Sensitive wide-field VLBI observations of the COSMOS field

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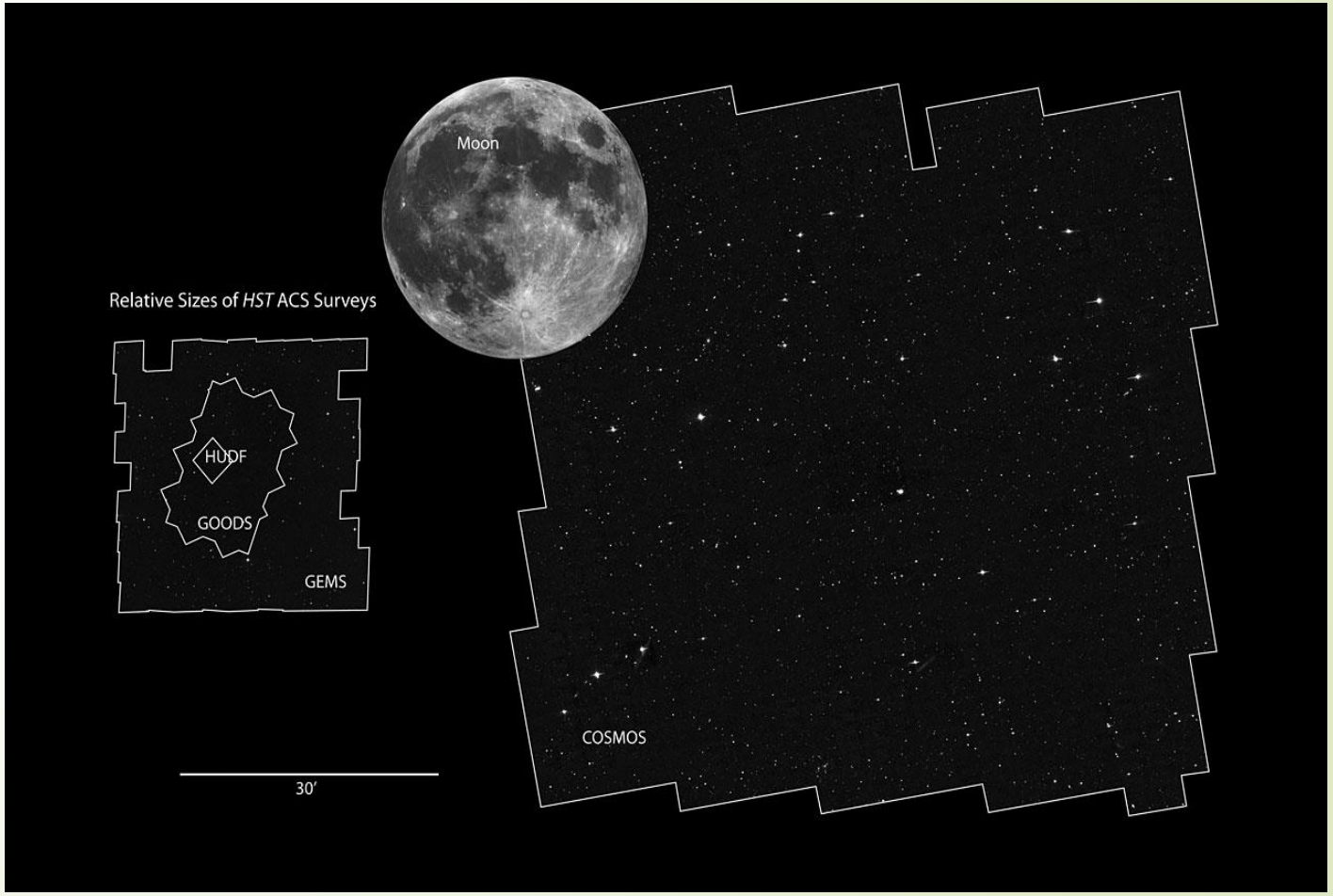


