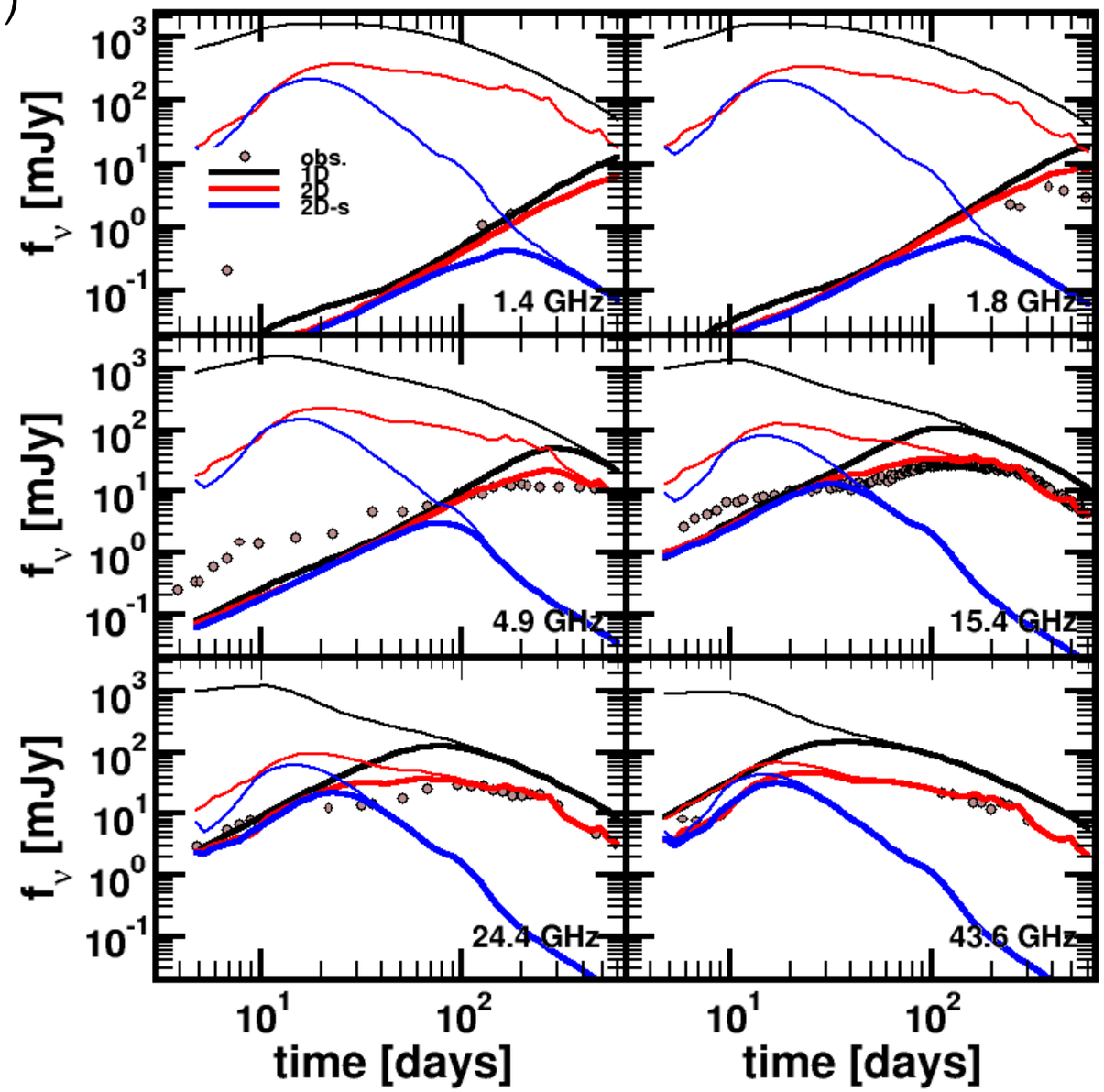
- **Future plan:**

1. HI and H_2 gas evolution from high redshift to low redshift.
2. SFR density profile and HI density profile for individual galaxies and their evolution.
3. Predictions for ongoing and future projects.
4. Dependance on evironment.

