Prevalence of radio jets associated with quasar outflows and feedback

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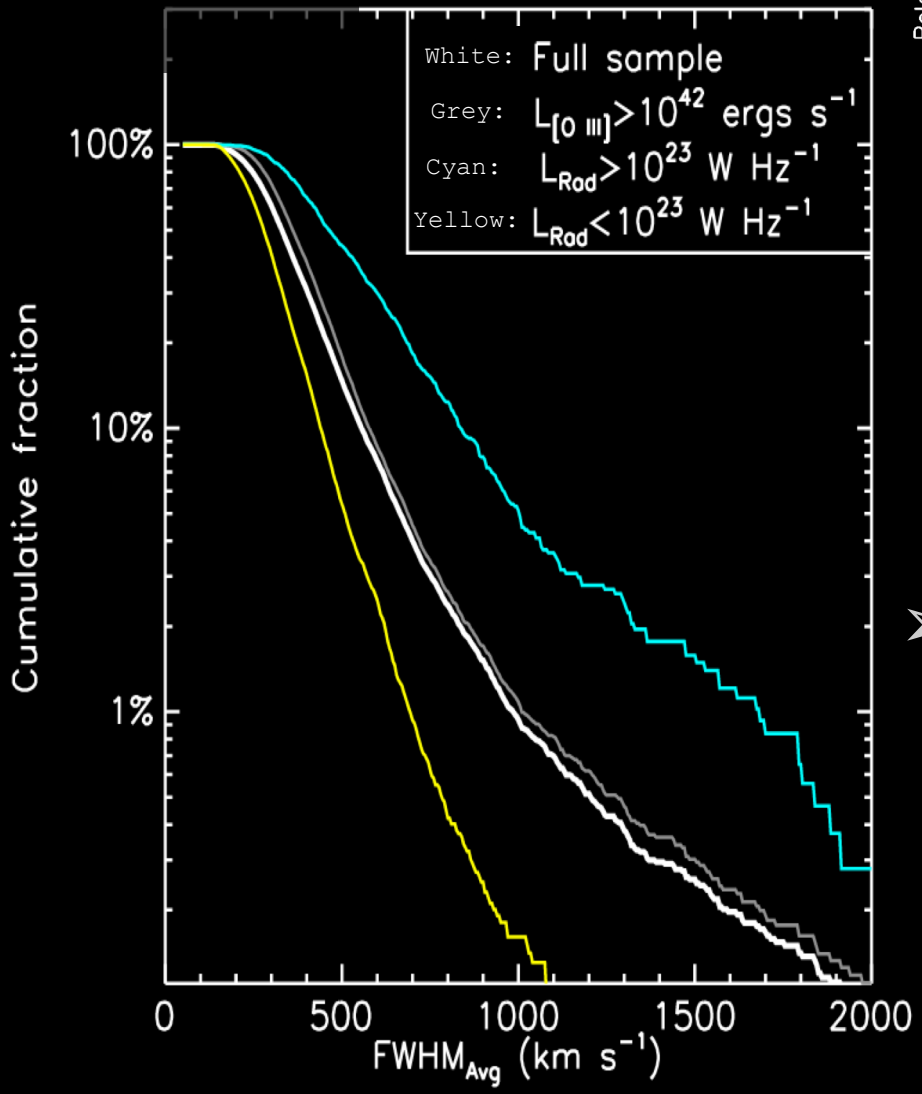
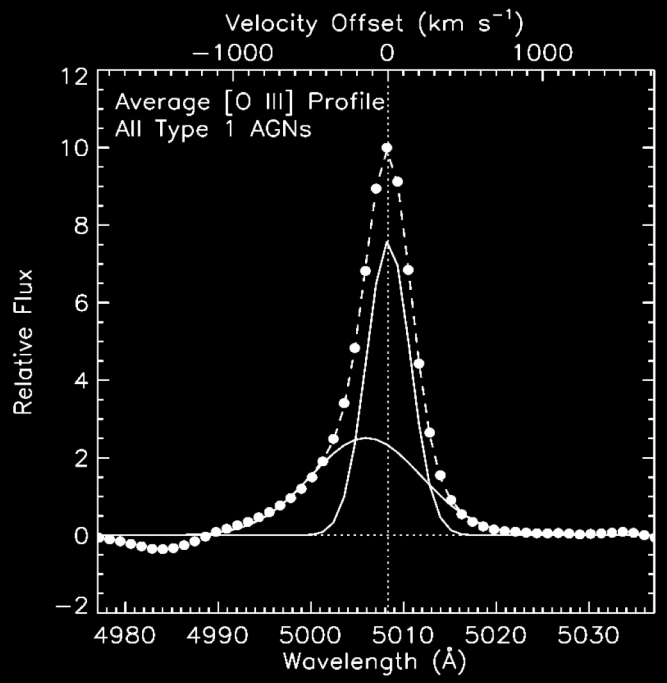
With Chris Harrison (ESO),
Vincenzo Mainieri (ESO) and Alasdair Thomson (Durham)
et. al.

Radio linked to outflows?

Cumulative fraction with FWHM > given value:





➢ Higher outflow fraction for higher radio luminosity

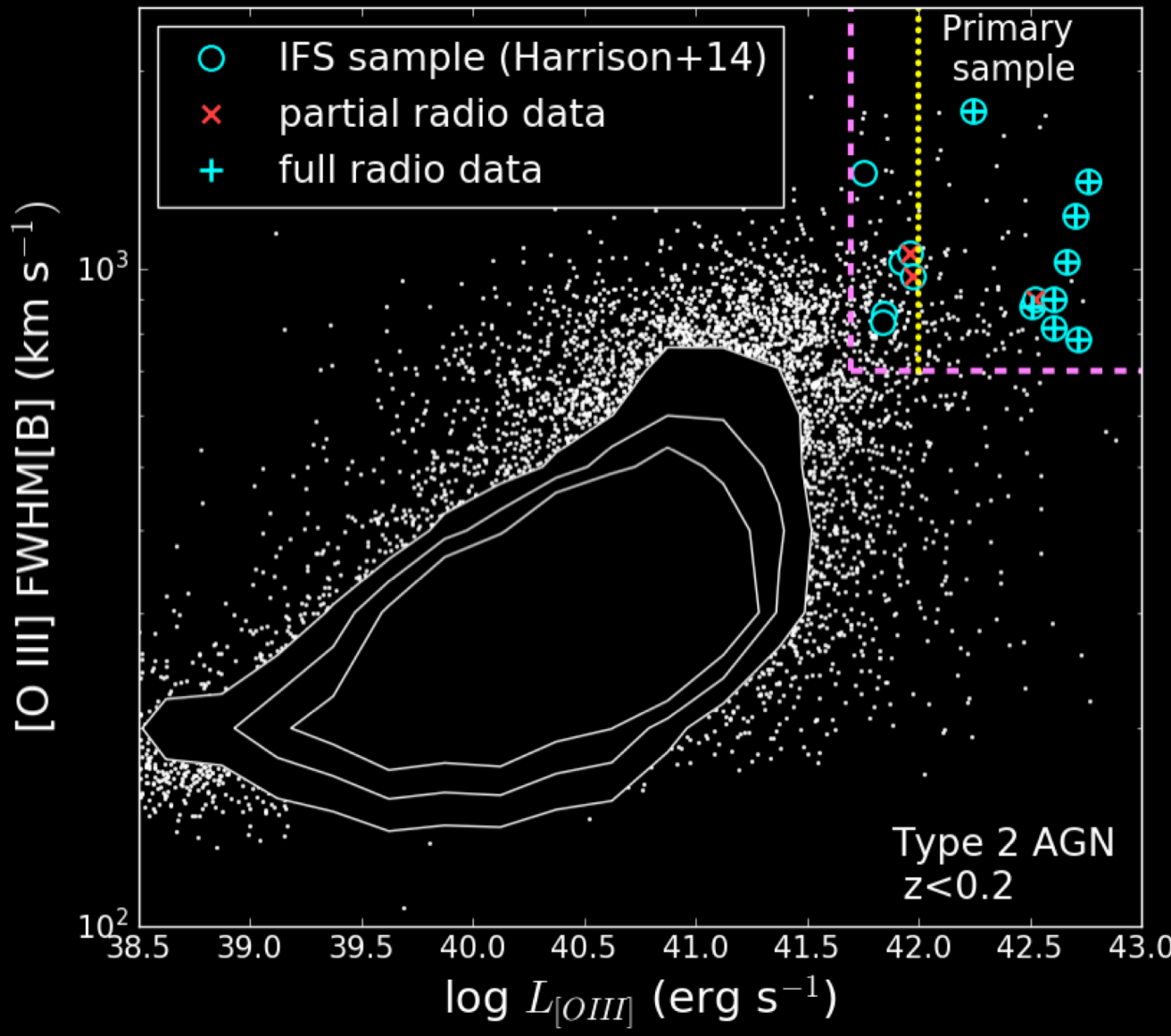
Mullaney et.al. 2013

What is producing the radio emission and outflows:

