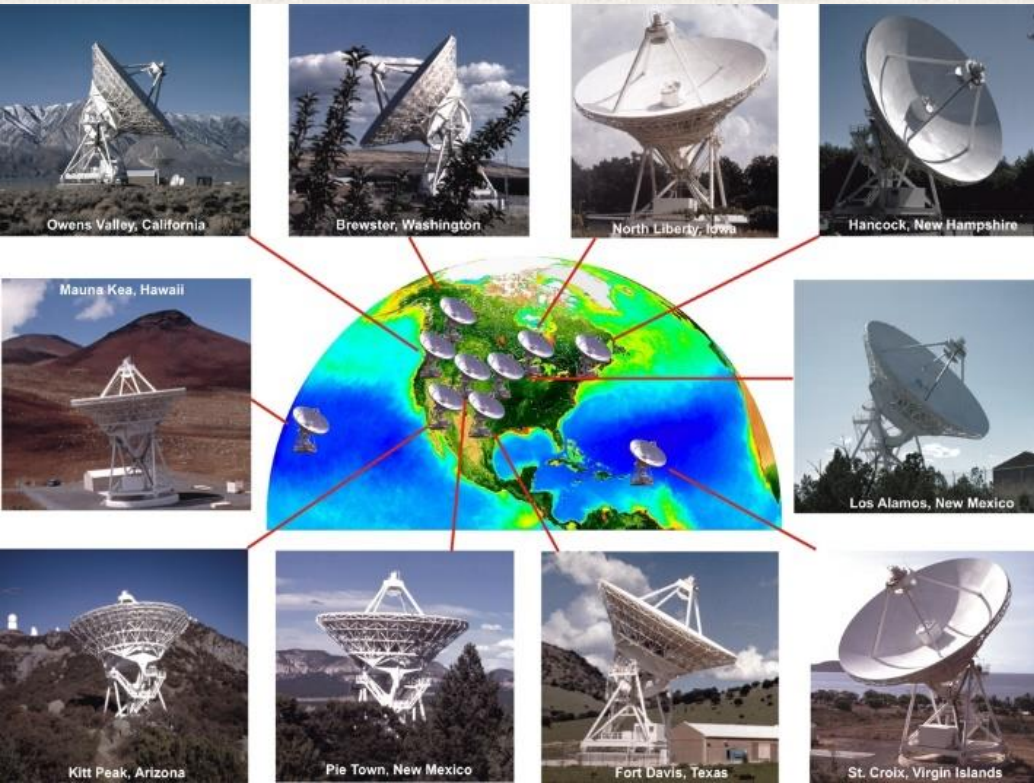


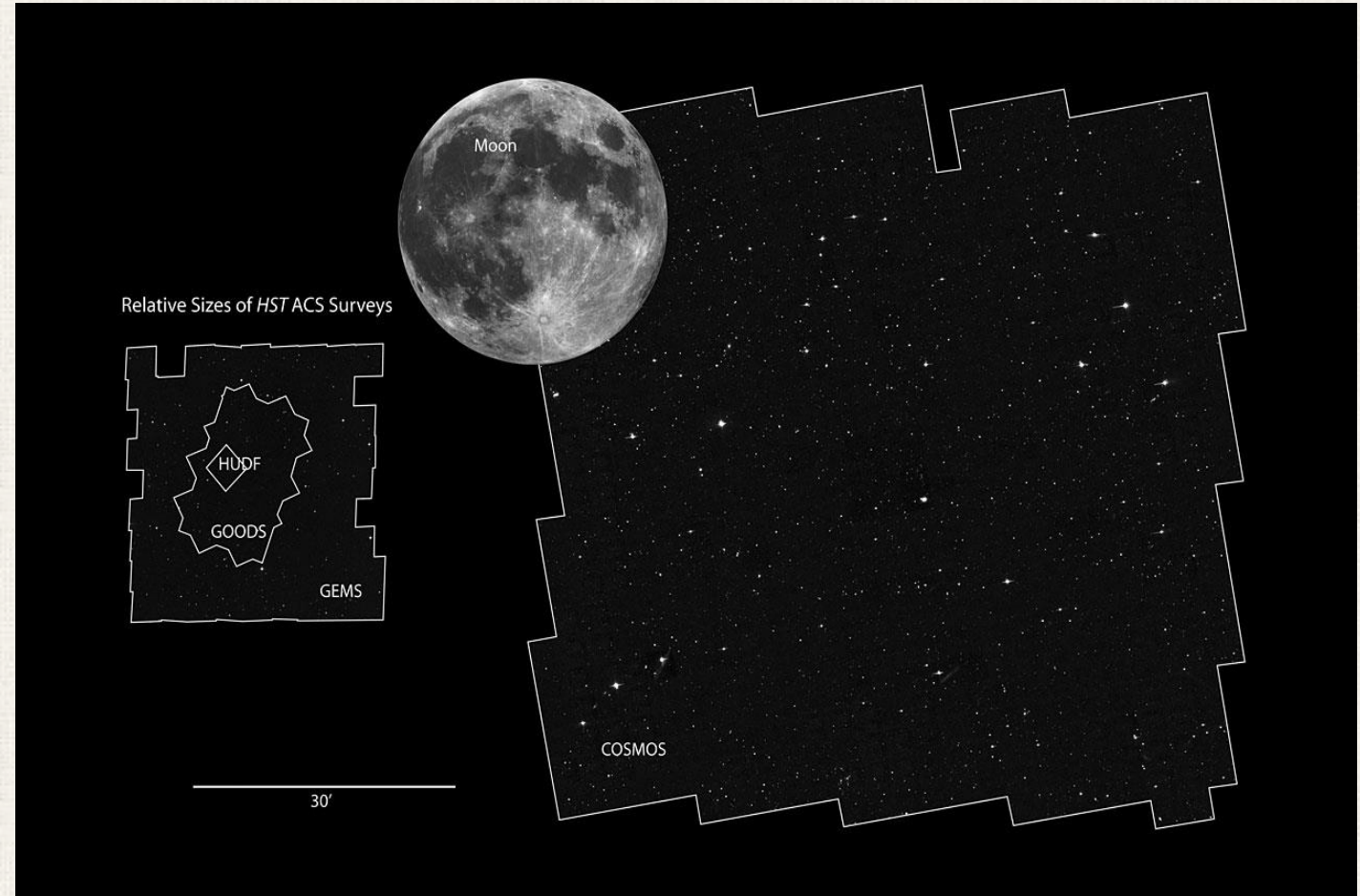
VLBI and the faint radio AGN population

Noelia Herrera Ruiz

EVN Symposium & Users Meeting, 09/10/18

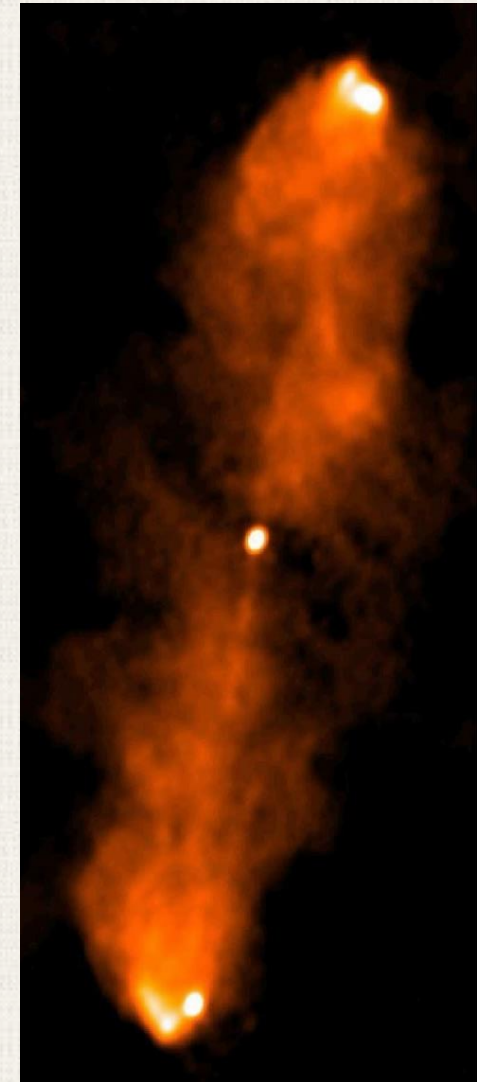


Credit: NRAO/AUI/SeaWiFS (NASA/GSFC)/ORBIMAGE



Motivation