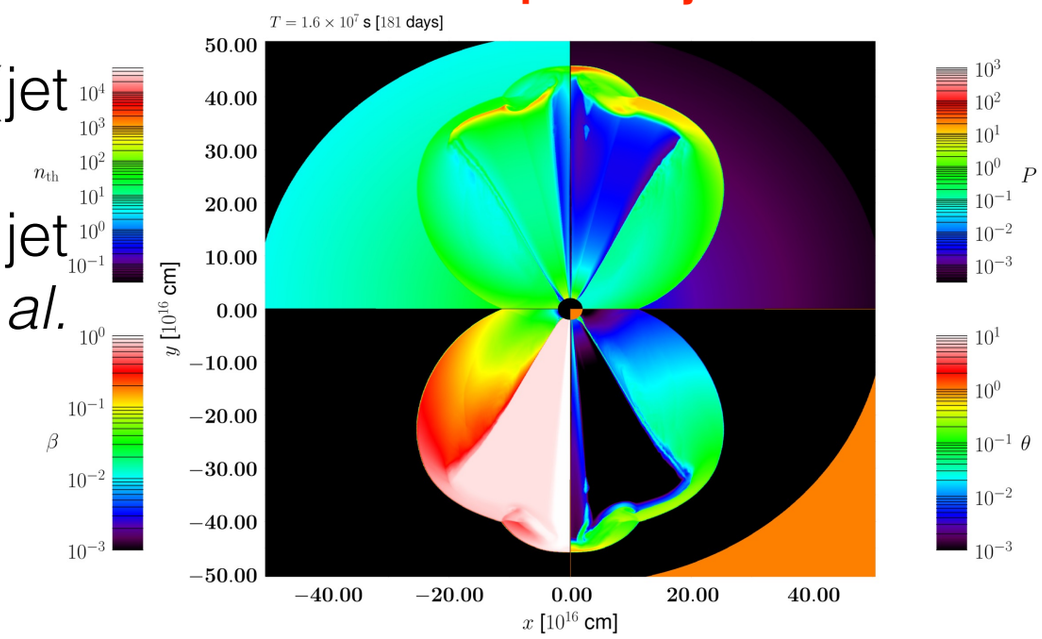
.....

Simulations of Swift J1644+57 jet dynamics and emission

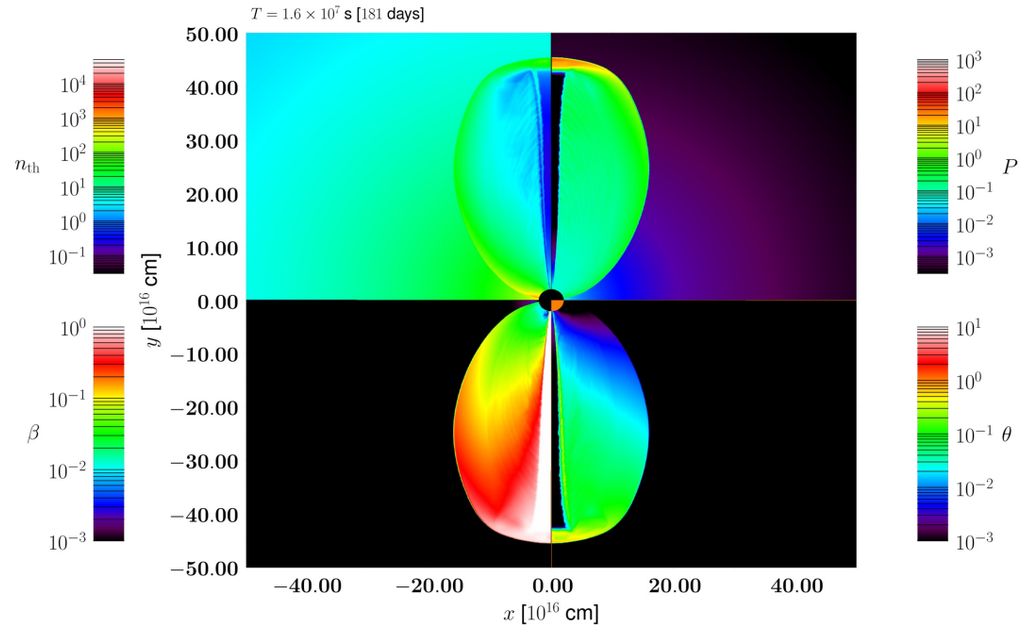
- Source: GRB110328 / Swift J1644+57
- jet launched after a tidal disruption event,blazar-like (jet pointing directly towards us)
- radio emission from a powerful two-component jet expanding into circumnuclear medium (Mimica *et al.* 2015)