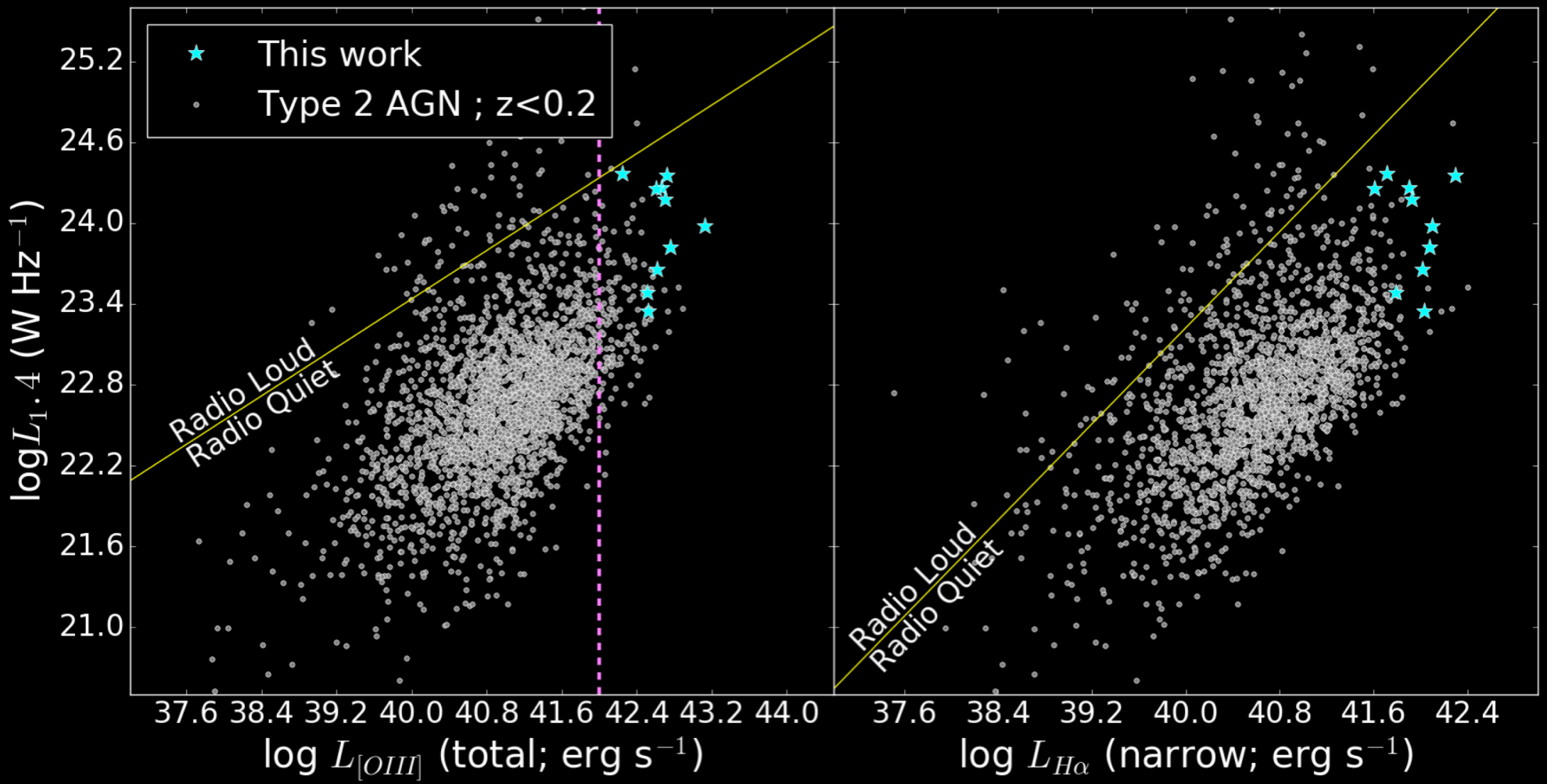
- Compact radio jets (e.g., Kukula et al. 1998 ; Ulvestad et al. 2005 ; Singh et al. 2015),
- Shocks from quasar winds (Zakamska & Greene 2014 ; Nims et al. 2014), or
- Star formation (e.g., Sopp & Alexander 1991 ; Condon et al. 2013)
- …?

Our sample:

- VLA at 1.5GHz, ≈5 and ≈7GHz with beams from 3-0.25 arcsec
- eMERLIN at 1.5GHz ≈0.25 arcsec beam

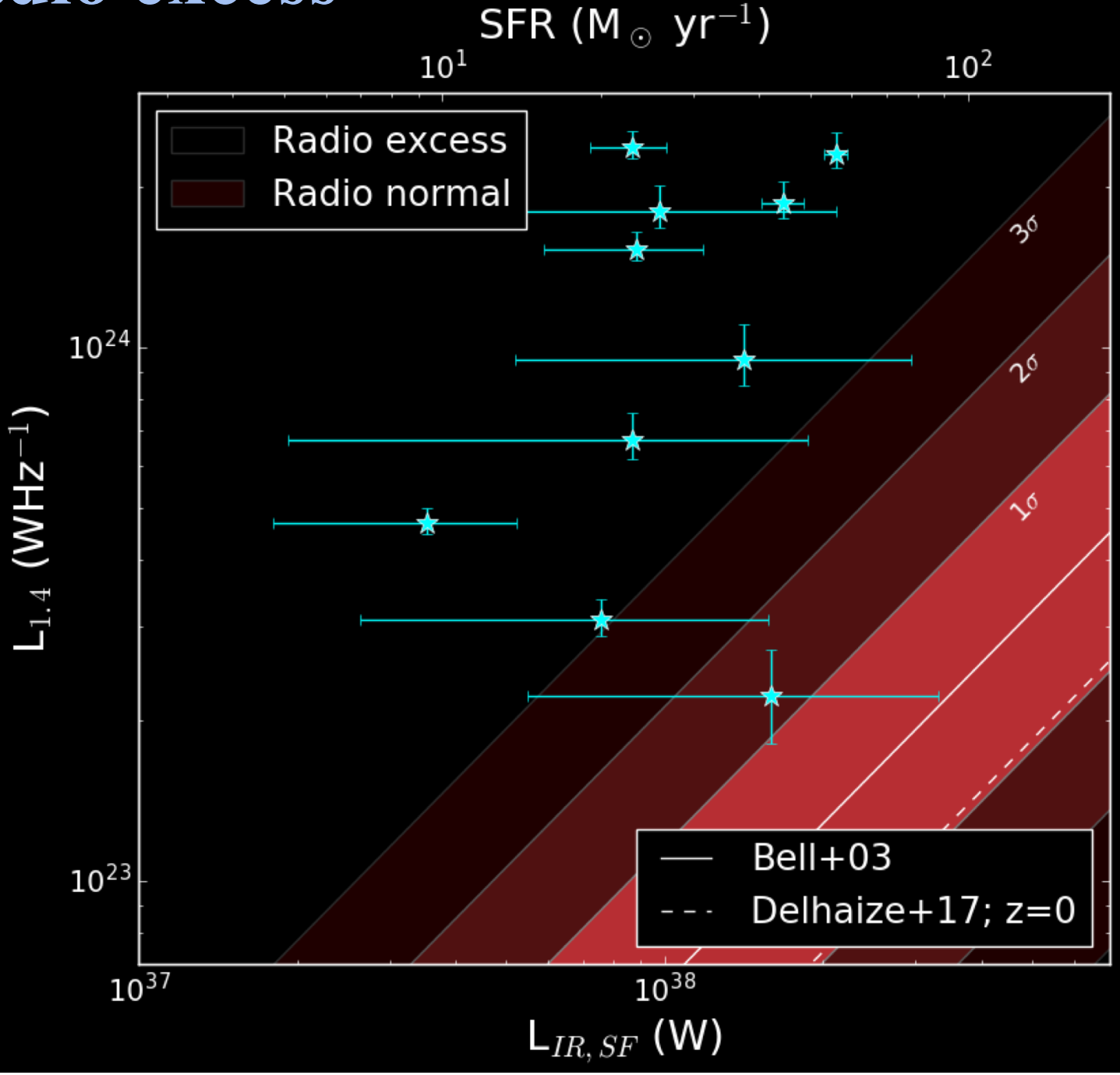


All are ‘radio quiet’:

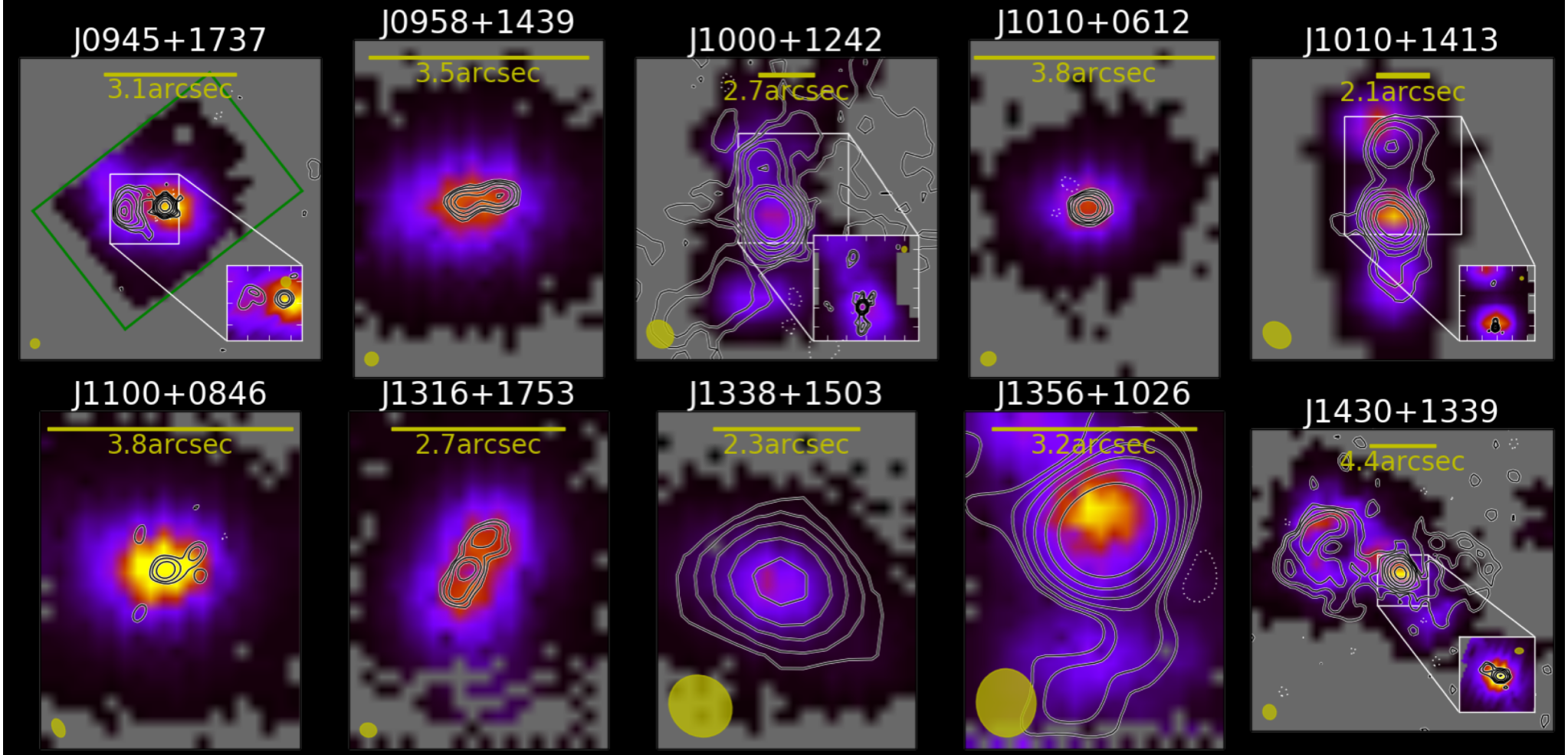


Characterizations from Xu et al. (1999) and Best & Heckman (2012)

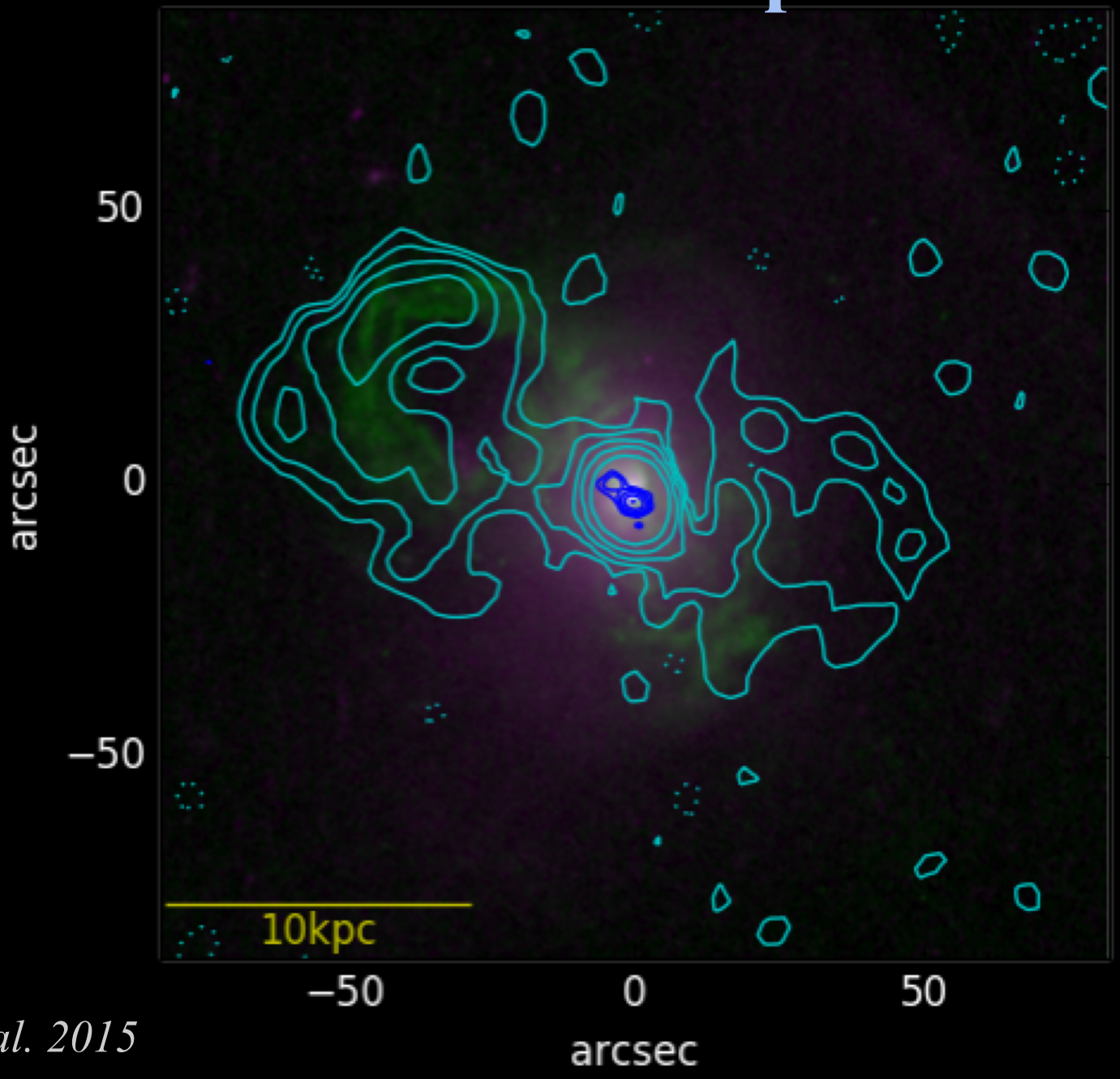
Most are ‘radio excess’