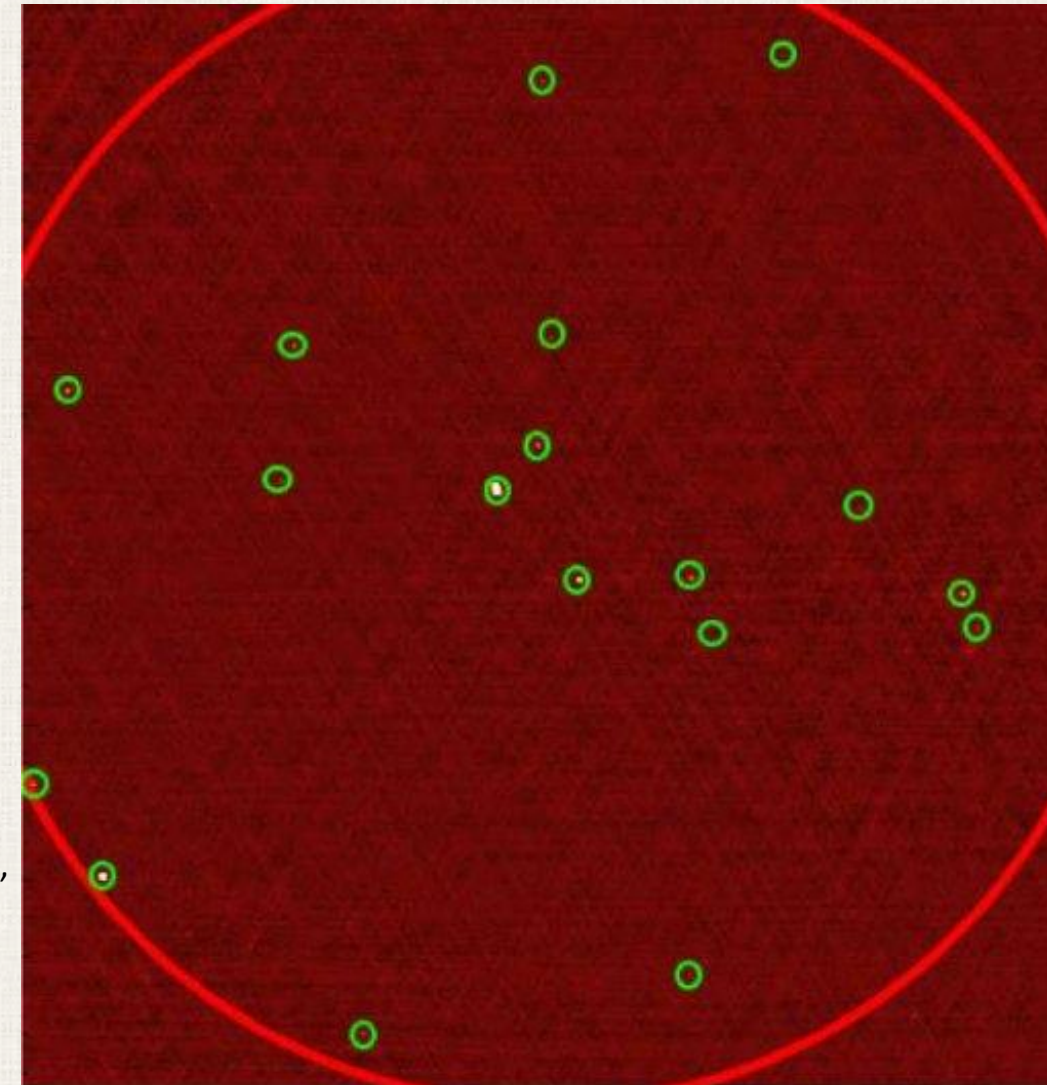
- AGN play an important role in galaxy evolution
- Radio surveys indispensable
- Statistically study the faint radio population:
 - Radio source count distribution
- Sub-samples of rare or sparse objects:
 - Radio-quiet quasars (RQQs)
 - Supermassive black hole (SMBH) binary systems