Background

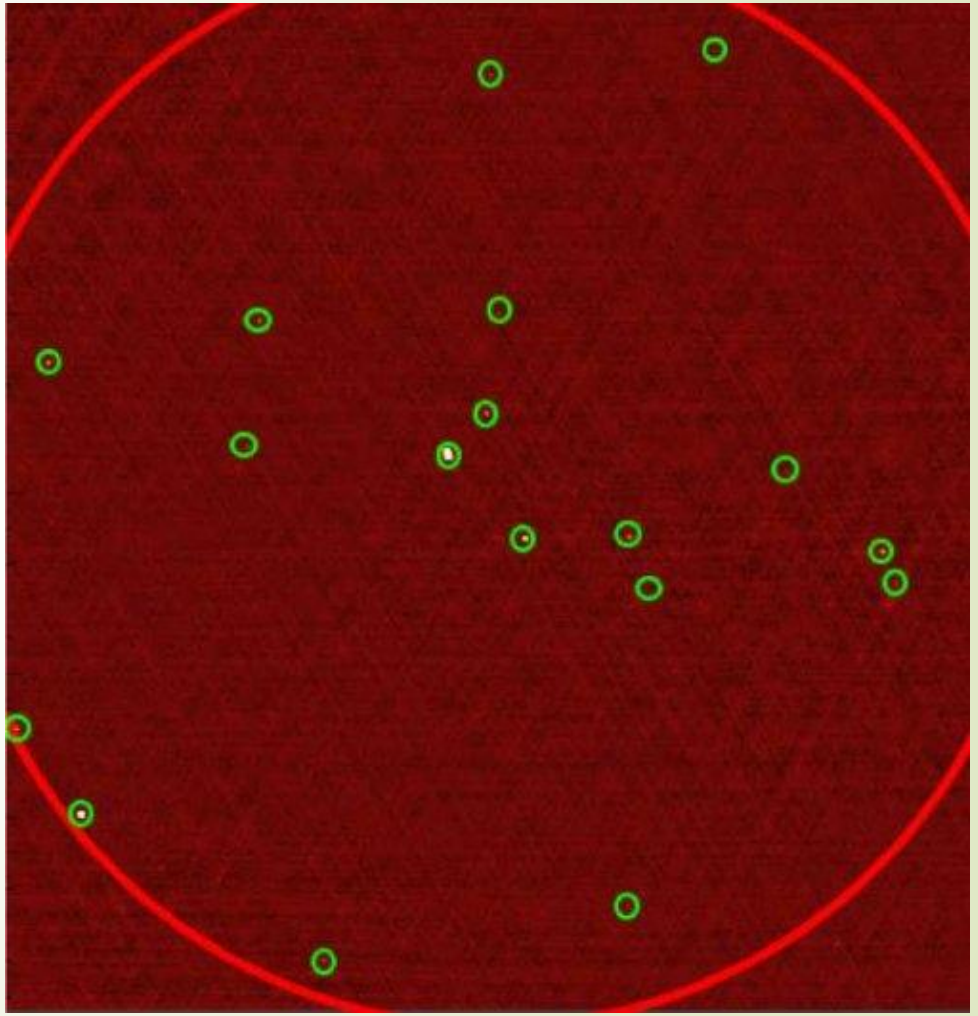
- Identifying AGN is a fundamental key in galaxy evolution and star formation.
- Radio source counts are a tool to measure the incidence of radio-active AGN in large samples of objects.
- Radio-loud AGN dominate at flux densities > 1 mJy.
- Sub-mJy radio sky appears to be a blend of star forming galaxies and radio-quiet AGNs (Smolčić et al. 2008, Padovani et al. 2011).

The project

- Goals of the PhD: Analyse the AGN component in the faint radio population and study the AGN-host-galaxy co-evolution.
- First step: ~ 3000 radio sources were observed in the COSMOS field with the Very Long Baseline Array (VLBA).
- Second step: ~ 200 radio sources were observed in the COSMOS field with maximum sensitivity adding the Green Bank Telescope (GBT) to the VLBA.
- Third step: Determine the AGN radio source count distribution down 25 µJy.

Wide-field VLBI

- Observations using Very Long Baseline Interferometry (VLBI) techniques targeting several objects at one go.
- New method: multiple phase centres in DiFX2.
- A detection in VLBI observations constitutes a radio-active AGN.



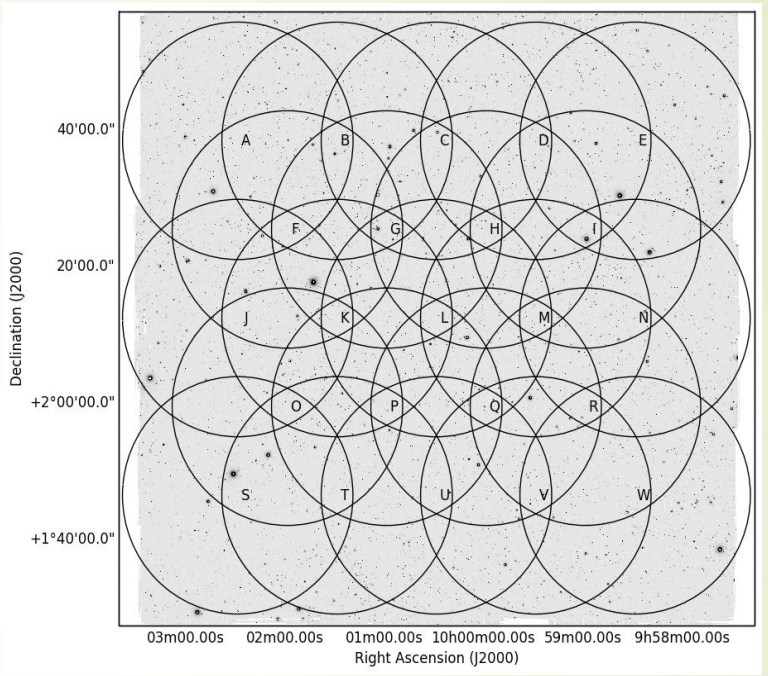
Deller et al. (2011)

