SHART

Search for HI absorption with APERTIF

RadioLife group (partly supported by ERC):

Raffaella Morganti, Filippo Maccagni, Tom Oosterloo, Bjorn Adebahr, Brad Frank, Nicolas Vilchez, Robert Schultz, Suma Murthy (PhD)

Elaine Sadler (PI FLASH), James Allison, Vanessa Moss, Elizabeth Mahony

Neeraj Gupta (PI MALS)

RadioLife

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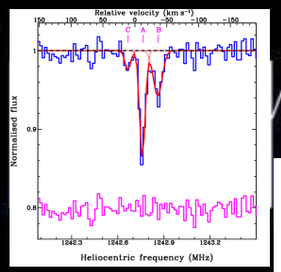
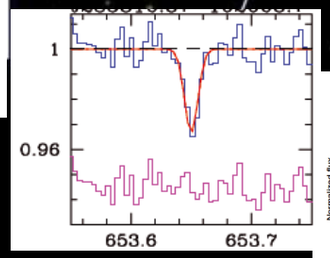
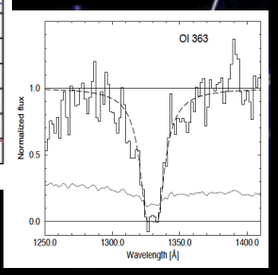
Tracing HI with absorption: intervening and associated

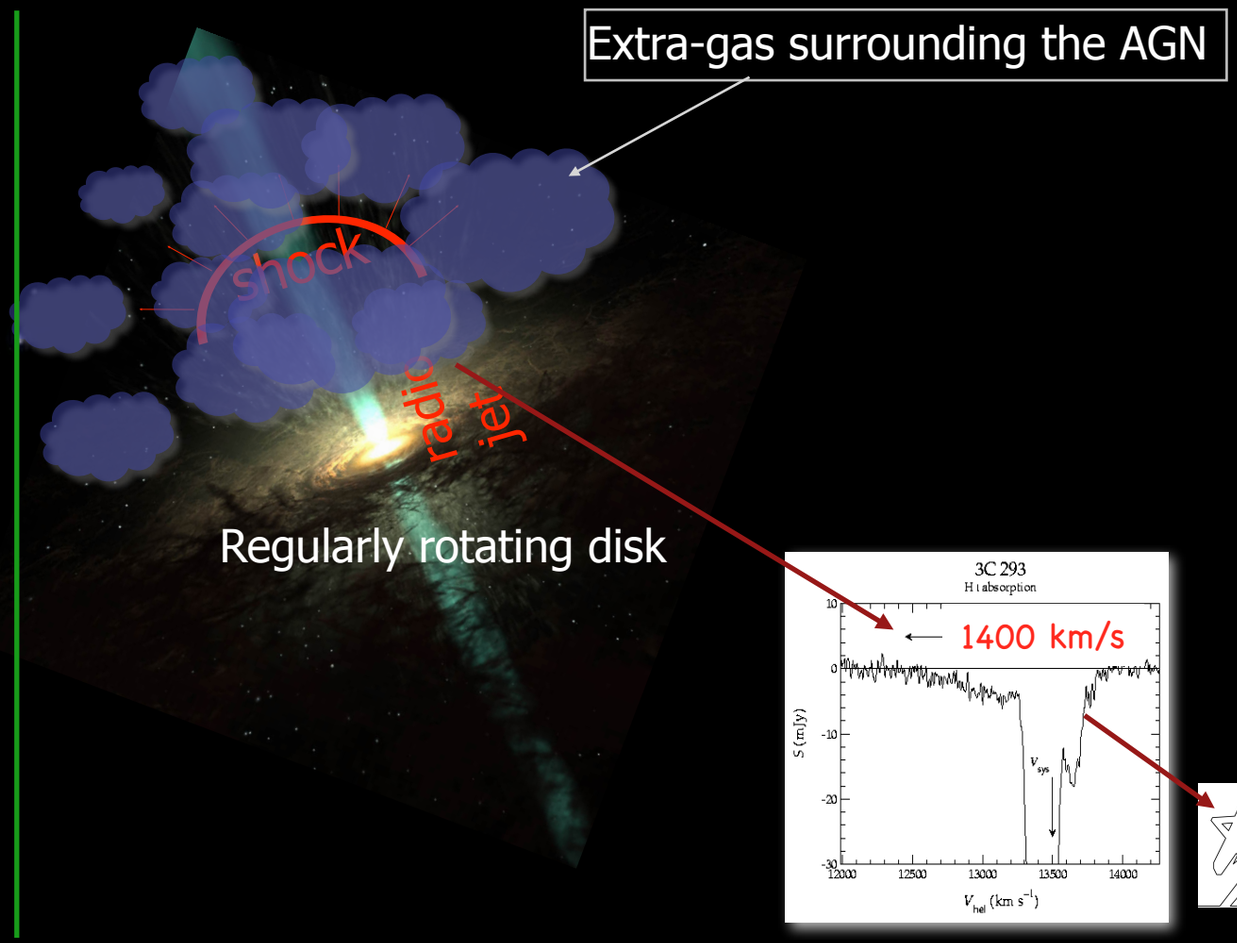






Tracer of *cold* neutral hydrogen in the distant universe, can detect and
probe gas within **normal** galaxies out to very high redshift:

- *Typical size and mass of galaxies as function of redshift ➜ test galaxy formation scenarios*
- *Evolution of neutral gas content with redshift ➜ explore relation HI content and SFR*



Tracer of the gas in the inner parts of the galaxy close to AGN

- *Tracer of circumnuclear disks*
- *Infalling gas ➜ feeding*
- *Outflowing gas ➜ feedback*

Plans for SHARP

- Piggyback from all Apertif surveys
  (maybe also from observations with poor imaging performances, i.e. during “transients” configuration or with no full-12h tracks => mode transient&imaging simultaneously)

- **“Blind” unbiased search →** extract spectrum for every continuum sources

  → *shallow survey (12h each pointing), coverage to z=0.26 and noise ~0.5 mJy/b chan width 30 km/s => down to at least 10 mJy → optical depth* $\tau \sim \Delta S_{abs}/S_{cont} = 0.15\ (3\sigma)$ *interesting also for stacking*

  → *medium-deep survey will be used to explore a new parameter space: low HI optical depth and/or HI in low power sources*

  - Cubes and continuum spatial res 15”
  - Velocity 2.4 km/s but we will smooth the extracted spectra to lower resolution (~15 km/s)