Radio jets are prevalent:

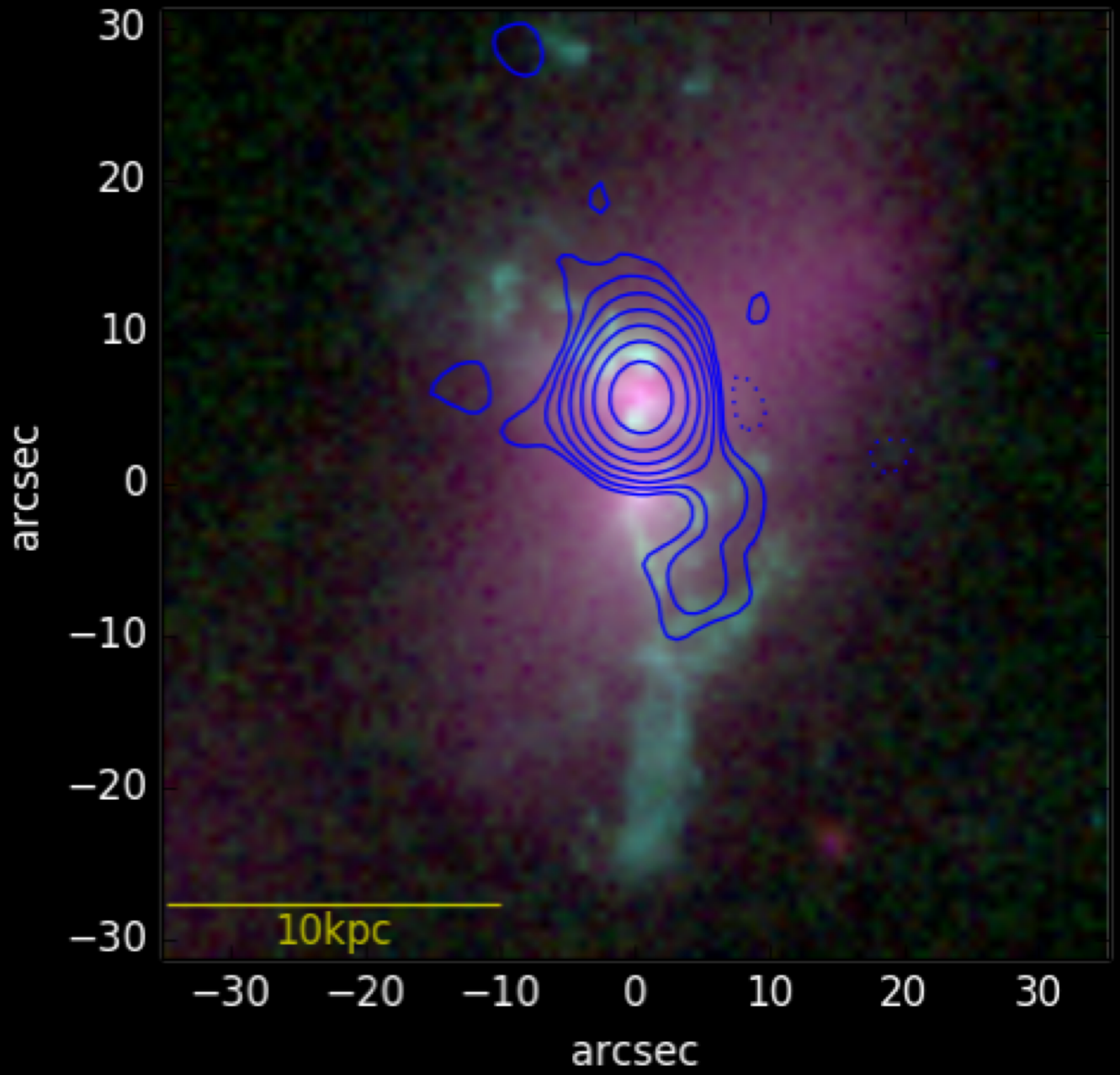


More Detailed look: the Teacup



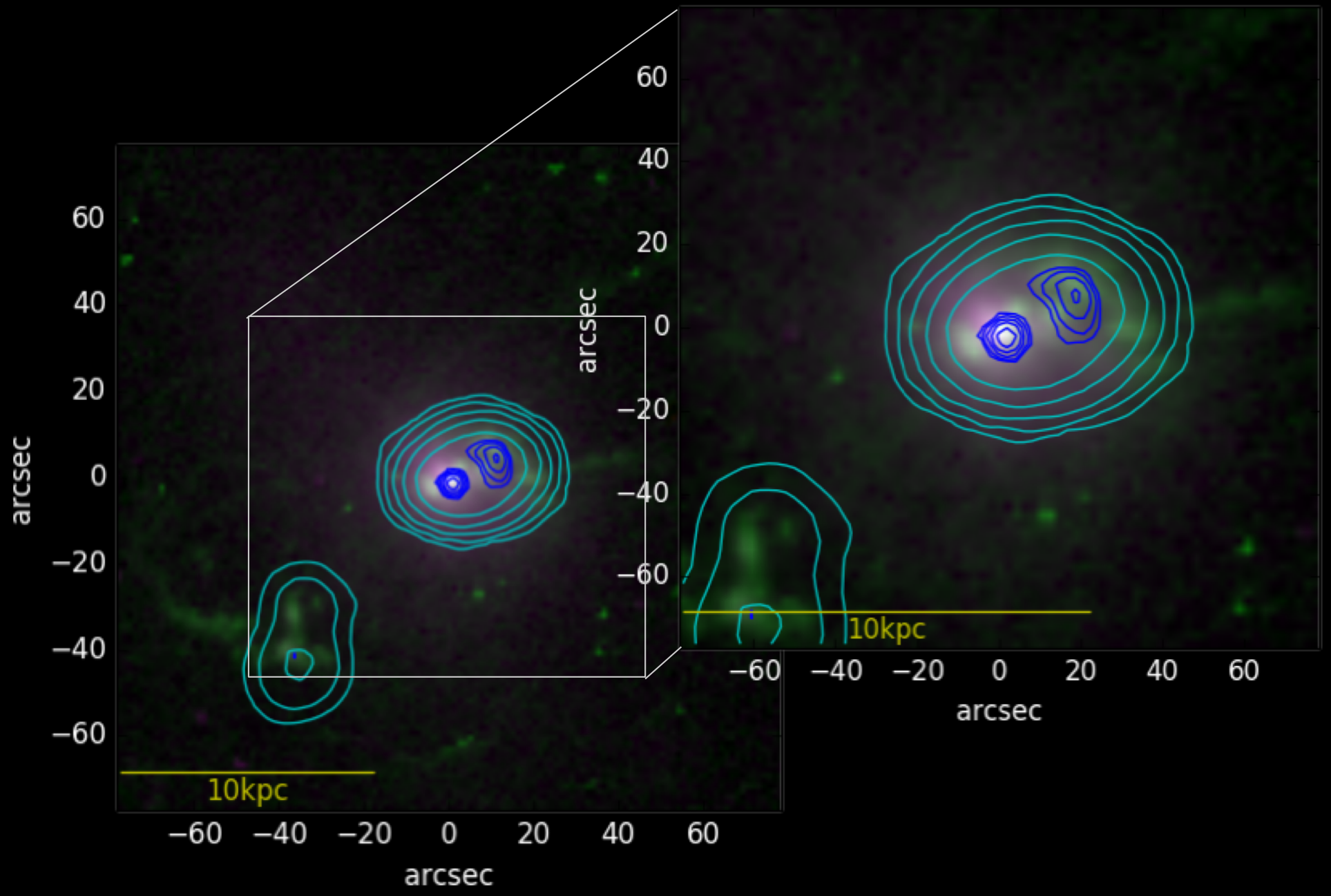
See Harrison et al. 2015

More Detailed look: J1356+1026