two-component jet



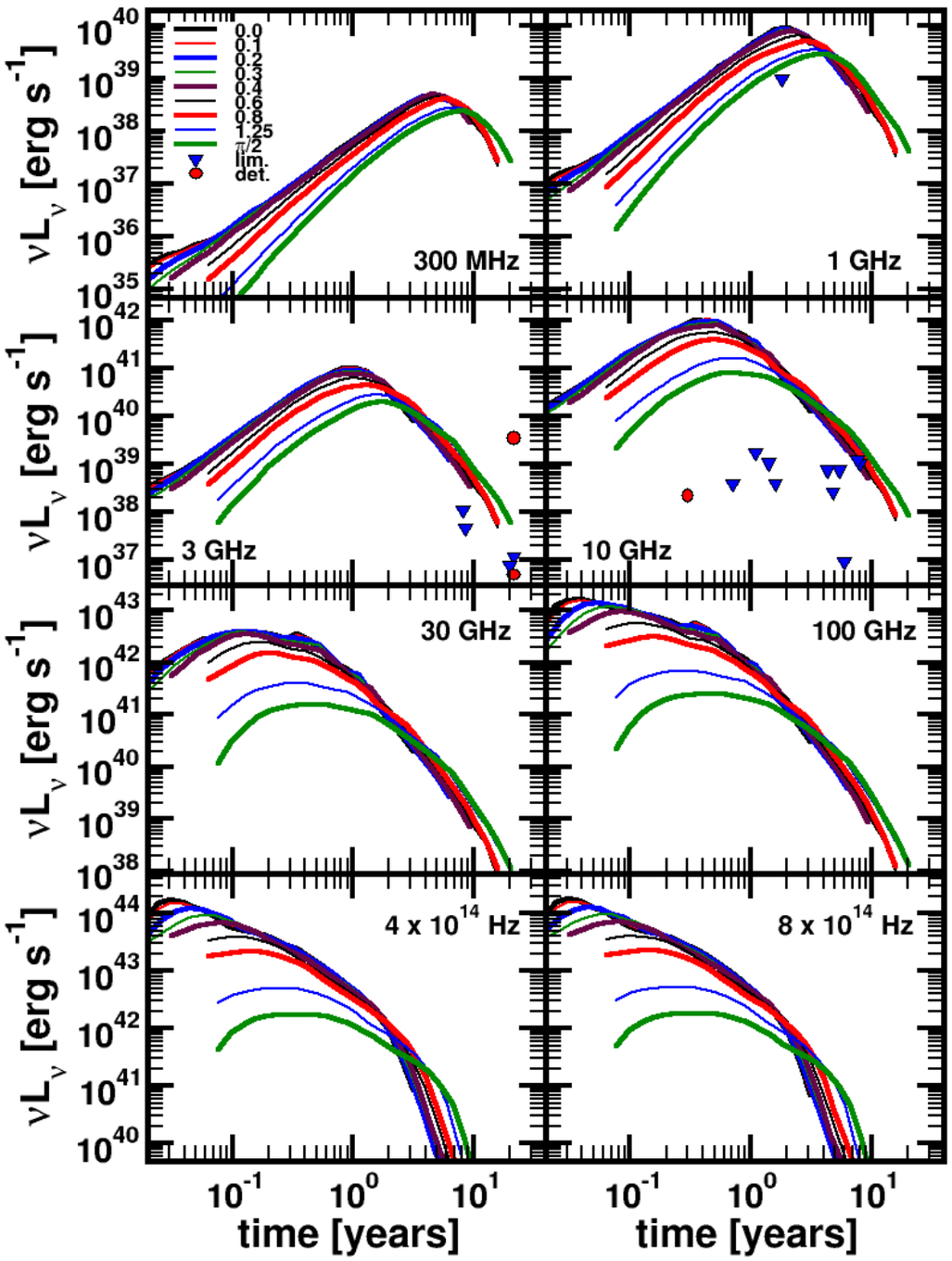
single-component jet

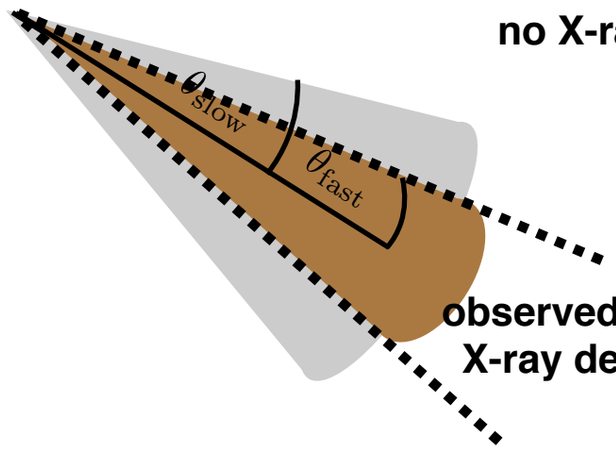


2D axisymmetric relativistic hydrodynamic simulations: *MRGENESIS* (Mimica et al. 2009 A&A 494, 879)
Time- and frequency-dependent radiative transfer: *SPEV* (Mimica et al. 2009 ApJ 696, 1142)

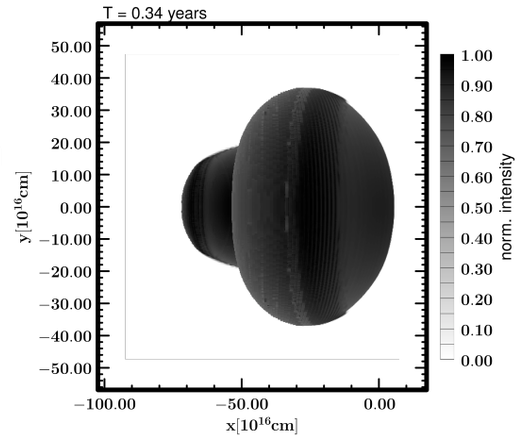
Off-axis emission and its implications for future radio detections

light curves of the same jet seen at different angles

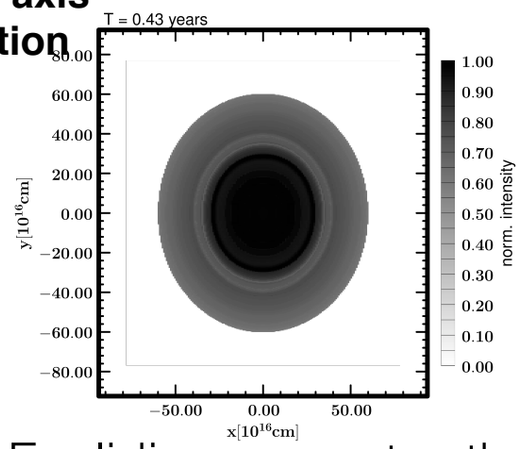




observed off-axis
no X-ray detection



observed on-axis
X-ray detection



Using a simple model and Euclidian geometry, the number of sources that a survey with limiting sensitivity F_{lim} can detect:

$$N_{\rm obs} = \frac{4\pi}{3} R_{\rm jTDE} f_{\rm sky} \Delta t D_0^3 \left(F_0/F_{\rm lim}\right)^{3/2}$$

Assuming $D_0=10^{28}$ cm and $F_0=0.2$ mJy we estimate at 1GHz:

$$N_{\rm obs} \approx 27 \left(\frac{R_{\rm jTDE}}{1{\rm Gpc}^{-3}{\rm yr}^{-1}}\right)\left(\frac{f_{\rm sky}}{0.25}\right)\left(\frac{\Delta t}{3{\rm yr}}\right)\left(\frac{F_{\rm lim}}{0.5{\rm mJy}}\right)^{-3/2}$$