Sirothia et al. (2013)

Wide-field VLBI

- VLBI technique, targeting hundreds of objects in one go.
- Method: multiple phase centres in DiFX2.
- Detection VLBI: AGN (high T_B + compact)



Red ring: 31'
Green rings: 12''

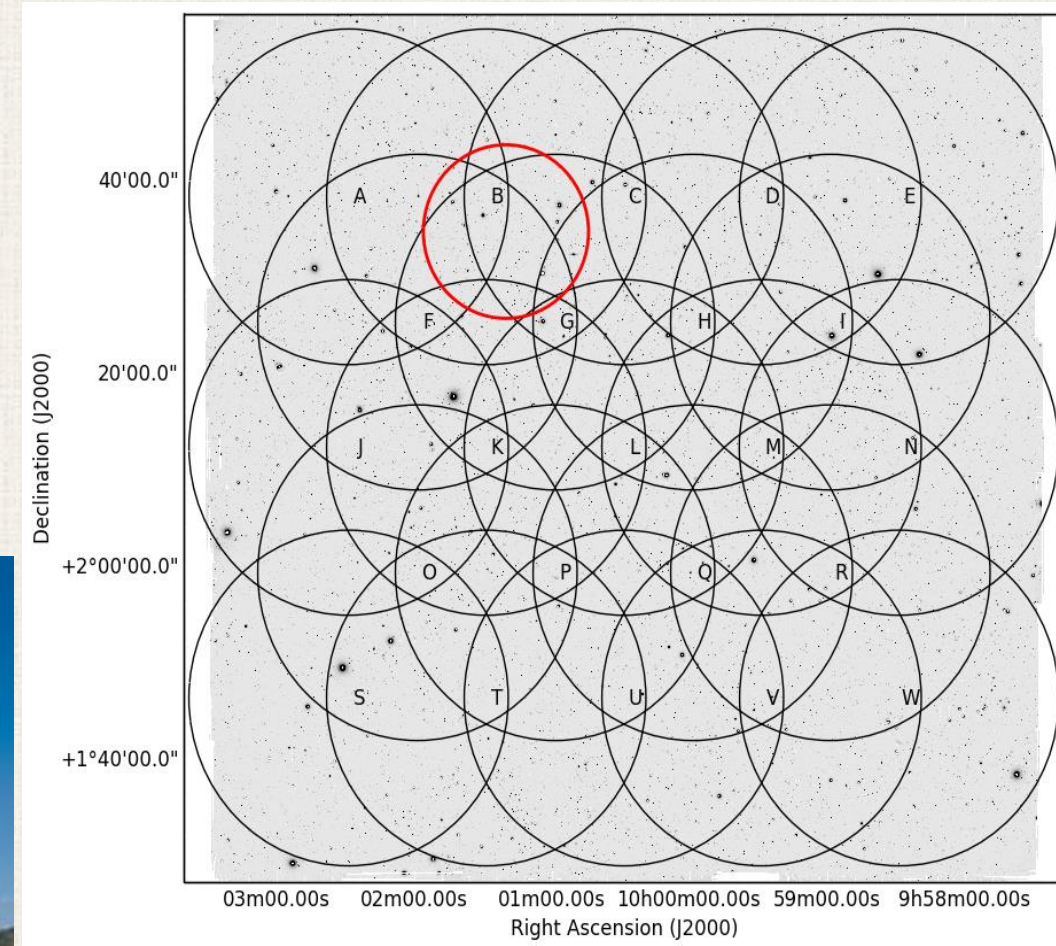
Deller et al. (2011)

Observations

- Input VLA catalog (Schinnerer et al. 2010)
- 2865 sources (131 multi): 3293 targets
- 23 pointings observed with the VLBA
(Very Long Baseline Array)
- 1 pointing (179 targets)
with the VLBA+GBT
(Green Bank Telescope)
- 1.4 GHz