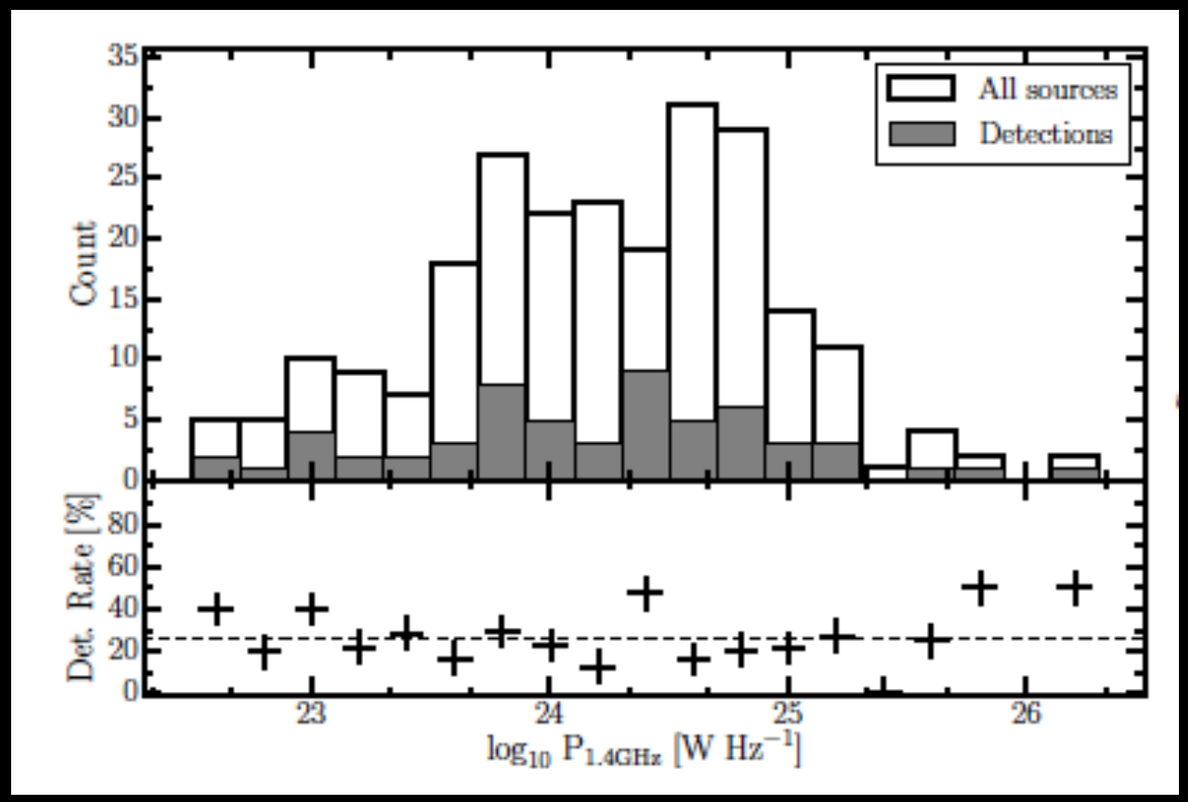
Advantages and disadvantages of SHARP

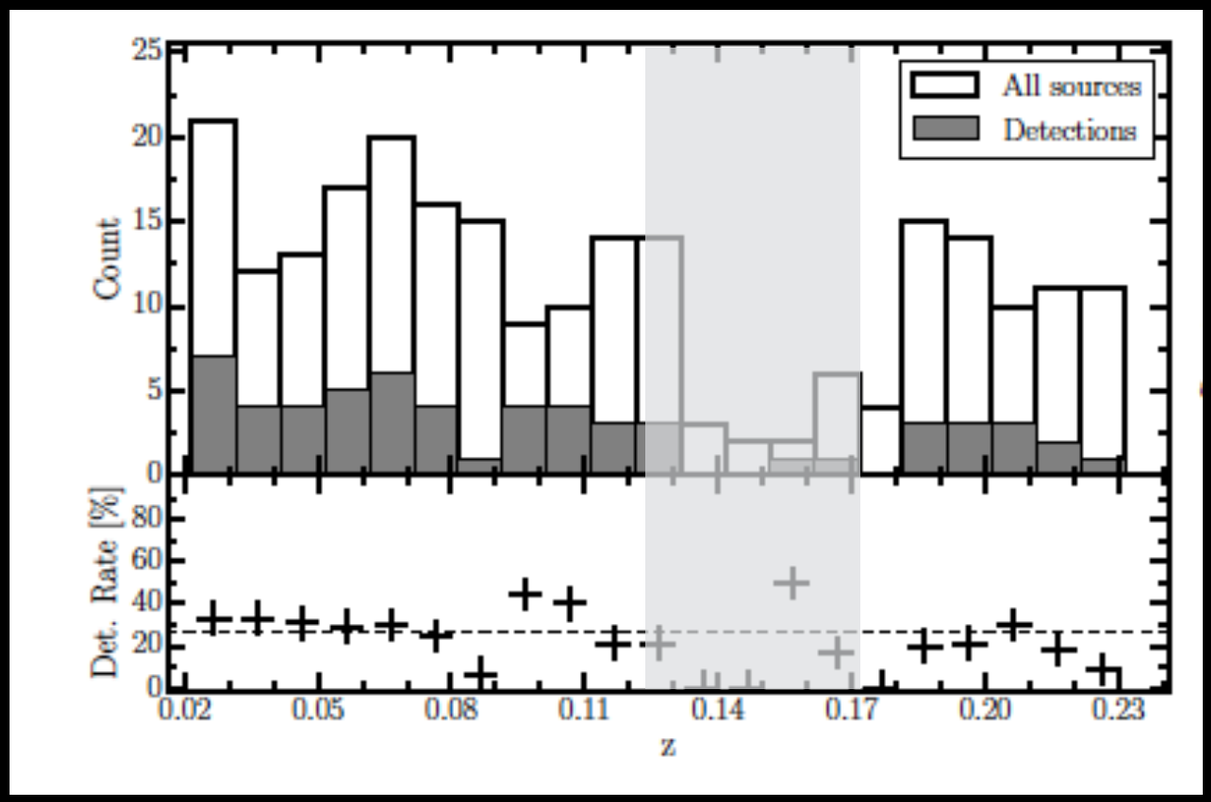
- Apertif covers only low redshifts
- Impact of RFI

Work done as preparation for Apertif:

WSRT surveys *(Gereb et al. 2014, 2015 Maccagni et al. 2017)*

HI detections at all radio powers (also low power) and all redshifts





Relevant for quantifying the impact of RFI

(Maccagni et al. 2017)

Advantages and disadvantages of SHARP

+ Availability of SDSS for optical identifications (and WEAVE coming up)