Conclusion: tens of off-axis J1644-like events could be detected on a timescale of a few years

B1834+620: a restarted AGN seen by LOFAR

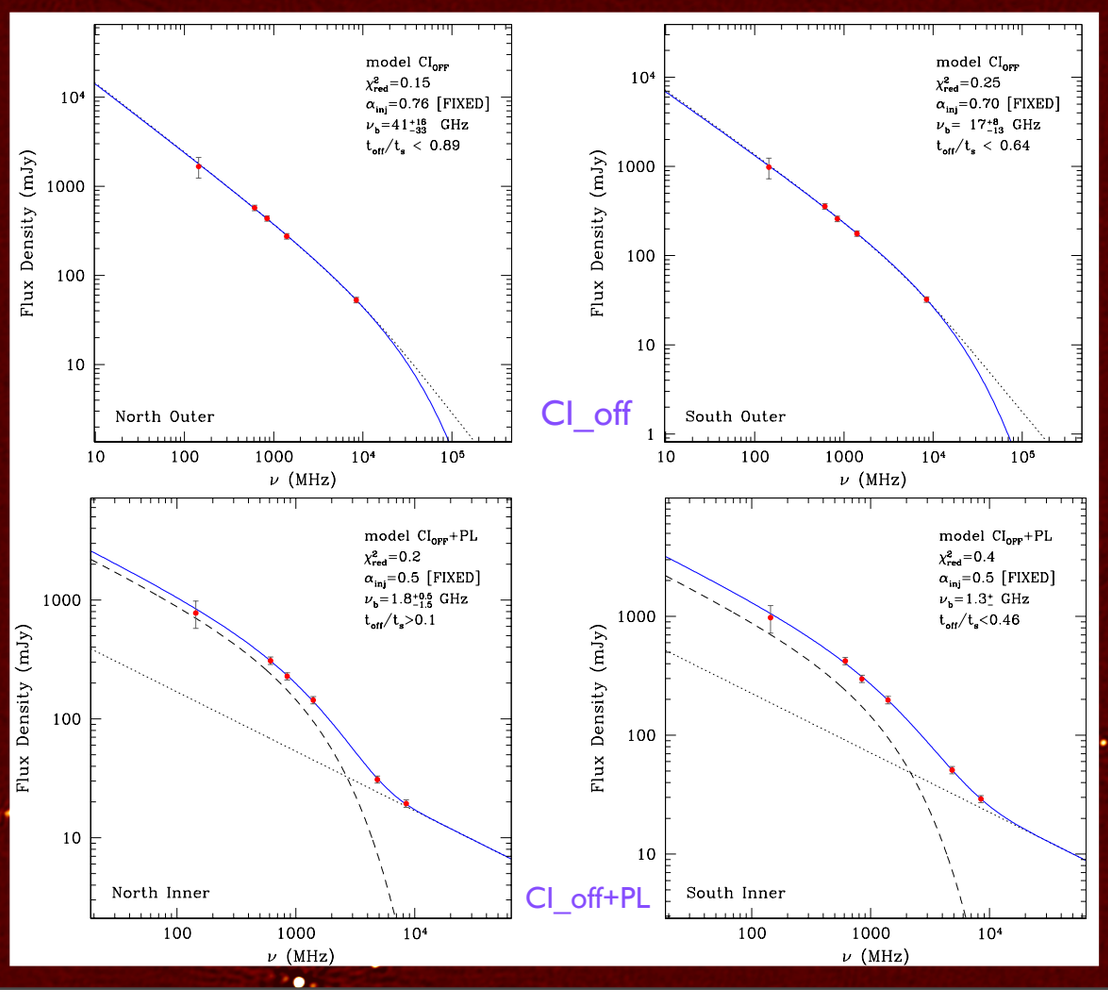
Emanuela Orru'
email: orru@astron.nl

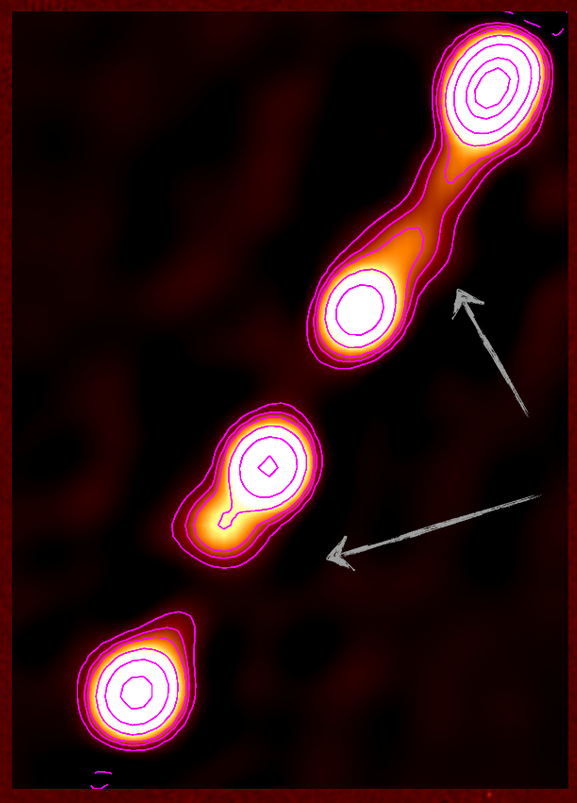
HBA freq. ~ 140 MHz

rms=1.2 mJy/beam

res=19"X18"

- no detection of the core (GPS)
- 4 components resolved
- new features elongation of inner lobes
- South-inner misalignment of elongation w.r.t the outer lobe