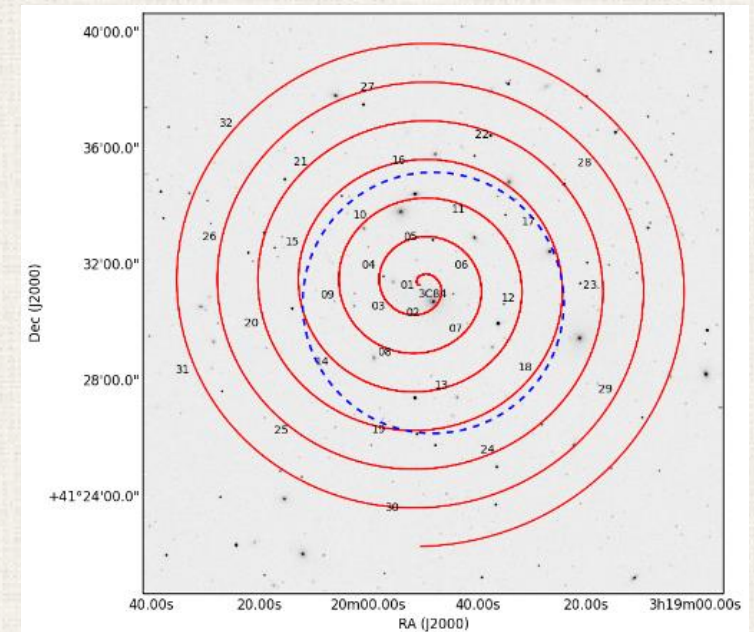
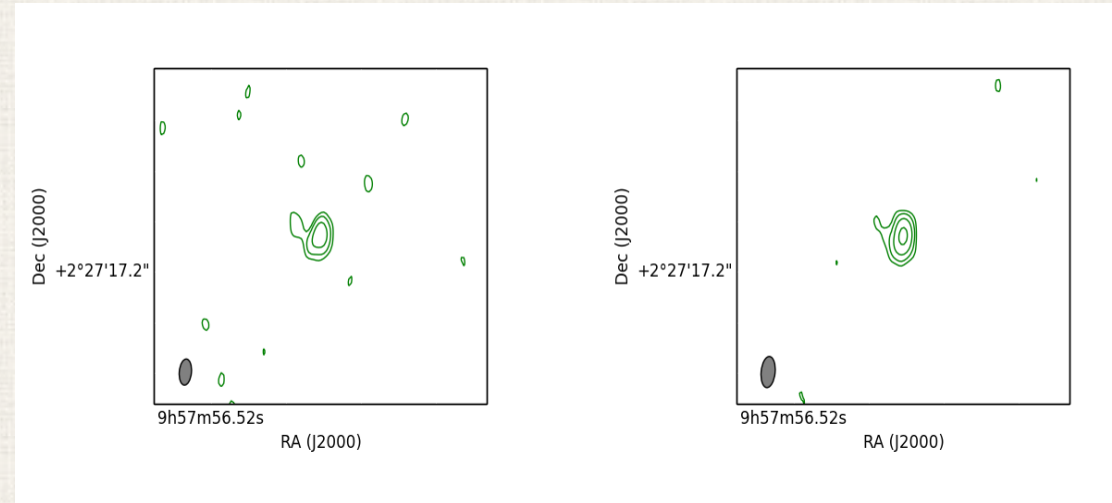
Credit: NRAO/AUI/NSF



Background: Subaru *i*-band data
<http://irsa.ipac.caltech.edu/data/COSMOS>

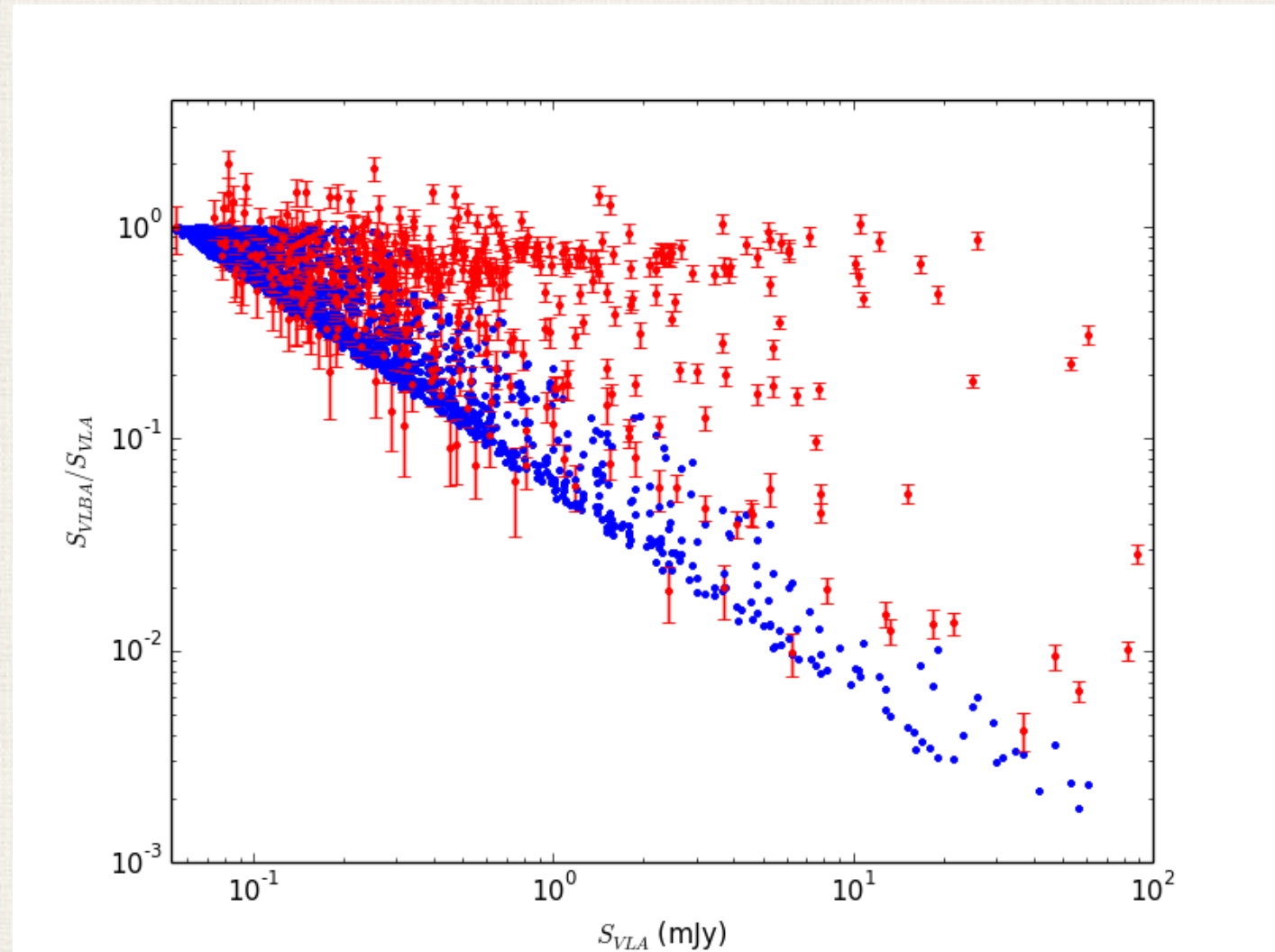
Calibration

- AIPS (ParselTongue)
- Specialised steps for wide-field VLBI:
 - Multi-source self-calibration
 - Primary beam correction
 - Data combination
- Measure GBT primary beam response