Observations

- VLBA data: 23 Pointings
(rms noise 10 µJy/beam)

- VLBA+GBT data: 1 Pointing
(rms noise ~ 3 µJy/beam)

- 1.4 GHz



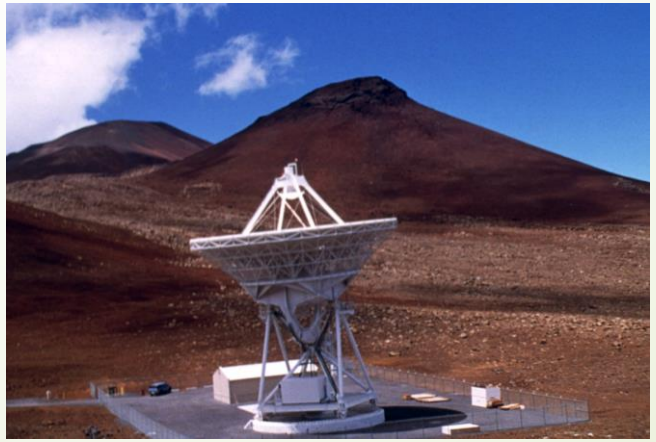
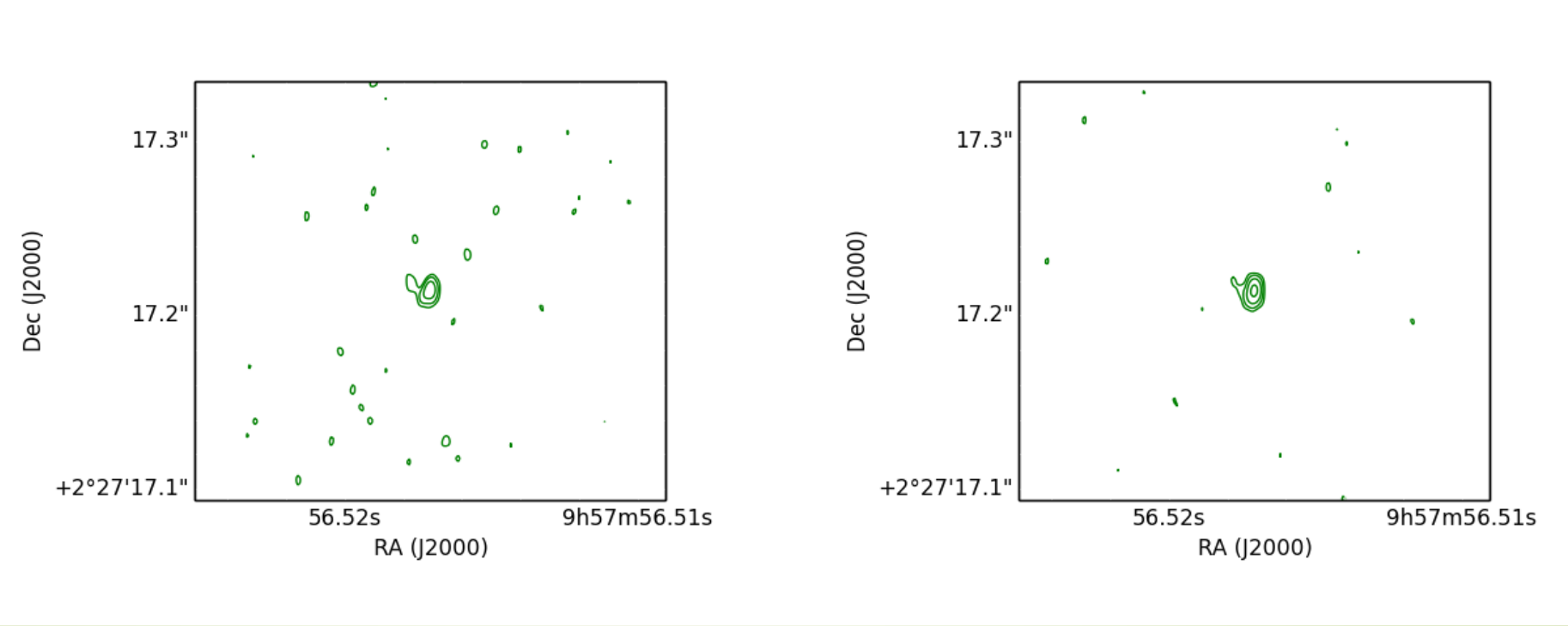


