Sensitive wide-field VLBI observations of the COSMOS field

Noelia Herrera Ruiz
PhD student

Supervisor:
Enno Middelberg

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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
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

\[ y = 1.04x + (-1.56) \]
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.