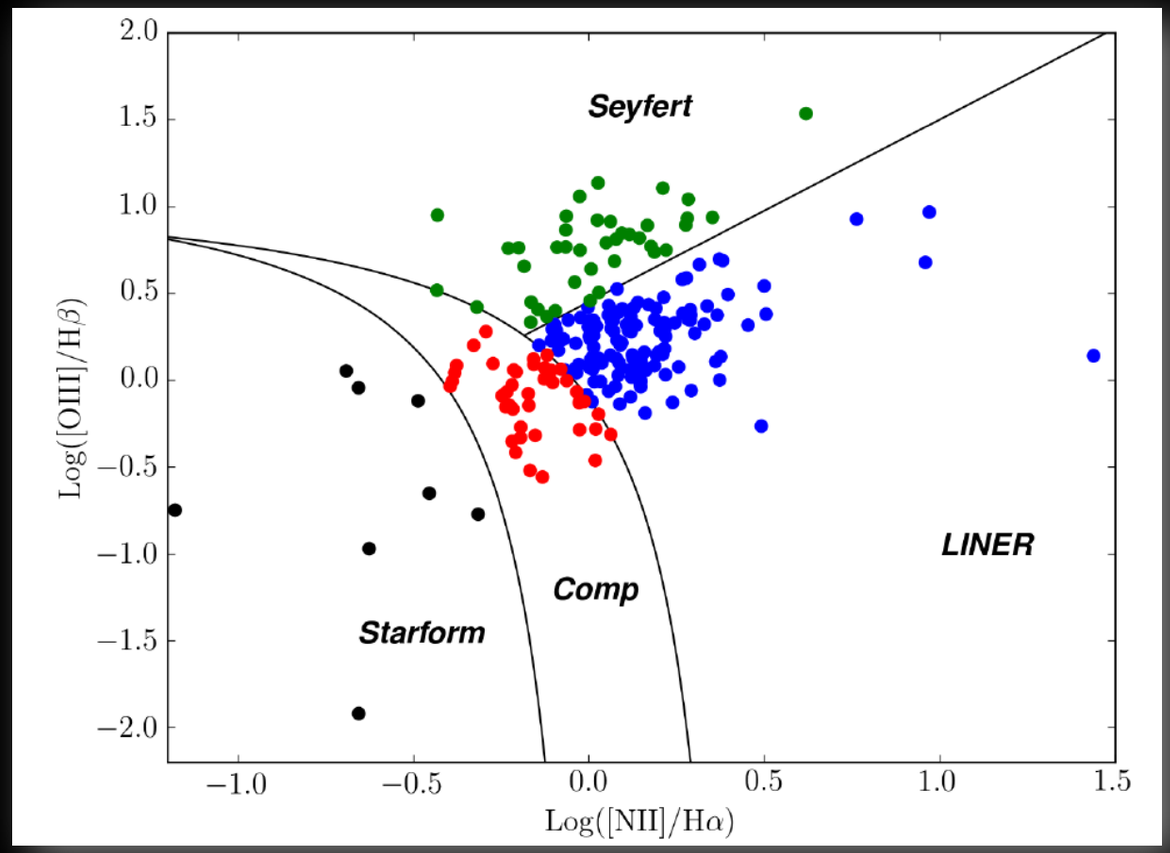
+ Synergy with LOFAR

+ VLBI network (including eVLBI) for follow up

IMPORTANCE of SDSS

- Very important for associated absorption:
  searching sources at low radio flux means many more identifications

On 4000 sq deg > 10 mJy: ~1500 sources
> 5 mJy: ~3000 sources
(compared to the 248 from Filippo's sample)

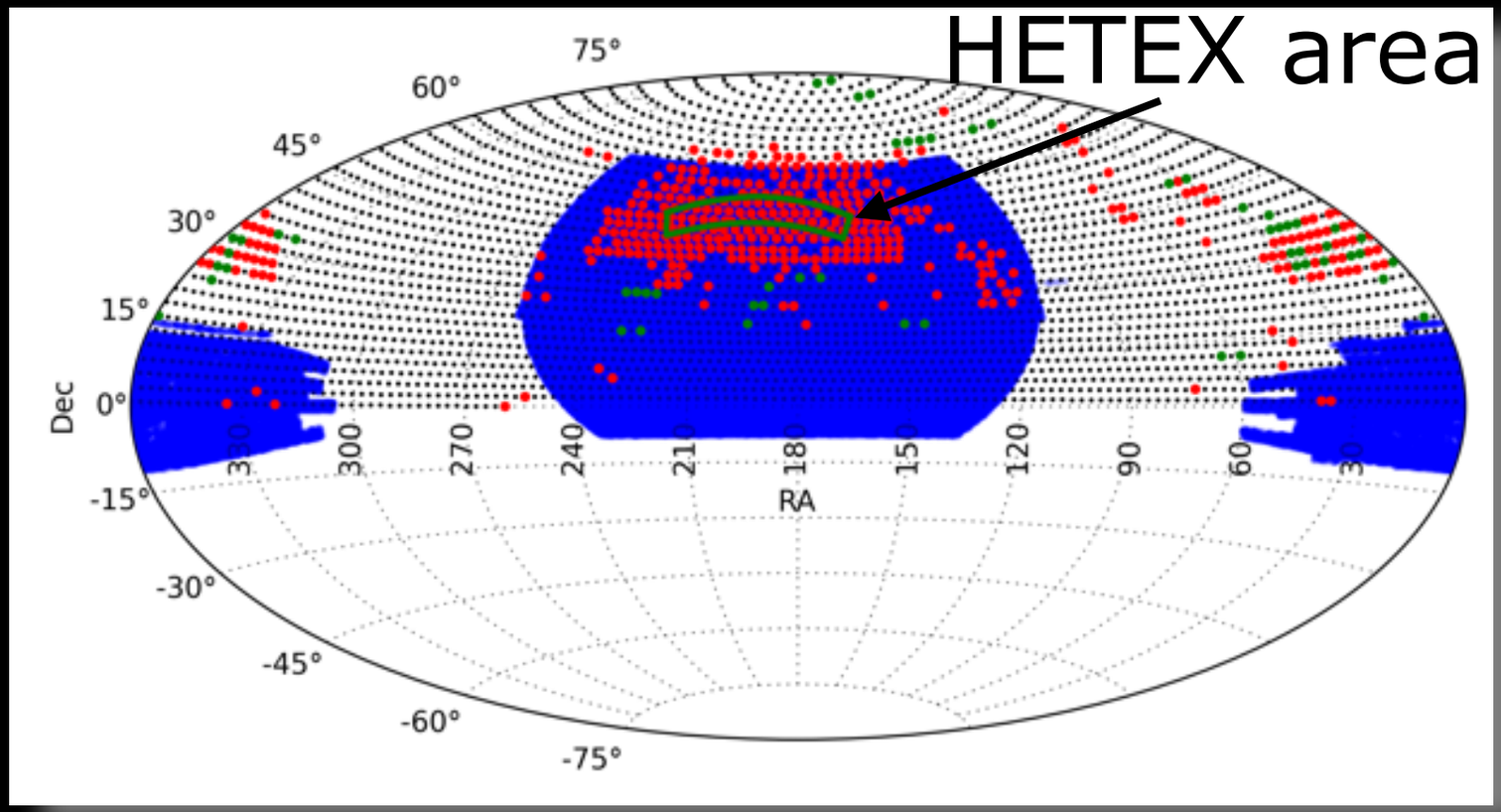


Santoro et al. in prep

SYNERGY WITH LOFAR

LoTSS - Tier 1

Shimwell et al. 2017
The LOFAR Two-metre Sky Survey. I. Survey description and preliminary data release.



the blue region is FIRST, the green box is the HETDEX Spring Field, t
he red dots are observed and the green dots are scheduled