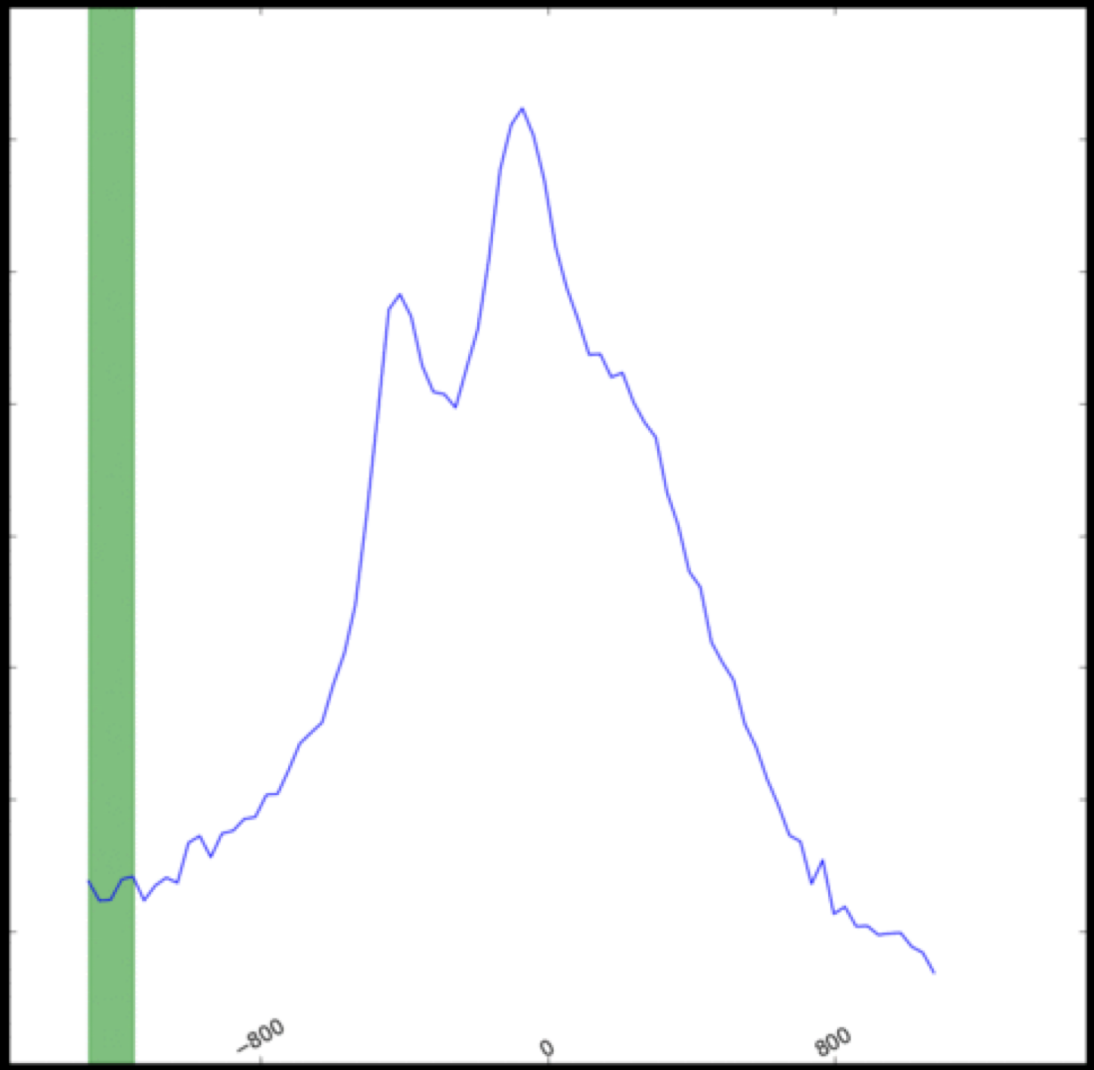
See also Greene et al. 2014 and Comerford et al. 2016

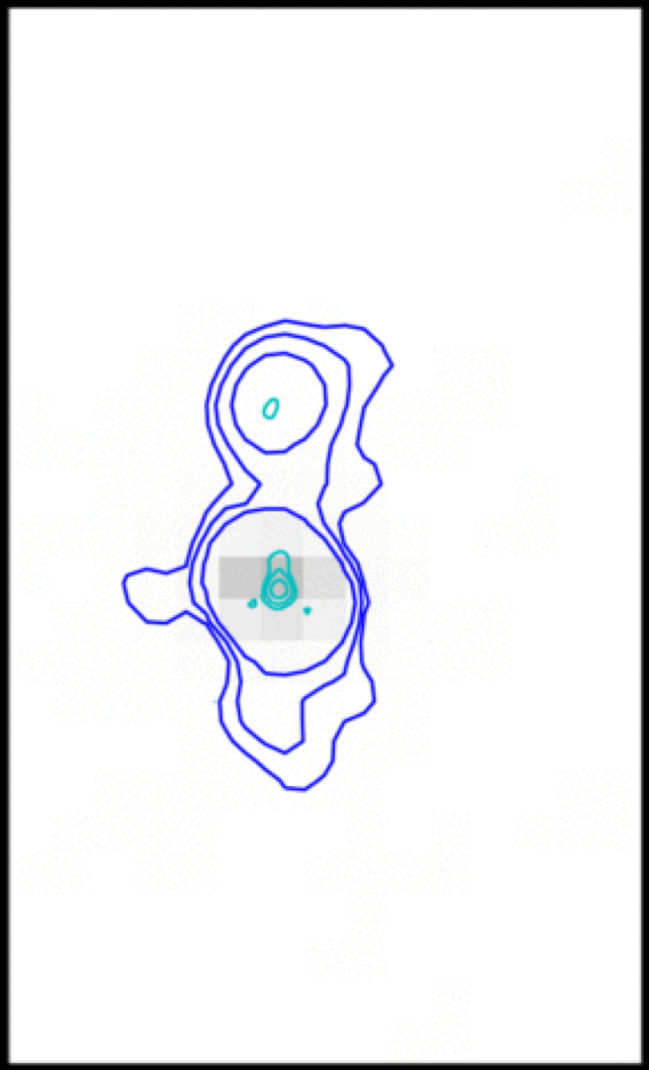
More Detailed look: J0945+1737



Radio jets kinematically linked to [OIII]:

J1010+1413





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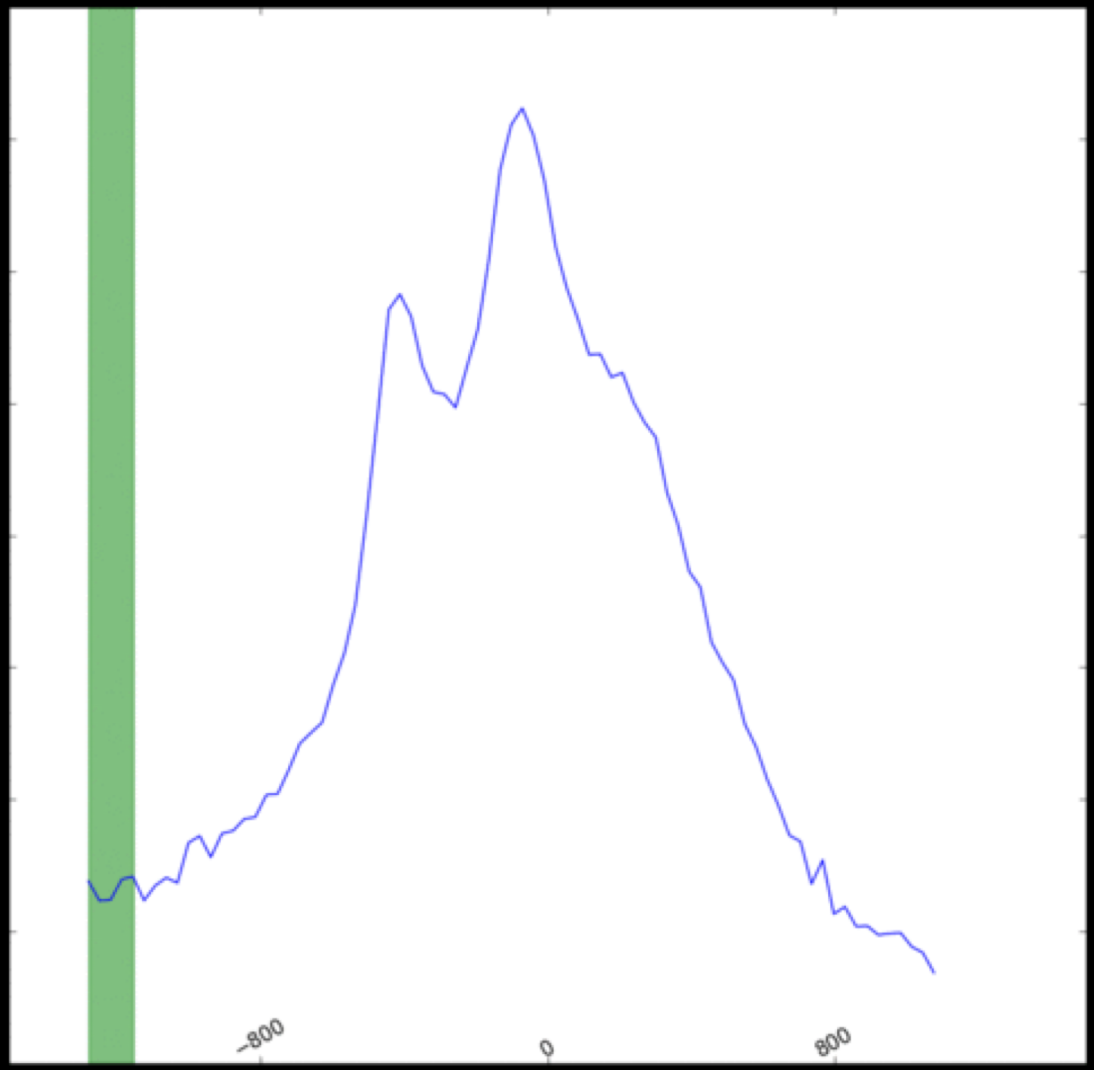
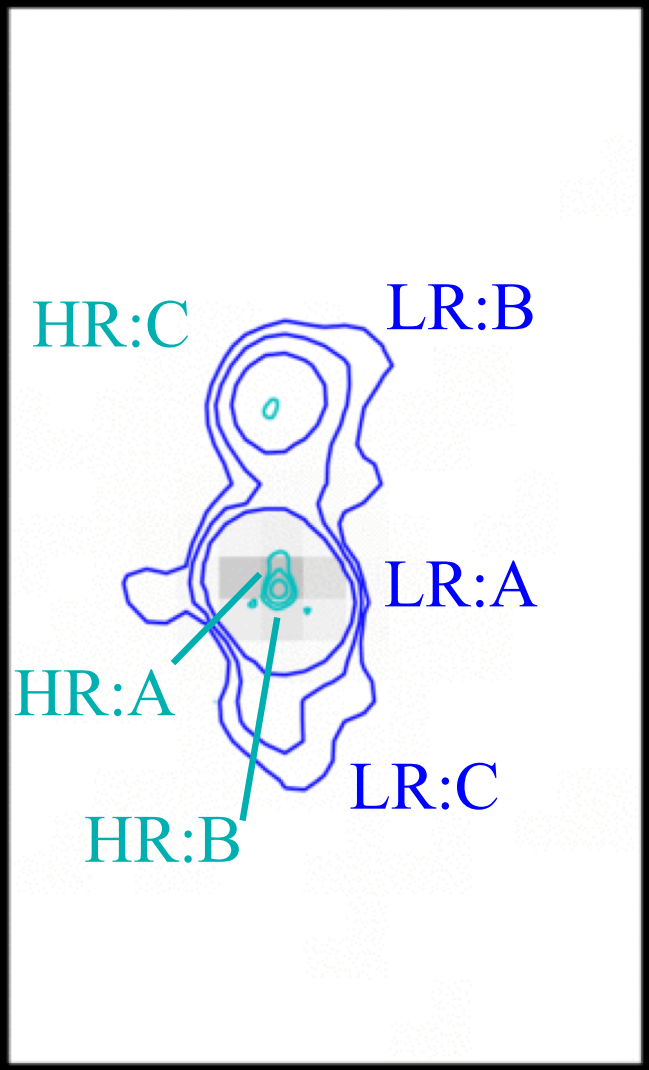
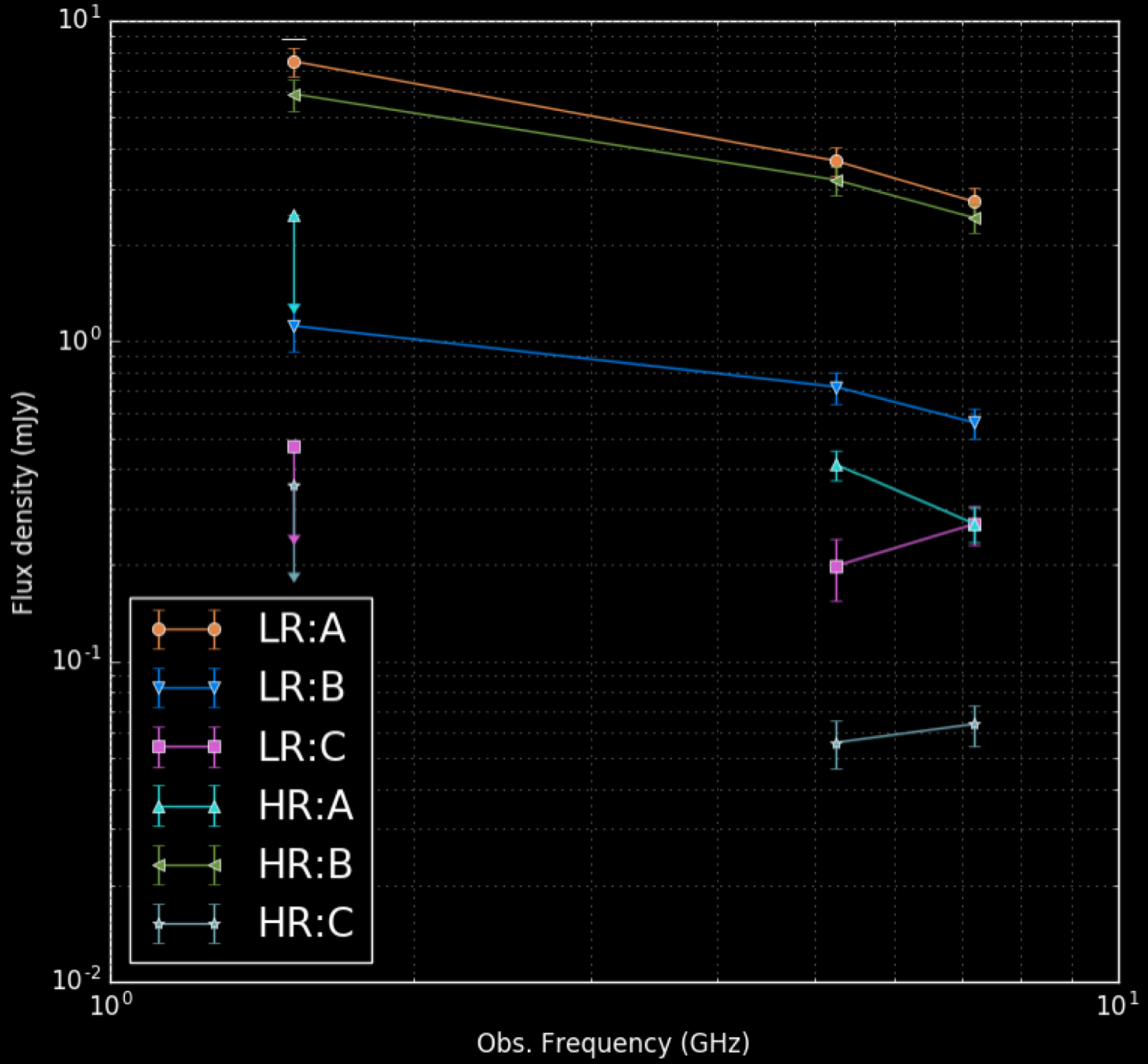
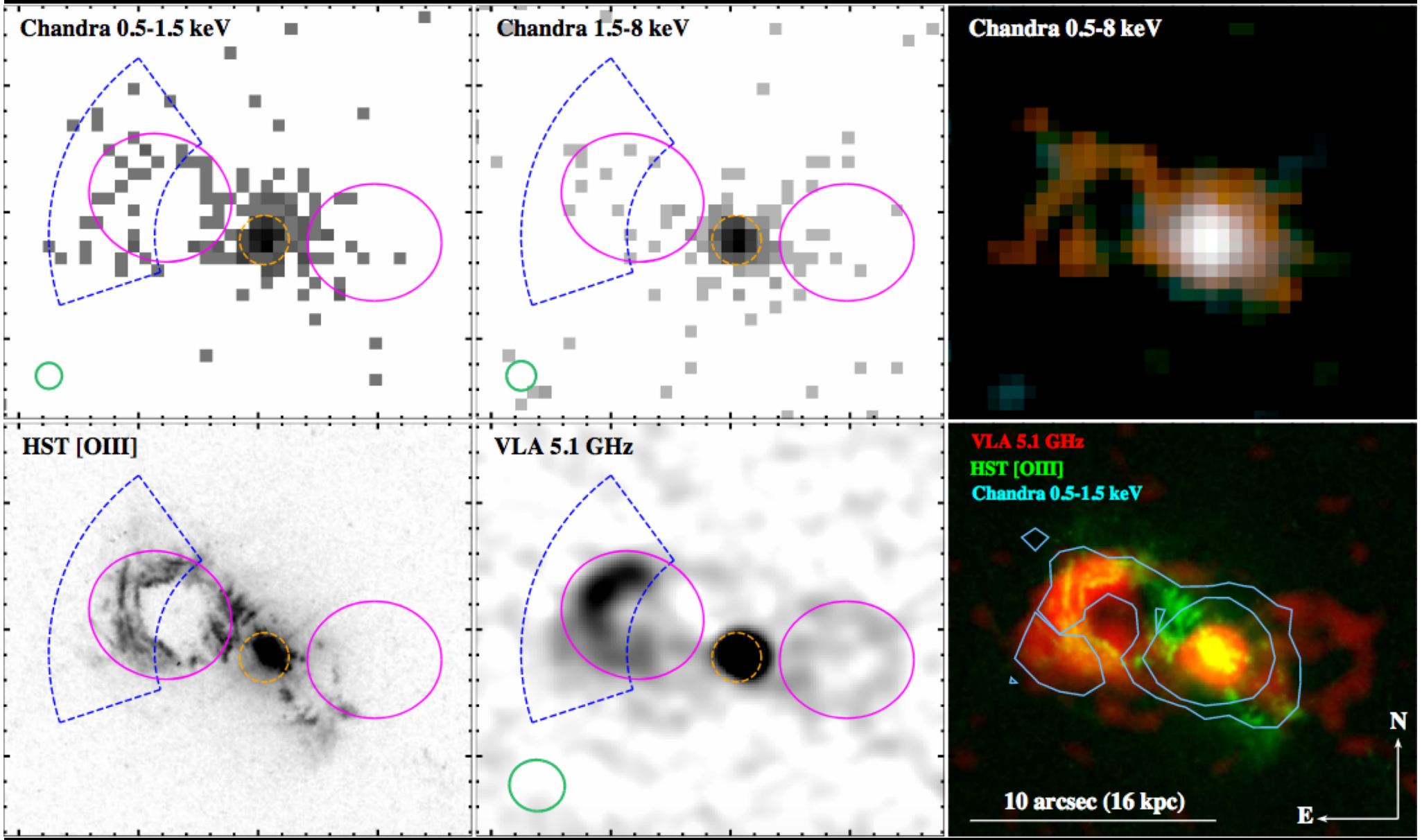