Image courtesy of NRAO/AUI

Credit: NRAO/AUI/NSF

Calibration

- Multi-source self-calibration



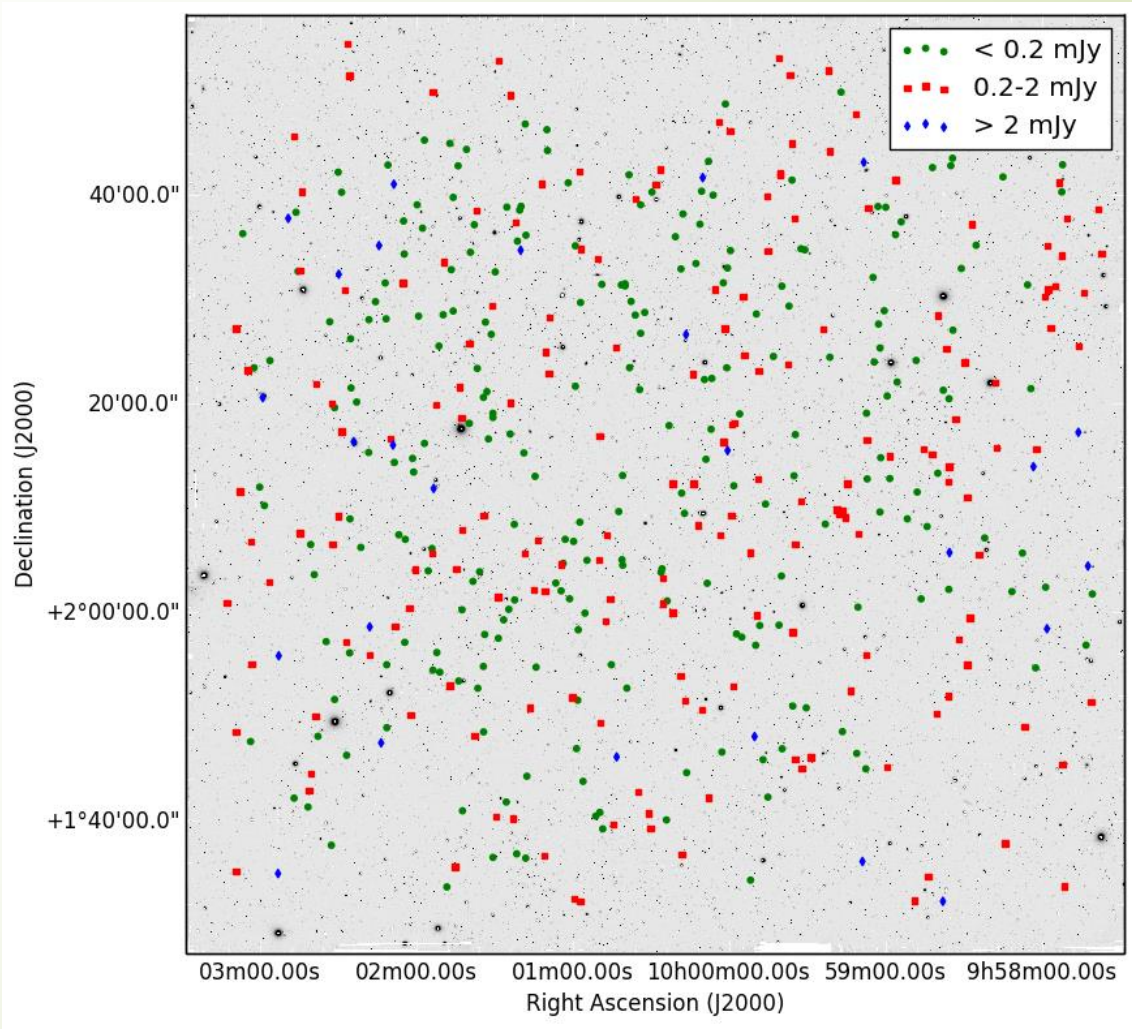
VLBA data

- 468 detections (AGNs).