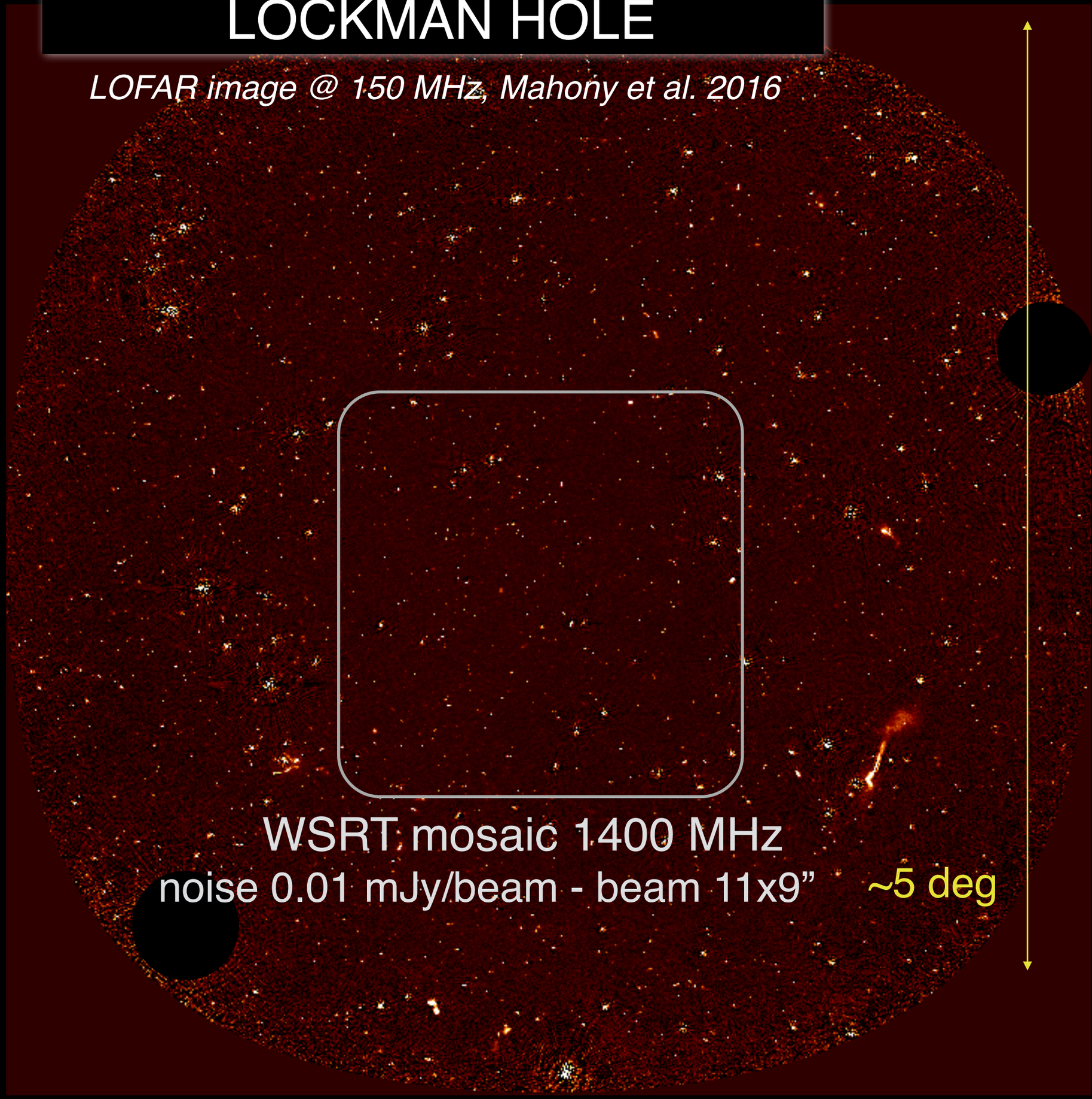
All-sky @ 150 MHz (HBA)
48 MHz bandwidth
~0.3 mJy noise
5 arcsec resolution