Radio SED :

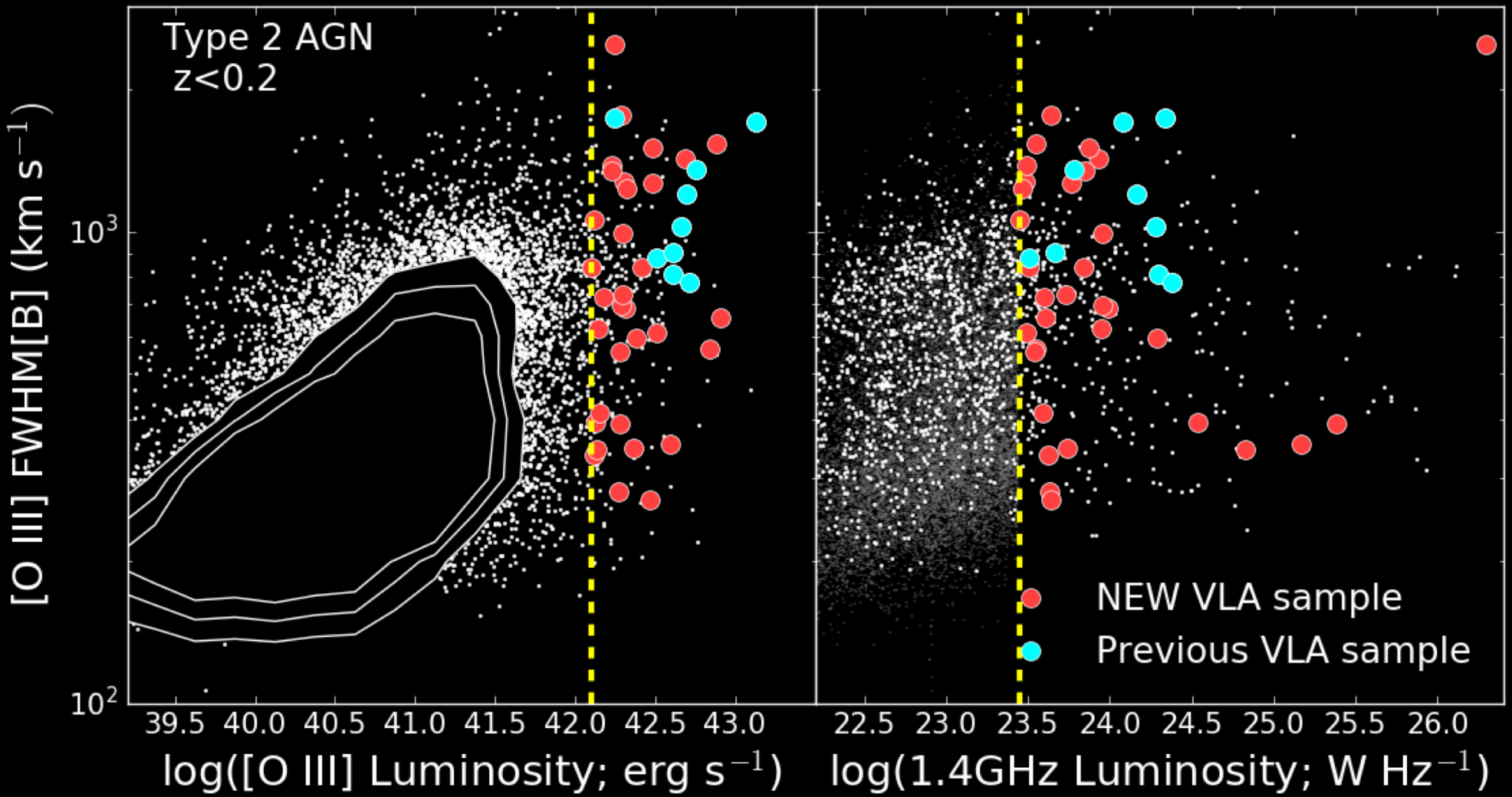

10^1
10^0
10^{-1}
10^{-2}
Flux density (mJy)
10^0
10^1
Obs. Frequency (GHz)
LR:A
LR:B
LR:C
HR:A
HR:B
HR:C