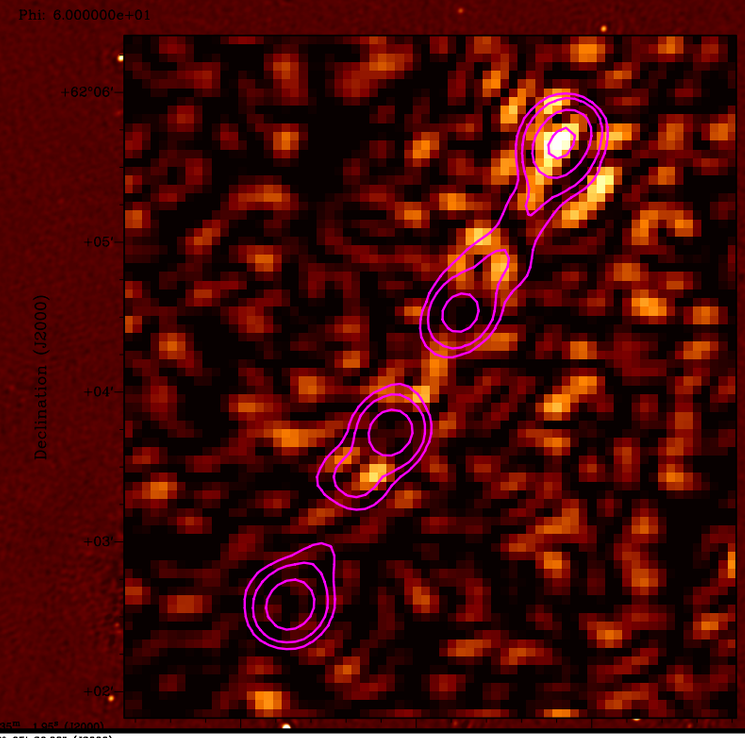


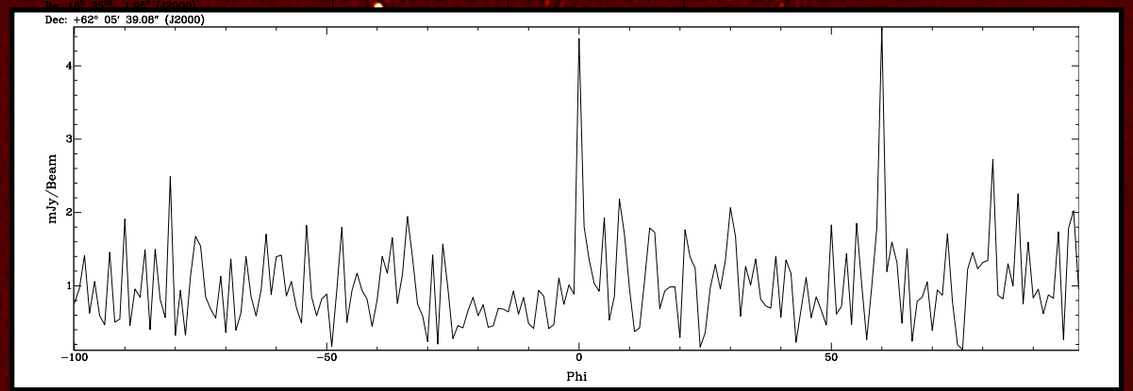


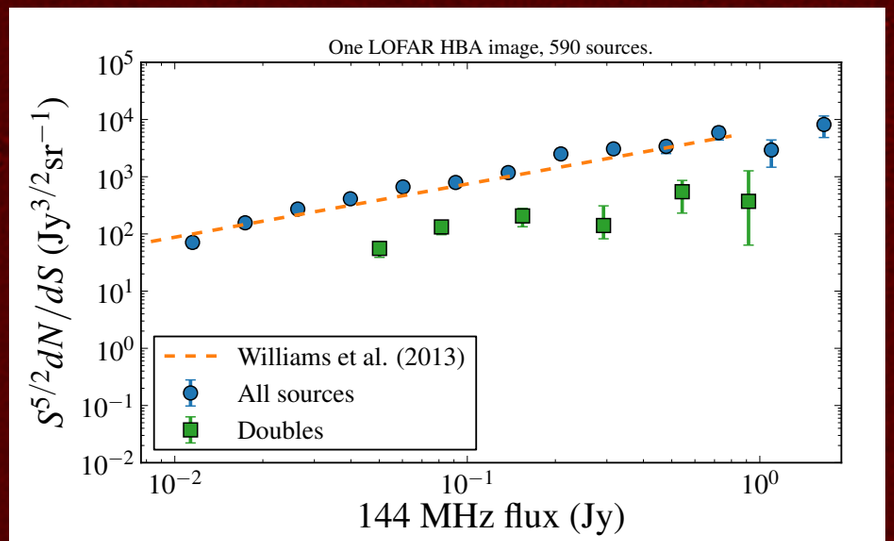
New features of low brightness emission. Spectral studies suggest due to a previous jet activity.