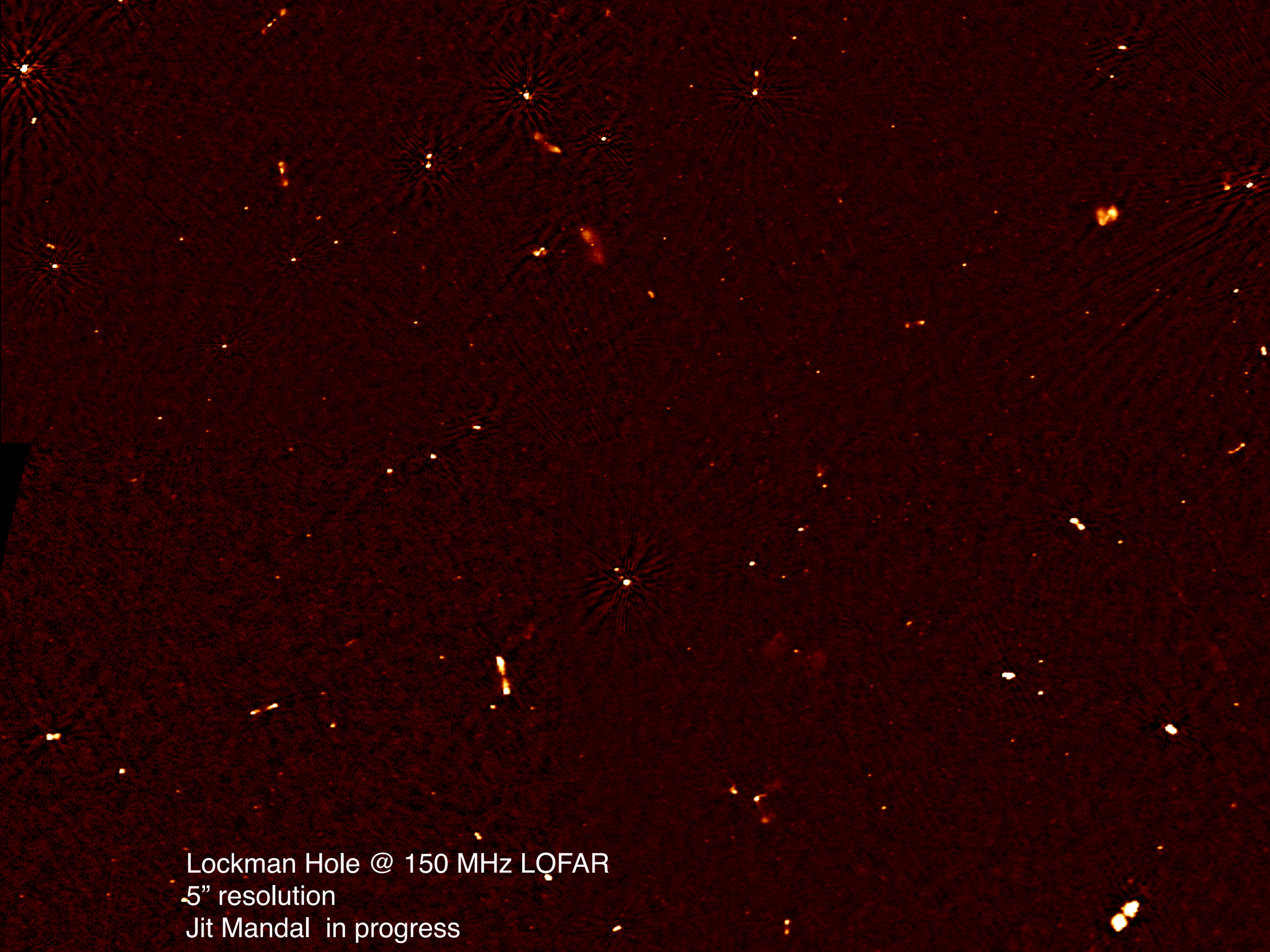
Survey at 60 MHz also in progress

LOCKMAN HOLE

LOFAR image @ 150 MHz, Mahony et al. 2016

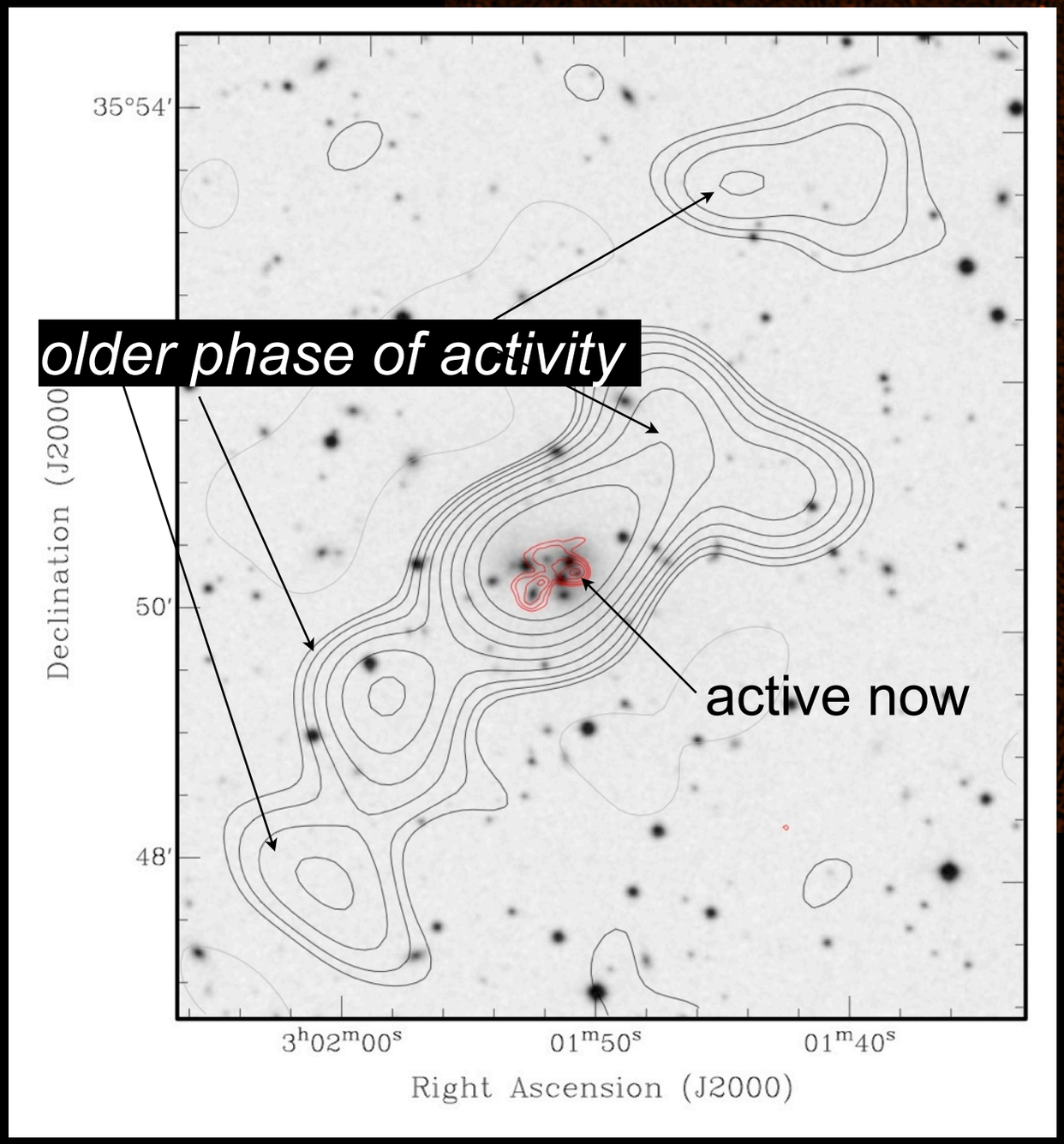
- HBA observation (110-180 MHz)
- 70 MHz bandwidth (300 subbands)
- 10 hrs int. time
- 14”x18” resolution
- rms~0.15 mJy
- about 6000 sources