VLBA Data

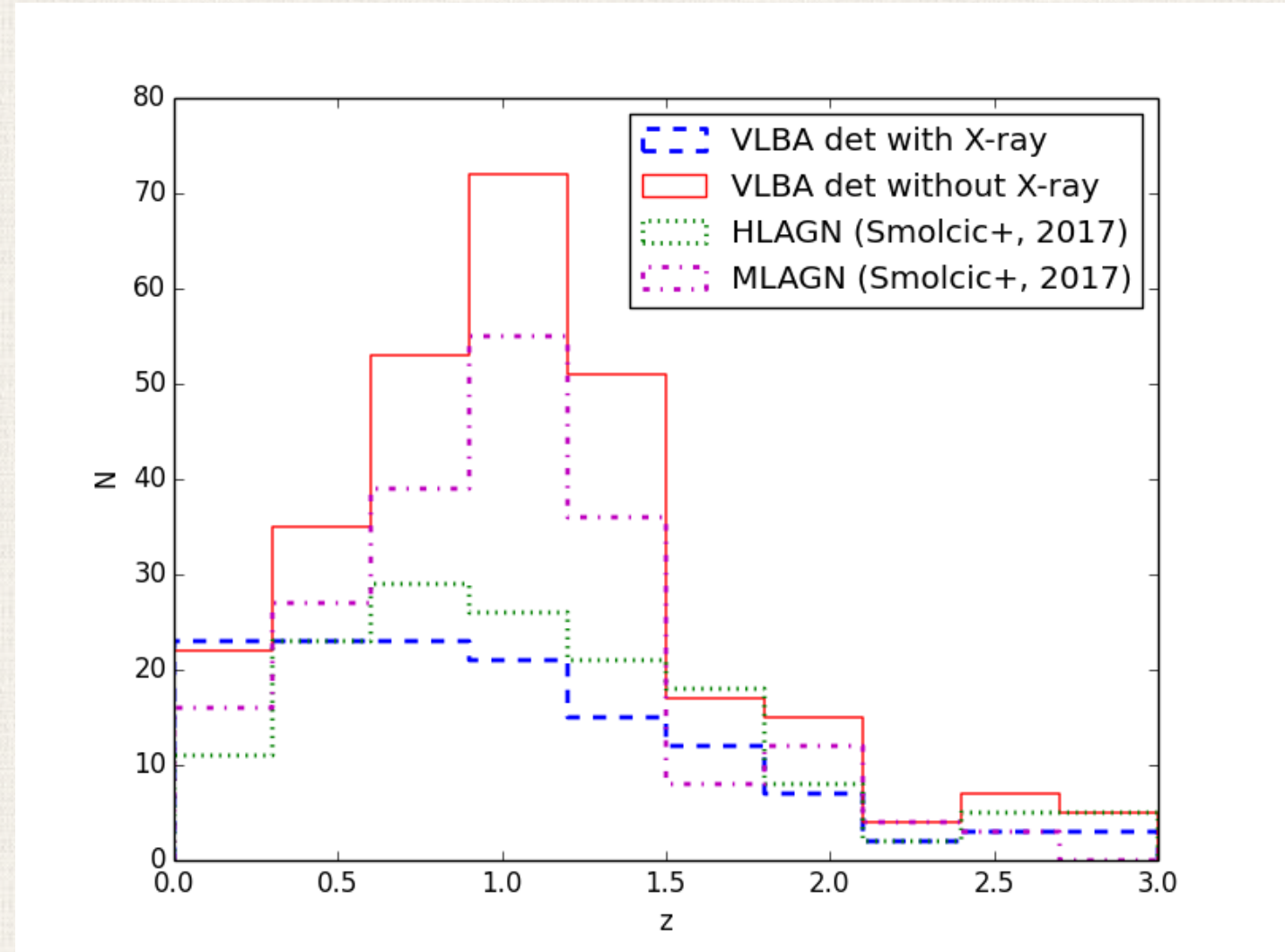
- 468 sources (AGN)
- Median redshift of ~ 1
- VLBA-VLA flux density ratio
 - Median ~ 0.6
 - Faint sources more compact



Herrera Ruiz et al. (2017)