SNRs larger than 5.5

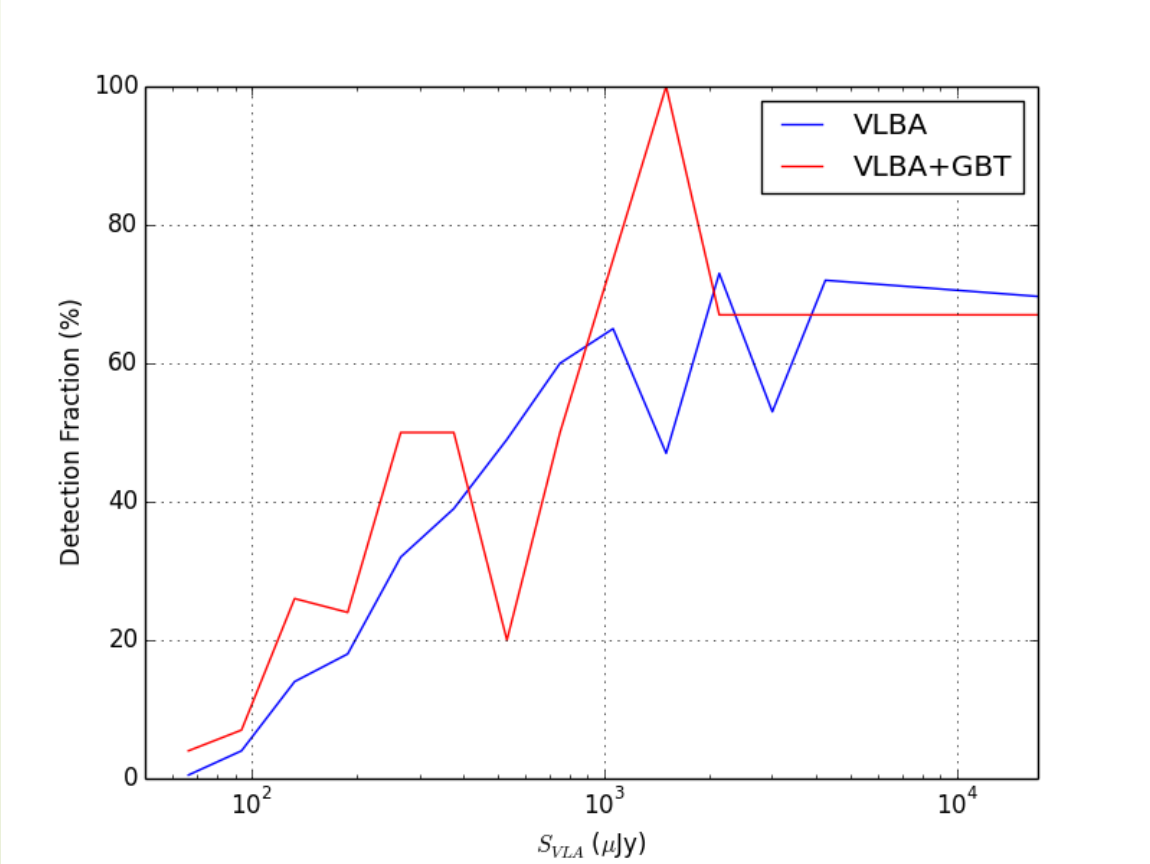
- Median redshift 1

- The majority of the detections have been morphologically classified as early type (Tasca et al. 2009)



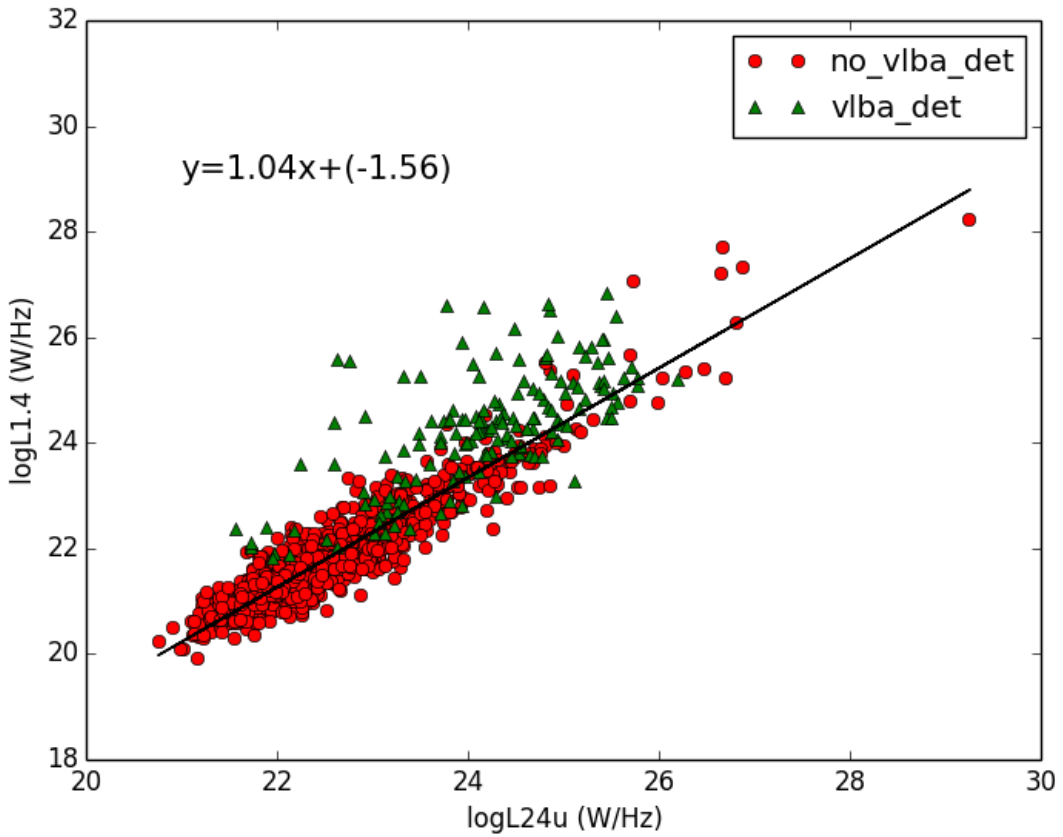
VLBA+GBT data (Preliminary)