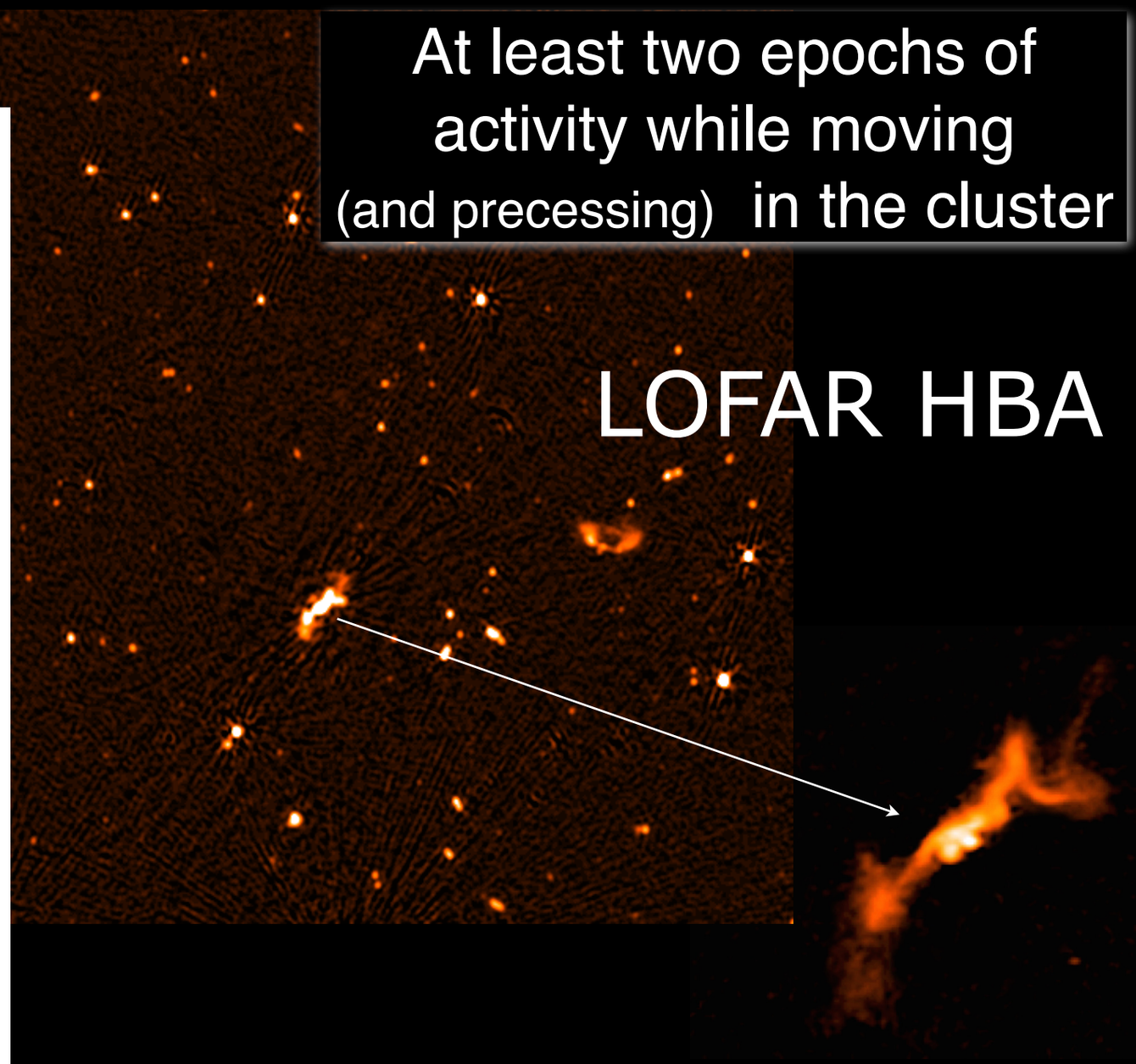



Lockman Hole @ 150 MHz LOFAR
5” resolution
Jit Mandal in progress

SYNERGY WITH LOFAR

At least two epochs of activity while moving (and precessing) in the cluster



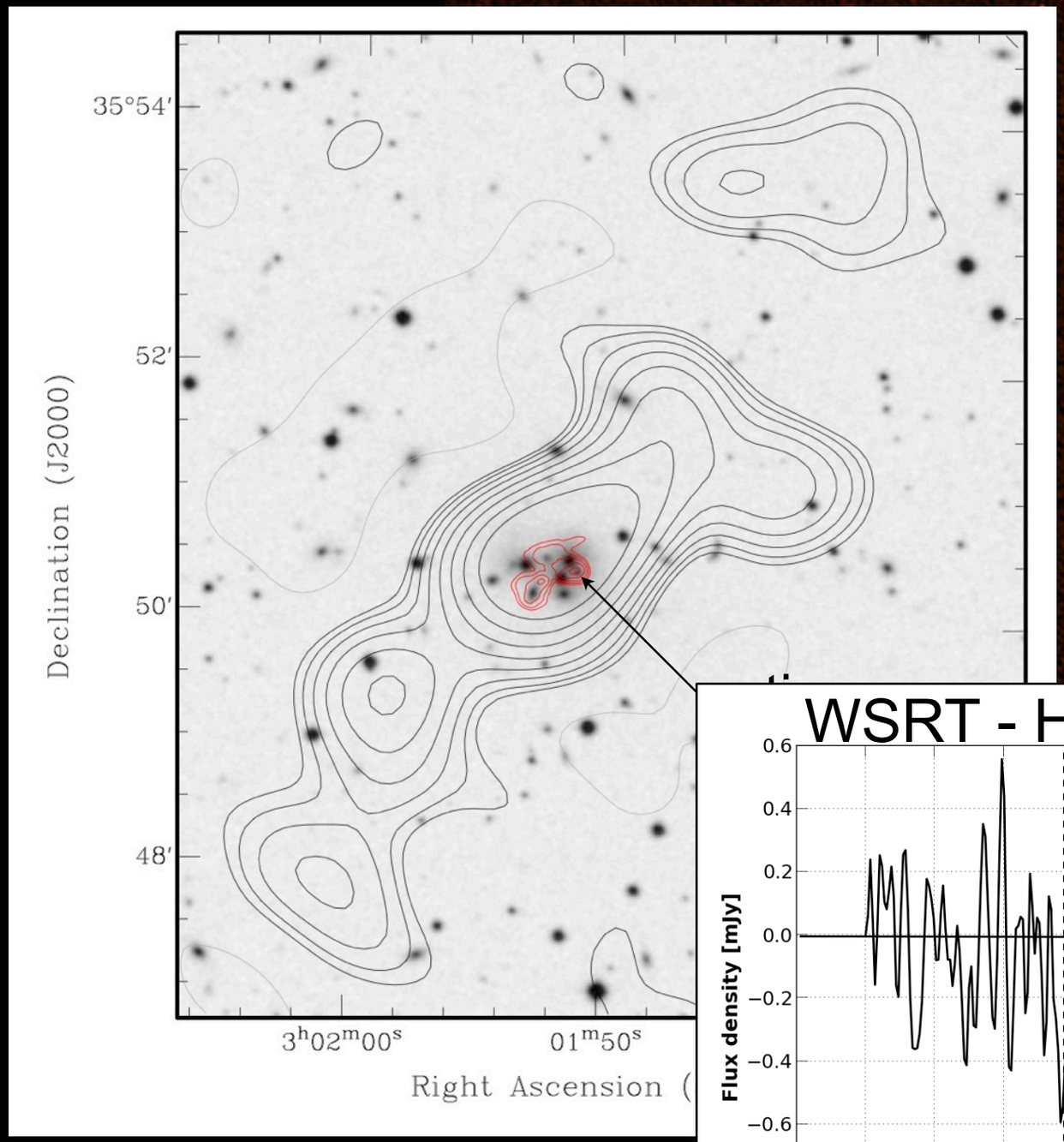


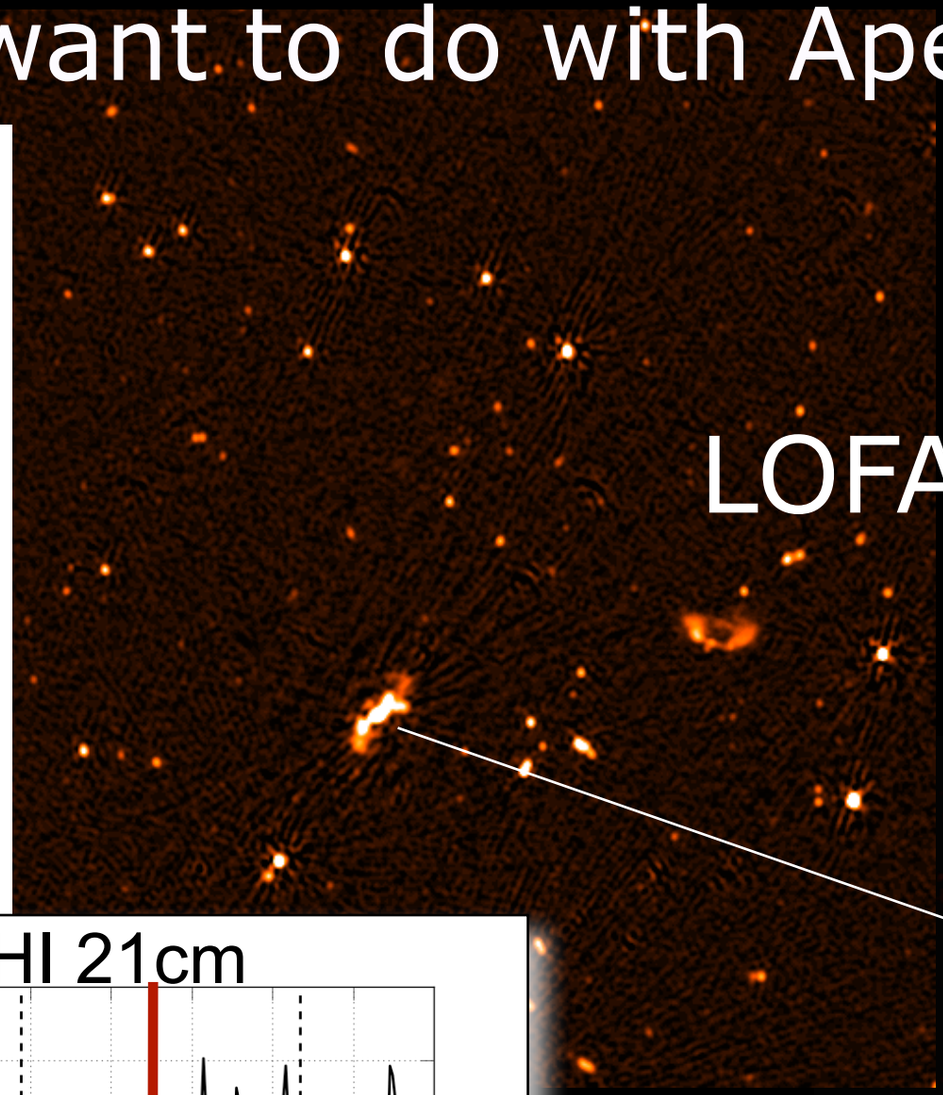
4C35.06

Shulevski et al. (2015)