VLBA Data

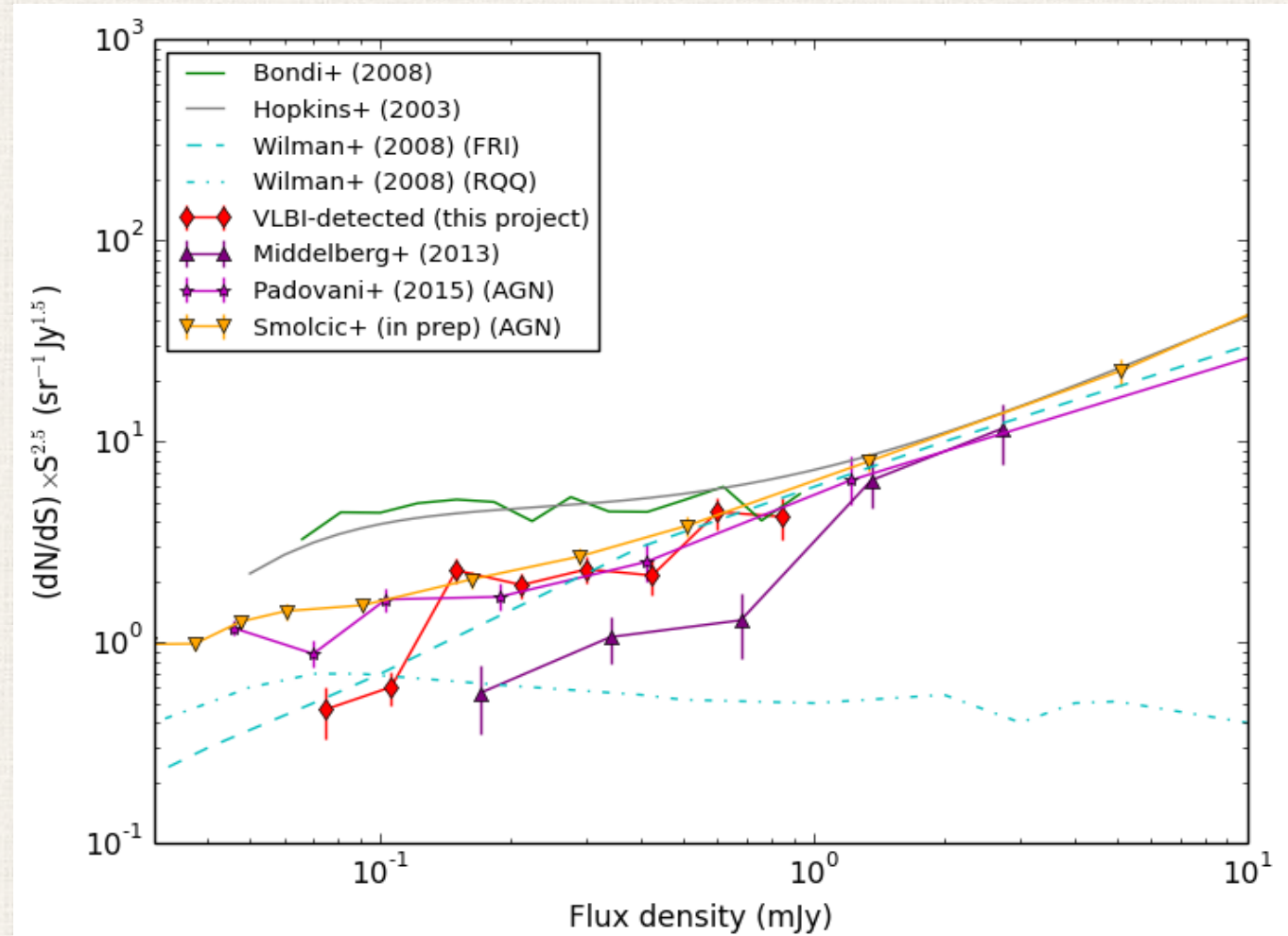
- X-rays
 - No detection for low radiative Luminosity



Herrera Ruiz et al. (2017)

VLBA+GBT Data

- 35 detected sources with the VLBA+GBT
 - 10 more than only with the VLBA
- Euclidean-normalised radio source counts (40-55%)

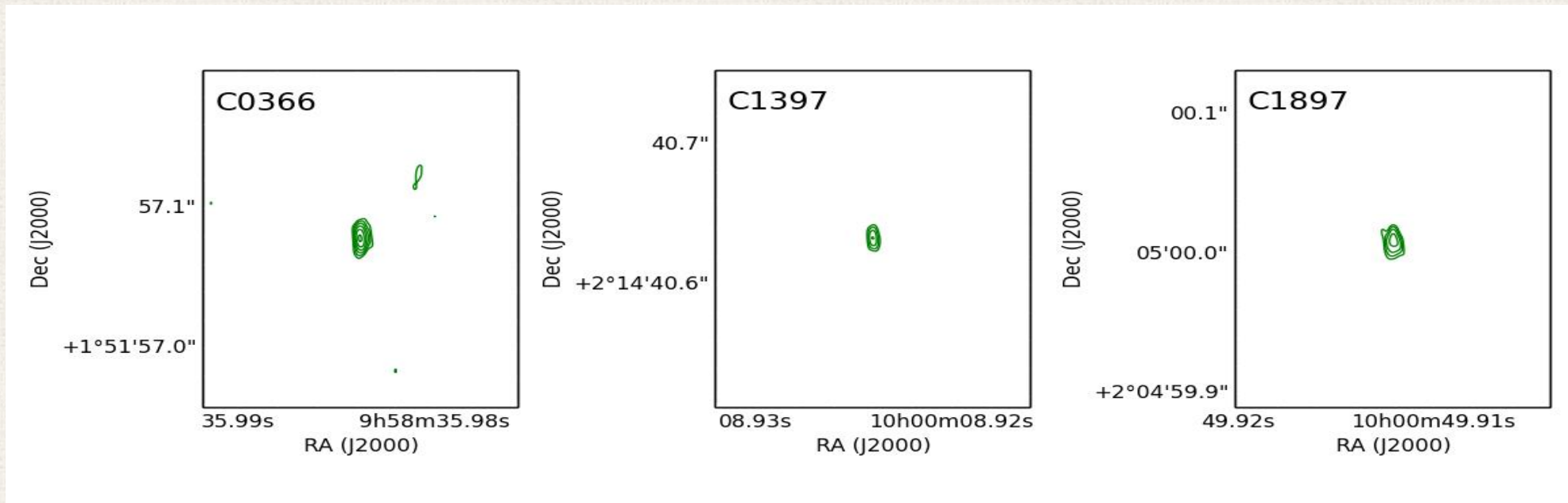


Herrera Ruiz et al. (2018)