- 36 VLBA+GBT detections. 9 more detected sources than only with the VLBA



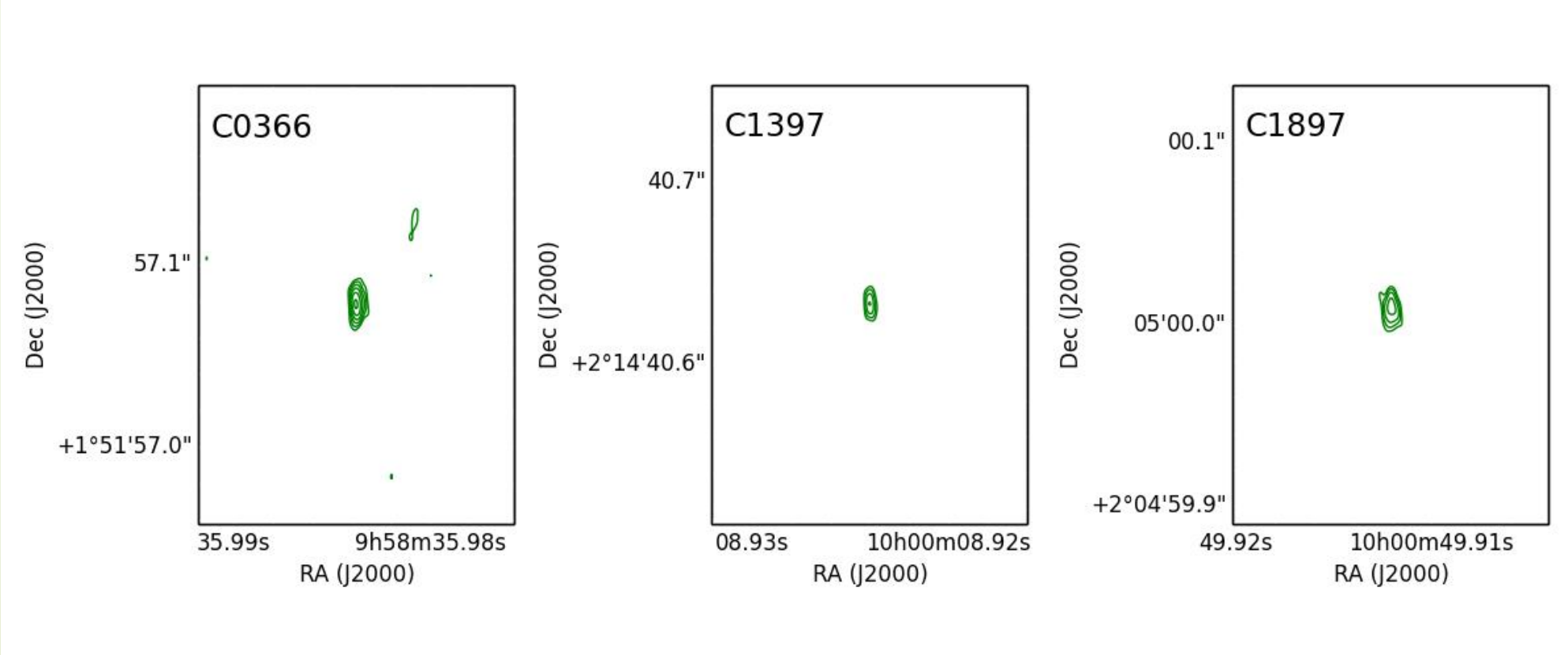
VLBA data

- Radio-Infrared correlation

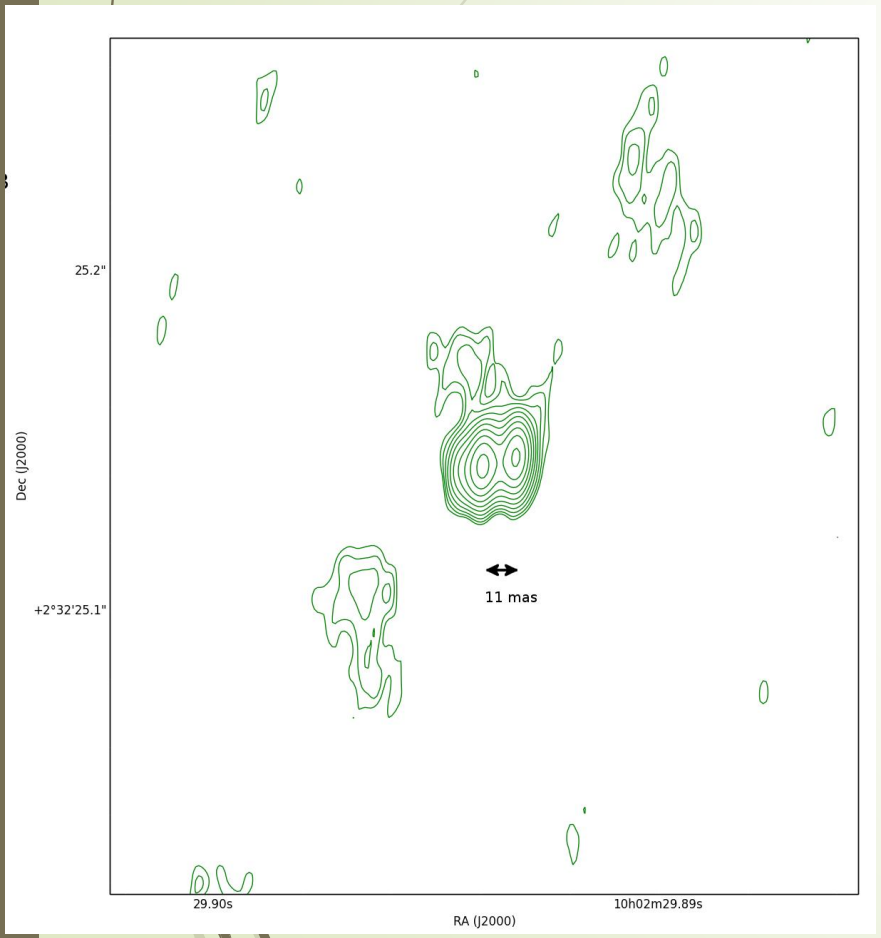