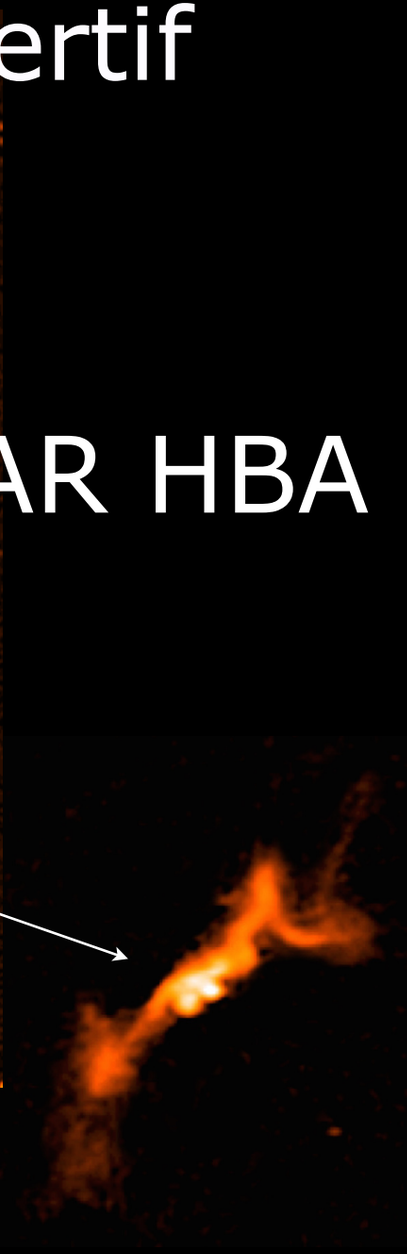
SYNERGY WITH LOFAR

Test case for what we want to do with Apertif





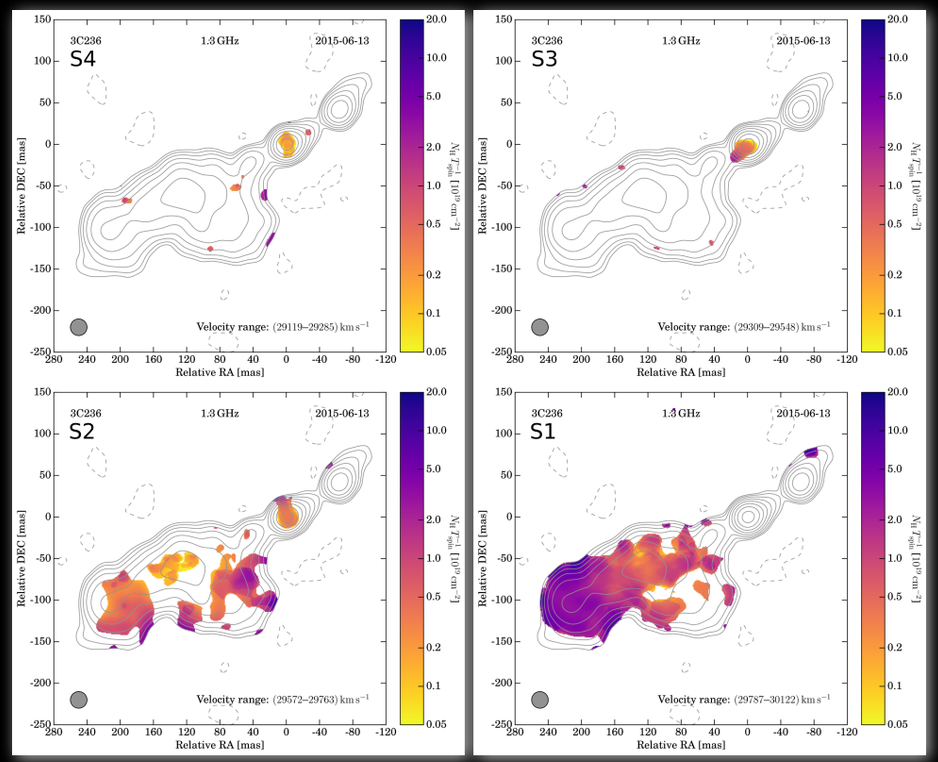
LOFAR HBA



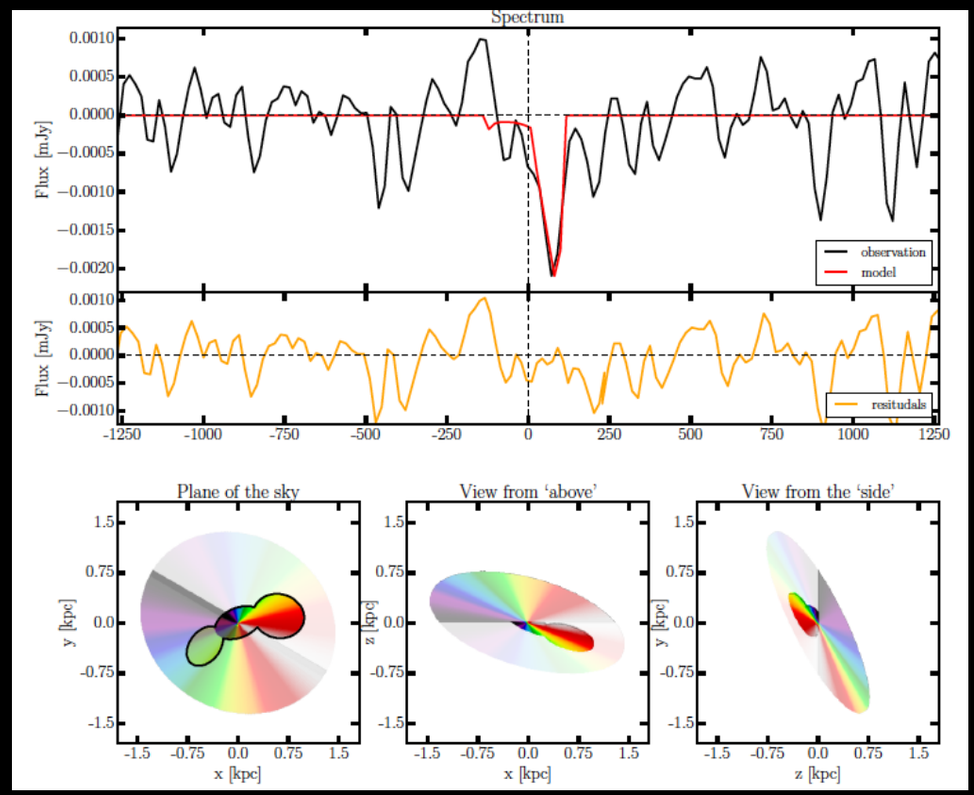
Shulevski et al. (2015)

VLBI follow-up

- Possibility of follow up the continuum structure with eEVN
  → combined with Filippo's modelling
- see talk Robert