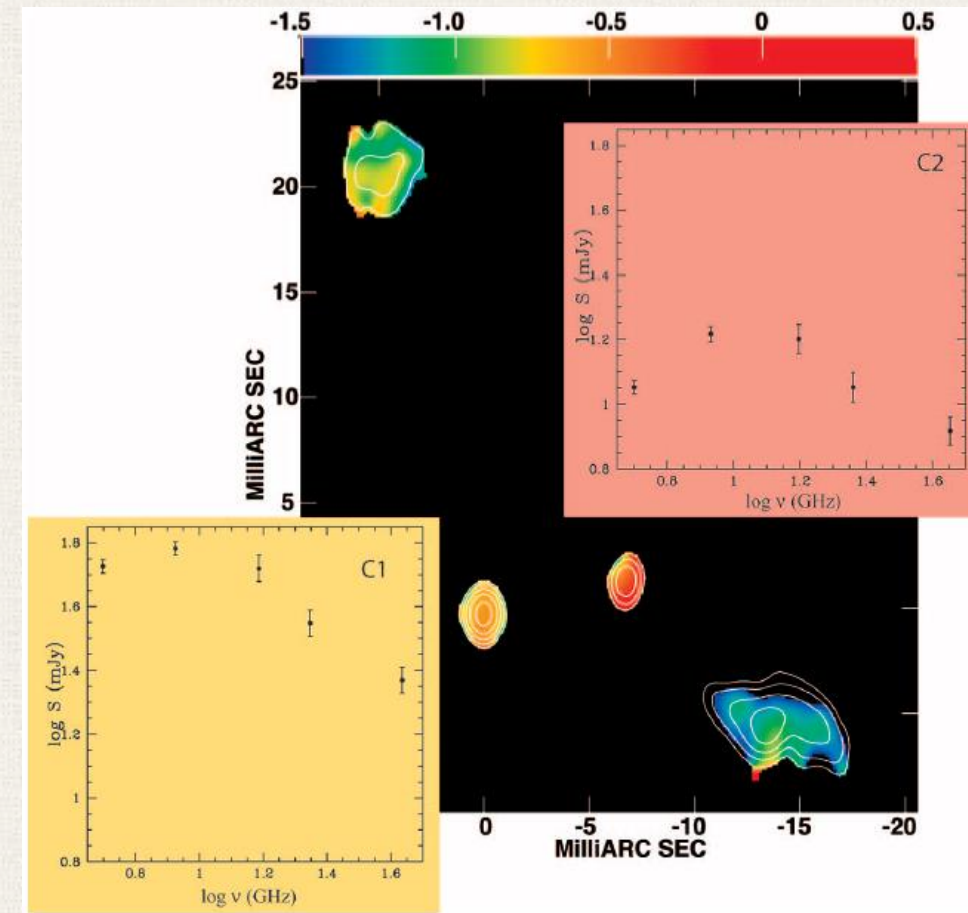
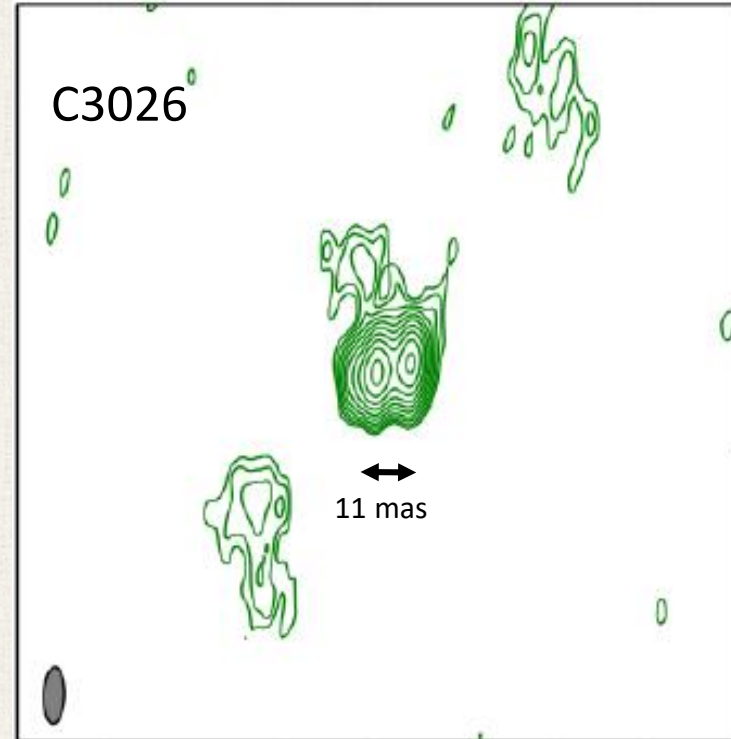
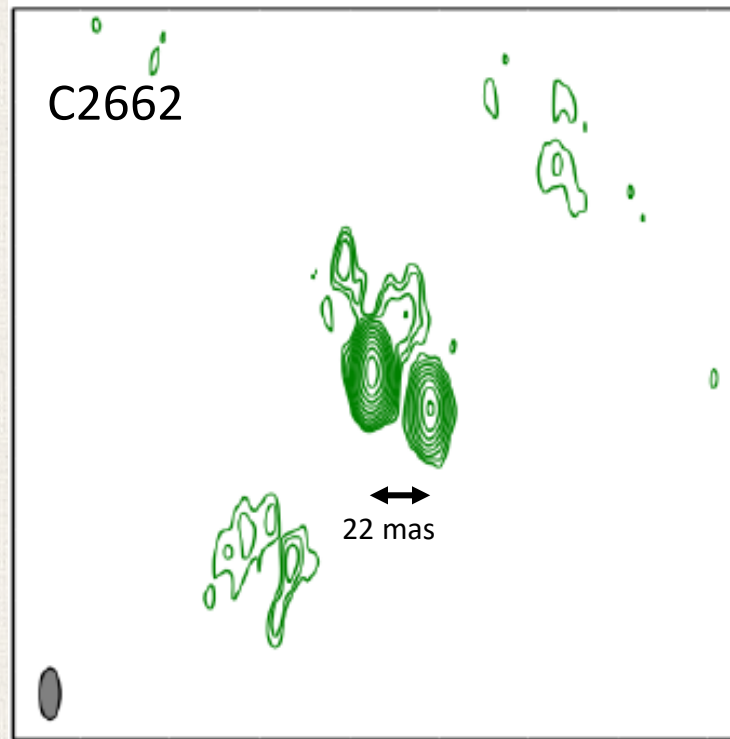
VLBA-detected Radio Quiet Quasars

| ID | q24 | R _i | R _x | P _{5GHz} | R | R _V | L _x | q24obs | DW ^a |
|-------|-----|----------------|----------------|-------------------|---|----------------|----------------|--------|-----------------|
| C0366 | ✓ | ✓ | × | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| C1397 | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| C1897 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Herrera Ruiz et al. (2016)