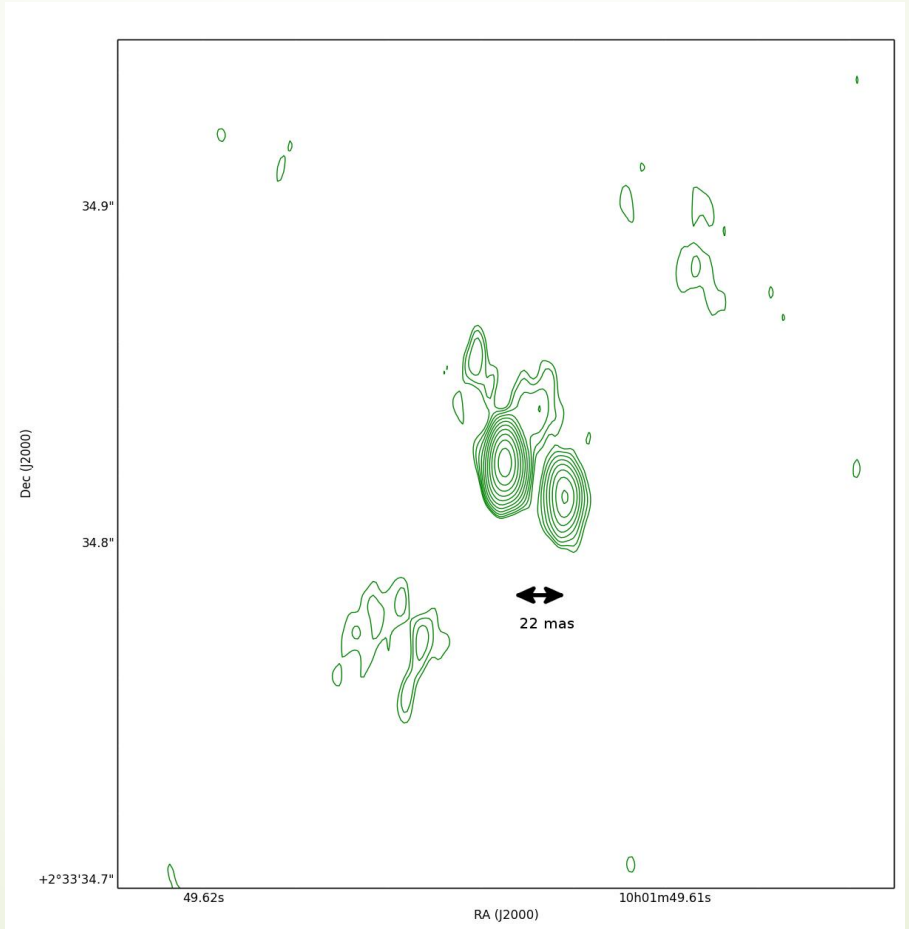
VLBA-detected Radio Quiet Quasars

- Herrera Ruiz et al. (2016), Maini et al. (2016)

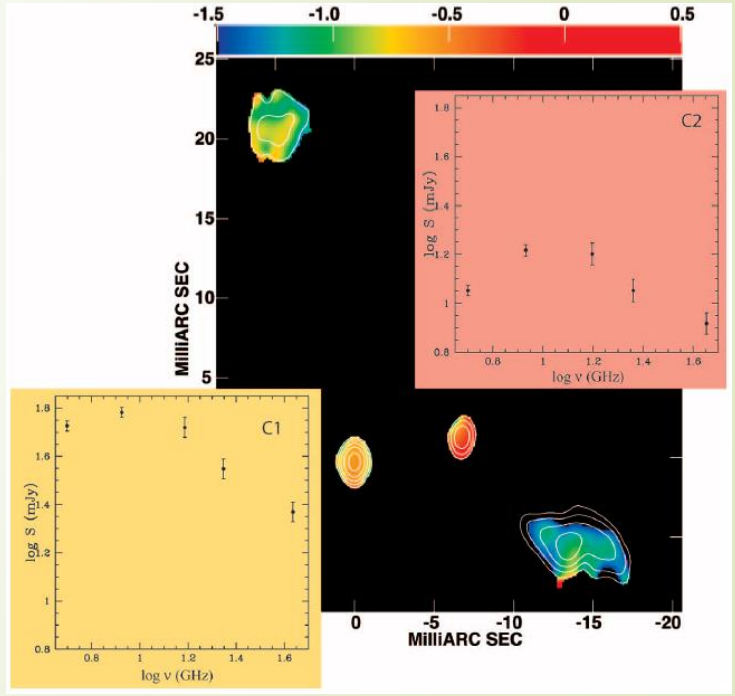


Binary black holes?