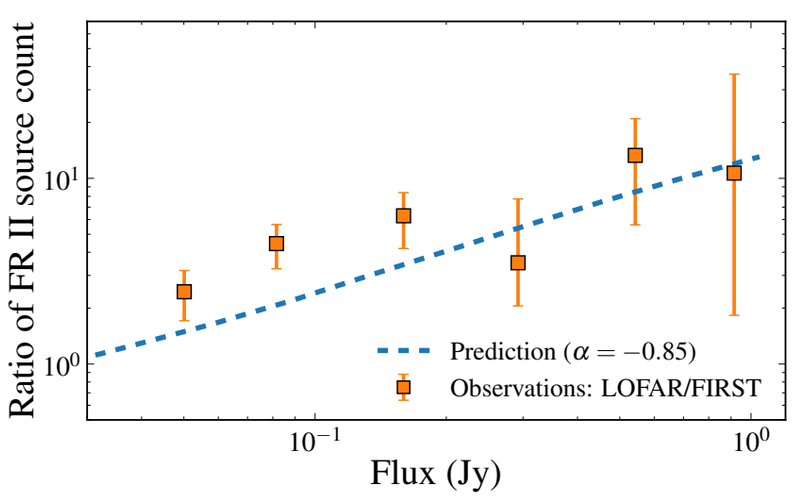
Polarization:

- To study the IGM properties.
- Detection lower than expected due to various reasons: ionosphere, calibration ...
- confirmed the RM of 60 rad m m found at hight frequencies.