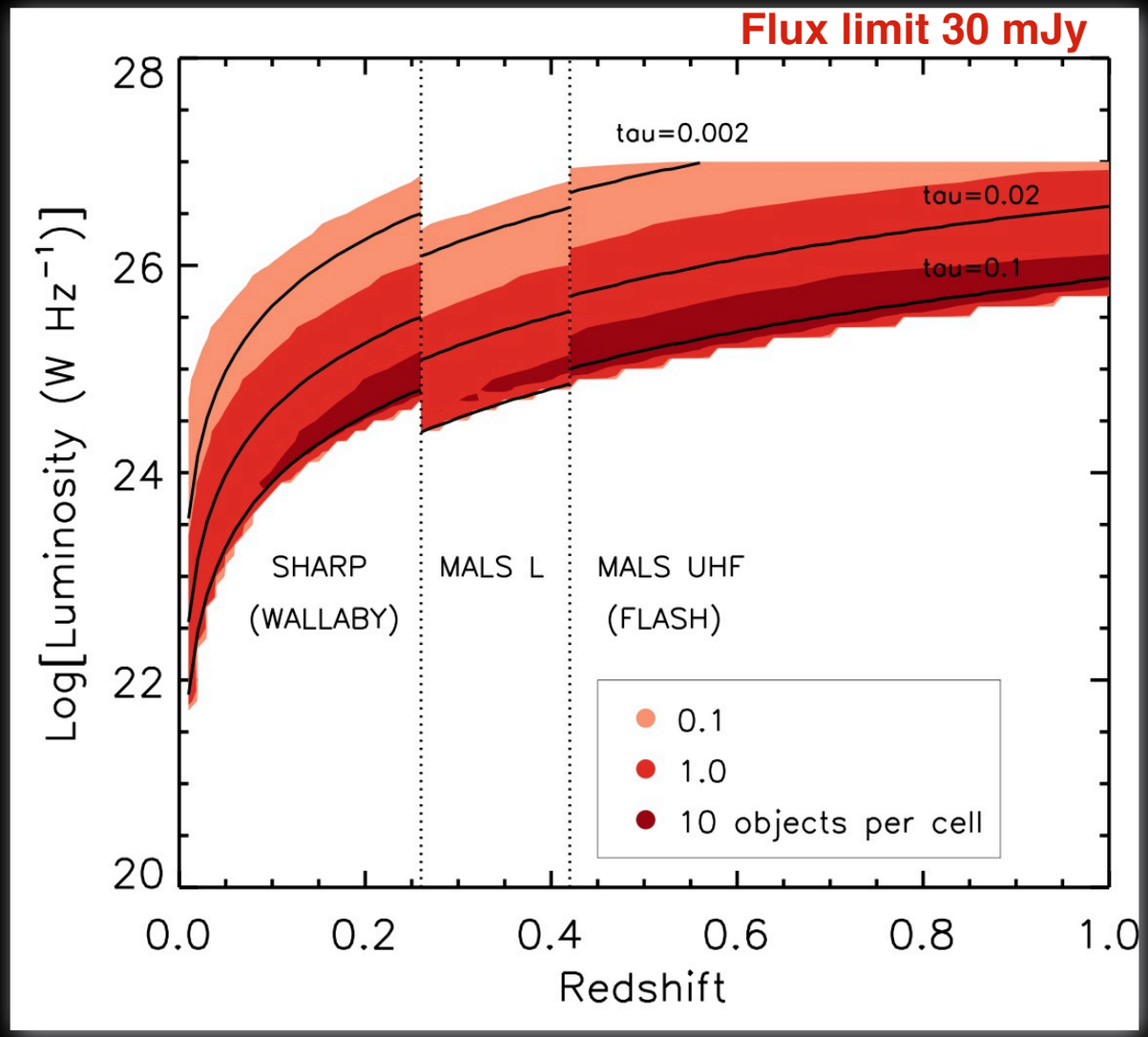
Schulz et al. in prep.



Maccagni et al. in prep.

Synergy with the other surveys for associated absorption

from Natasha Maddox (Maccagni et al. 2016)
see also Maddox et al. 2016



Luminosity function Mauch & Sadler 2007
Source number counts from Wilman +08

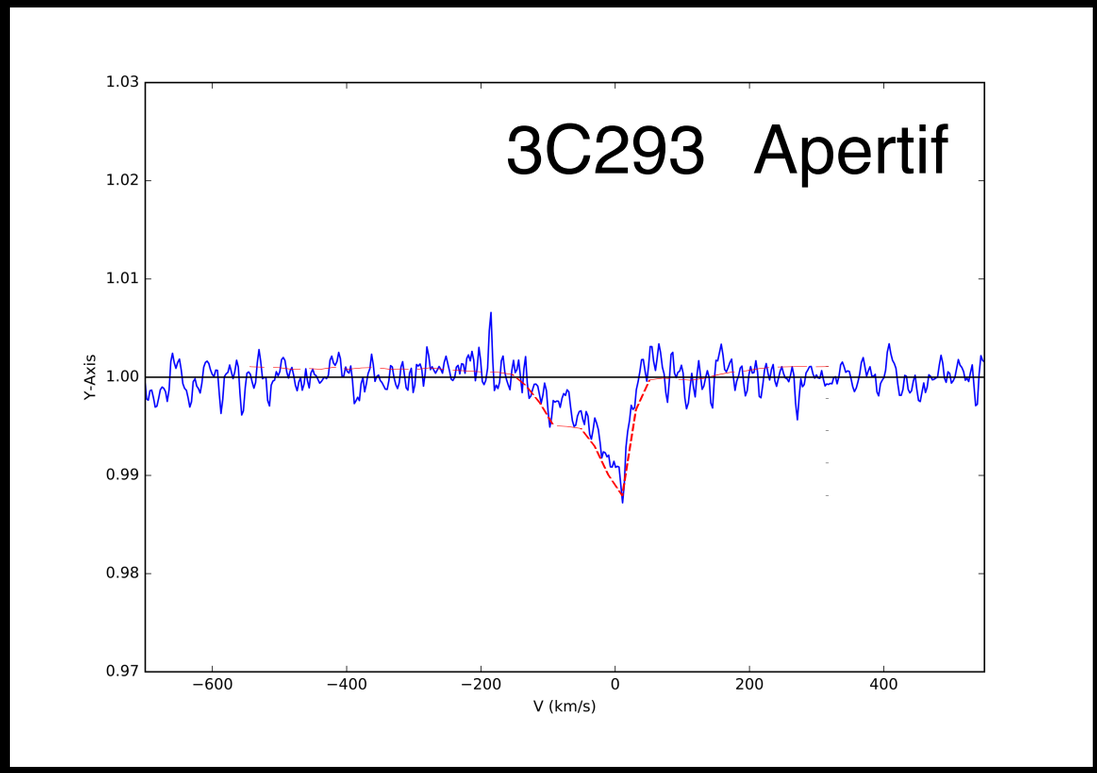
- Show the complementarity of the surveys
- Exploring low power sources only with the low redshift surveys important when comparing results from different surveys/samples

Are we ready for the surveys?

ready for commissioning surveys but not yet to exploit full surveys

- extra effort for RFI flagging
- scripts (Filippo & James) for extraction of spectra, automatic detection of absorption, characterisation of lines => needs to be integrated as pipeline
- optical identification and link to ancillary data, stacking (script available but …)
- database and final products needs to be stored (and available to the community)

What next?



Some targets that could be interesting during science commissioning :

- Test stability of the system, possibility of detecting broad, shallow absorption (stability 10^4) ➔ 3C293, 3C236, 4C12.50 etc.
- Repeat objects with available absorption: from Filippo's database
- Targets in which we can look for possible changes (NGC315, Mrk231 etc.)
- Major mergers with extremely broad absorption

- Early science: famous fields (on the Sloan and on LOFAR? e.g. Lockman Hole) in which we can check our scripts and routines including stacking.