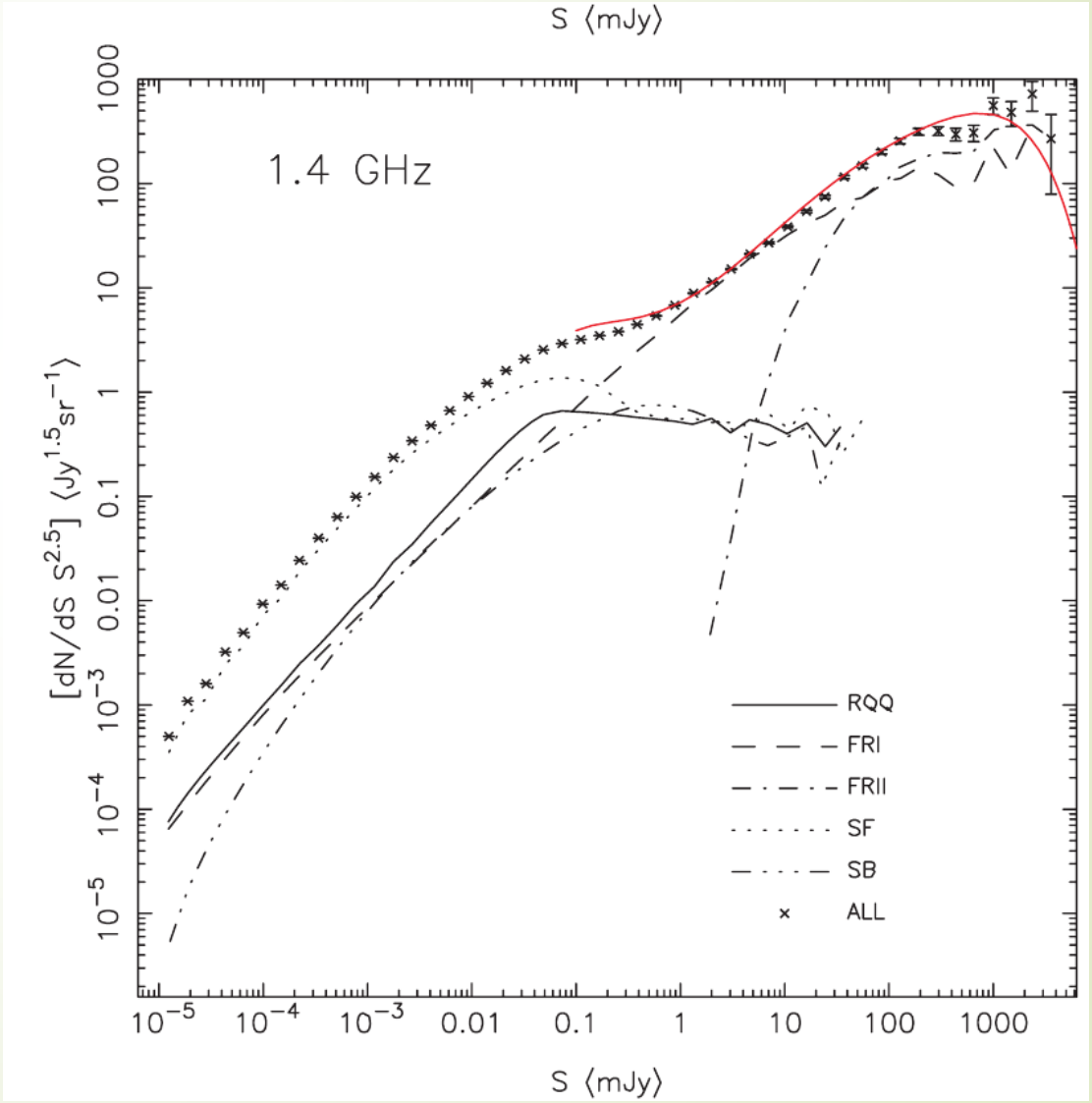


Rodriguez et al. (2006),



Future work

- SKA simulations by Wilman et al. (2008)



Summary

- We have detected 20% of the sources observed with the VLBA (468)
- We have detected 9 sources more with the VLBA+GBT than only with the VLBA, increasing the number of detected sources in that pointing by a third.
- We can be almost 100% confident that the detected sources are AGN
- The radio emission of at least some radio-quiet quasars is dominated by an AGN
- We will analyse the AGN radio source counts in the µJy regime and follow up the two candidates of binary black hole systems.