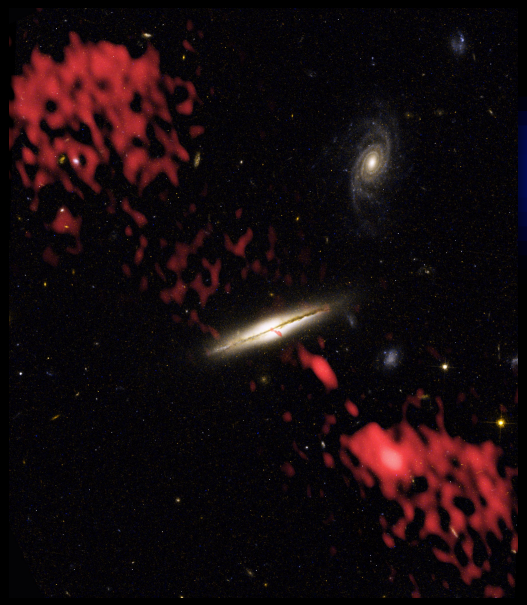


Source counts:

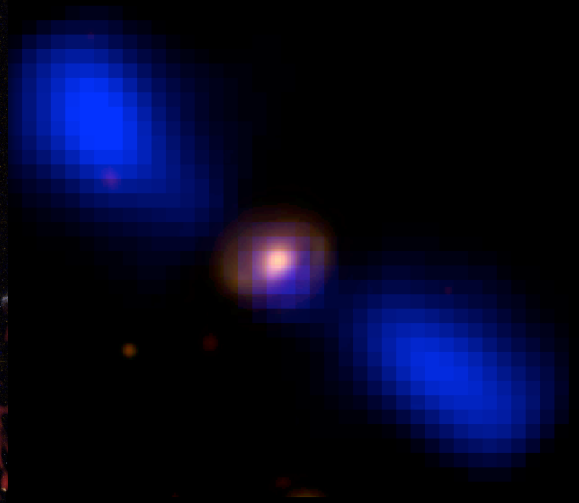
- More than 1000 sources were detected.
- The analysis of the areal density: no deviations from a single power- law are observed. A single population dominates our sample.
- 46 candidate FR-IIs (double lobed sources).
- For a given flux density limit, the areal density of the “doubeltjes” exceeds the density of these sources at 1.4 GHz by a factor of ~ 10.

Here be spiral dragns

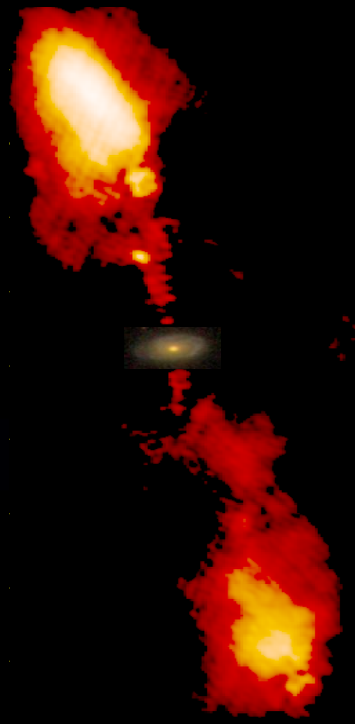
Minnie Yuan Mao, JIVE Support Scientist
* mao@jive.eu



0313-192
Keel et al. 2006



J1649+2635
Mao et al. 2015



J2345-0449
Bagchi et al. 2014

In Search of Erupting Black Holes

Help astronomers discover supermassive black holes observed by the KG Jansky Very Large Array (NRAO) and the Australia Telescope Compact Array (CSIRO)

Search for Black Holes

Black holes are found at the center of most, if not all, galaxies. The bigger the galaxy, the bigger the black hole and the more sensational the effect it can have on the host galaxy. These supermassive black holes drag in nearby material, growing to billions of times the mass of our sun and occasionally producing spectacular jets of material traveling nearly as fast as the speed of light. These jets often can't be detected in visible light, but are seen using radio telescopes. Astronomers need your help to find these jets and match them to the galaxy that hosts them.

Begin Hunting

NASA, ESA, S. Baum and C. O'Dea (RIT), R. Perley and W. Cotton (NRAO/AUI/NSF), and the Hubble Heritage Team (STScI/AURA)