Teacup in X-rays

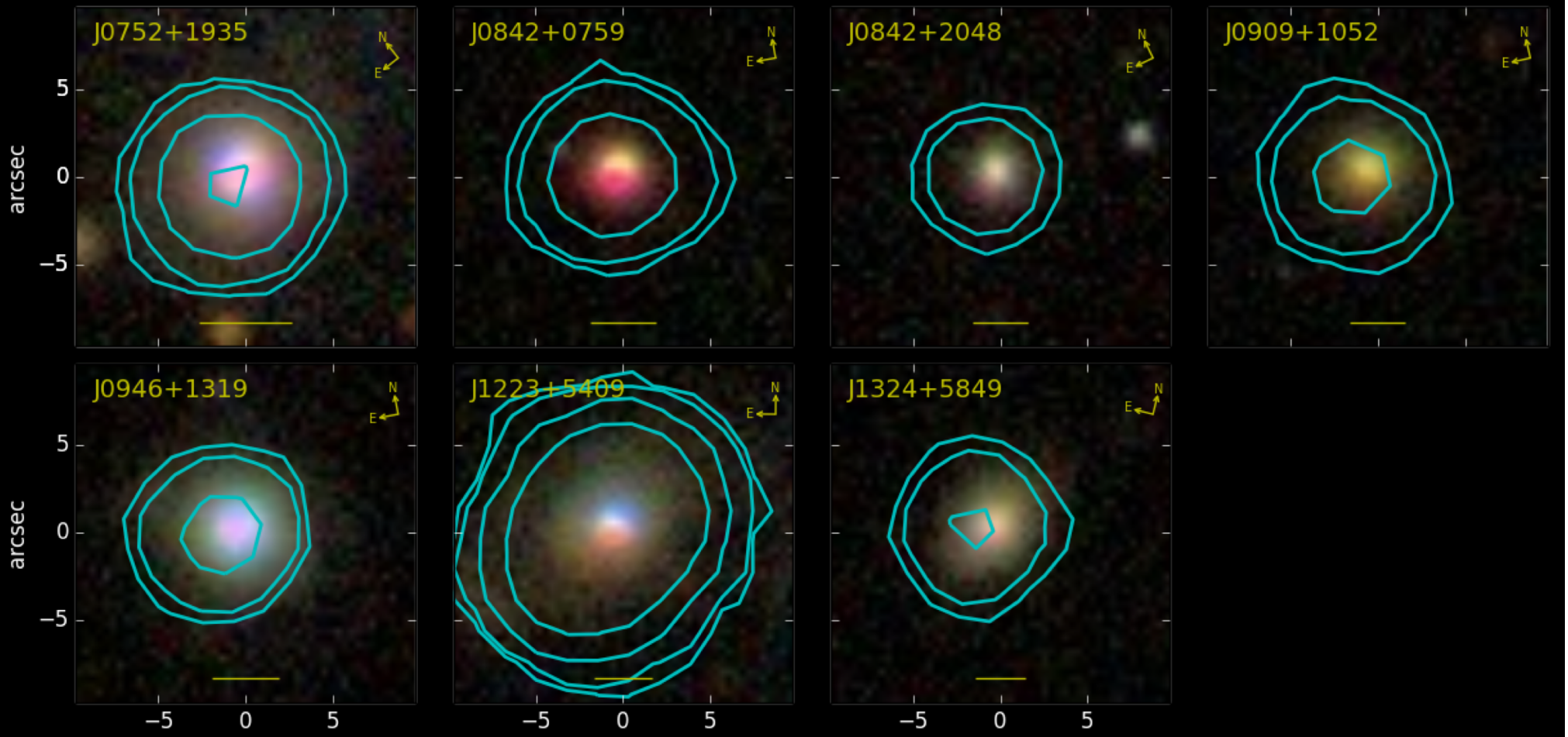


See Lansbury et al. 2018

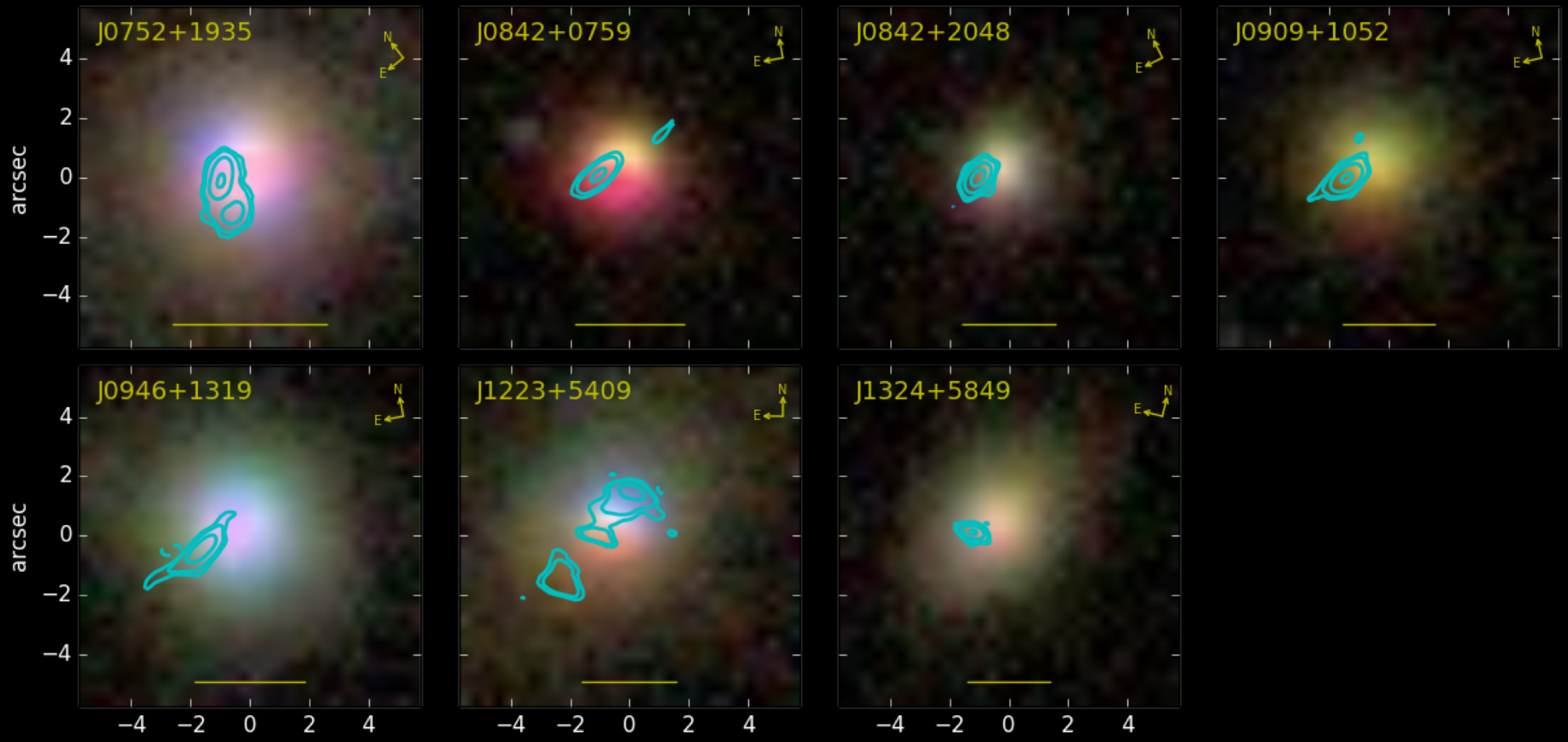
Expanding our sample:



Quick look at the new sample: (FIRST)



Quick look at the new sample: (my VLA)



Summary:

- Have high resolution radio data of 12 quasars with previously detected kpc scale ionized outflows
- ~8 show extended radio features, possibly compact (3-15kpc) jets
- Radio jets may drive outflows in quasars

Still working on:

- Interpreting the radio data especially in respect to the ionized gas outflows