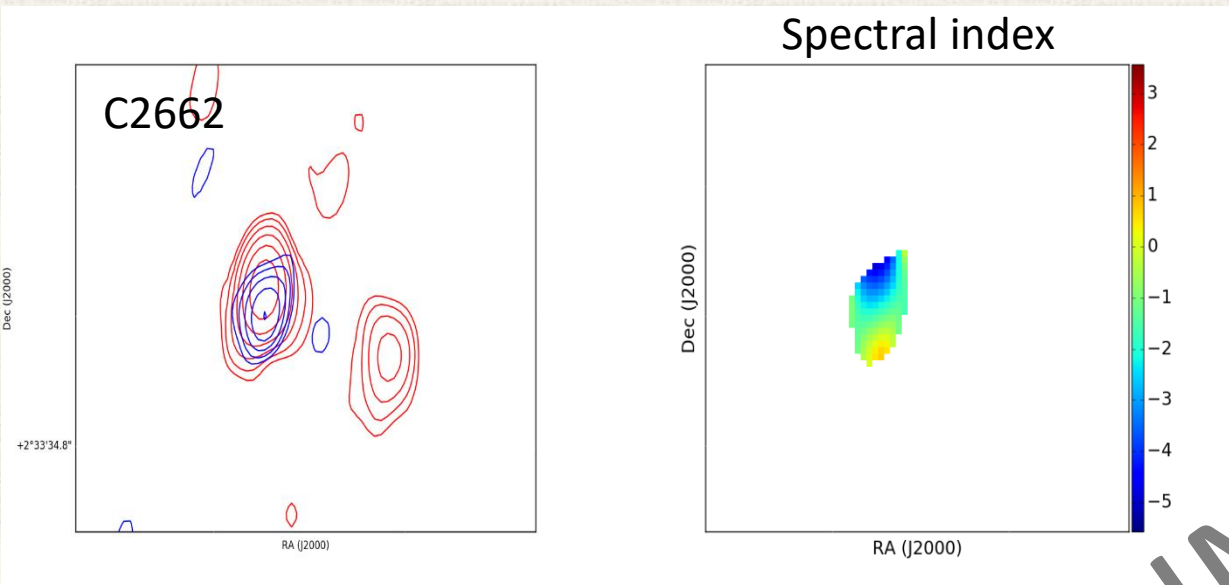


Binary black hole candidates

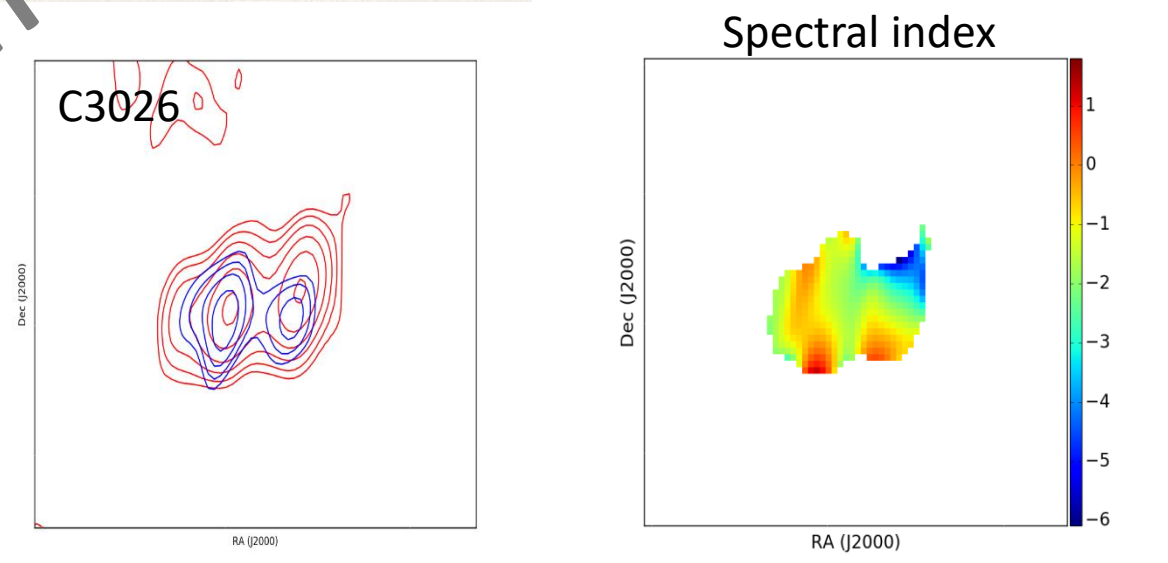


Rodriguez et al. (2006)

Binary black hole candidates



PRELIMINARY



Summary

- VLBI observations of 2865 radio sources of the COSMOS field at 1.4 GHz.
- Largest sample of VLBI detected sources in sub-mJy regime (478).
- 40-55% AGN contribution to the faint radio population.
- X-ray surveys may miss radiatively inefficient AGN.
- 3 radio-quiet quasars detected with VLBA (50-75% of their VLA radio flux density).
- Further analysis of the black hole binary candidates.