Spectral modeling of 4C 43.15

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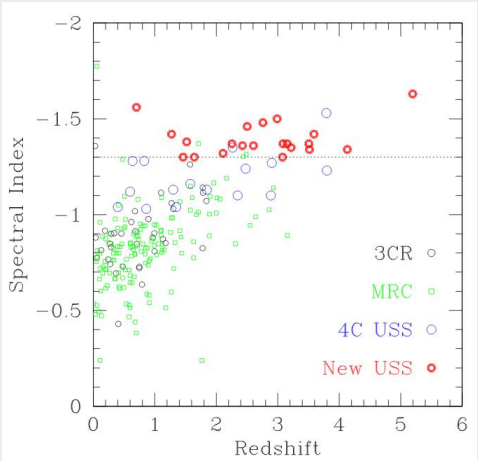
High-z radio galaxies and the α-z correlation

- Important probes for galaxy evolution: e.g. BH evolution, AGN feedback over cosmic time
- Steeper sources tend to lie at higher redshifts: the **α-z correlation**
- Known and used for decades to search for high-z objects
  - Tielens+1979, de Breuck+2000



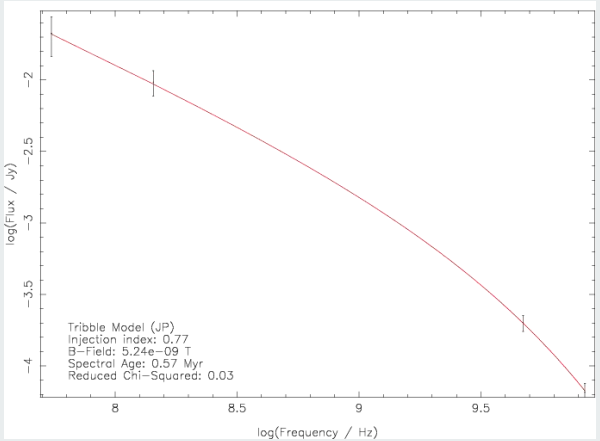
de Breuck+2000

High-z radio galaxies and the α-z correlation

- Origin has been discussed for long

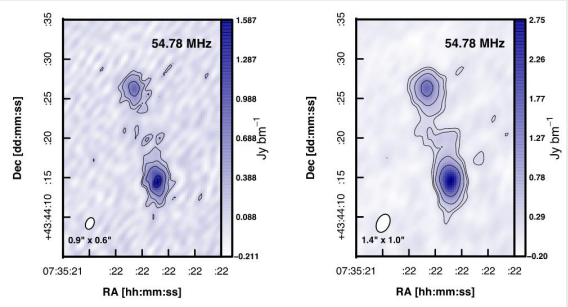
    1. Observational effects: Malmquist bias (e.g. Blundell+1999)
    2. Environmental effects: environmental density (e.g. Klamer+2006)
    3. Inverse Compton losses (e.g. Ghisellini+2014, Morabito&Harwood 2018)

Spectral ageing



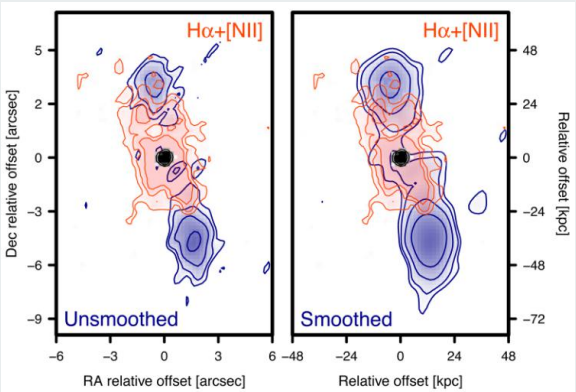
- Model energy losses as inverse Compton + Synchrotron losses
- Broadband Radio Astronomy ToolS (BRATS, Harwood+2013, Harwood+2015)
- Probing low (rest-frame) frequencies is important: injection index
- ILT uniquely probes the low rest-frame frequencies at high spatial resolution

4C 43.15



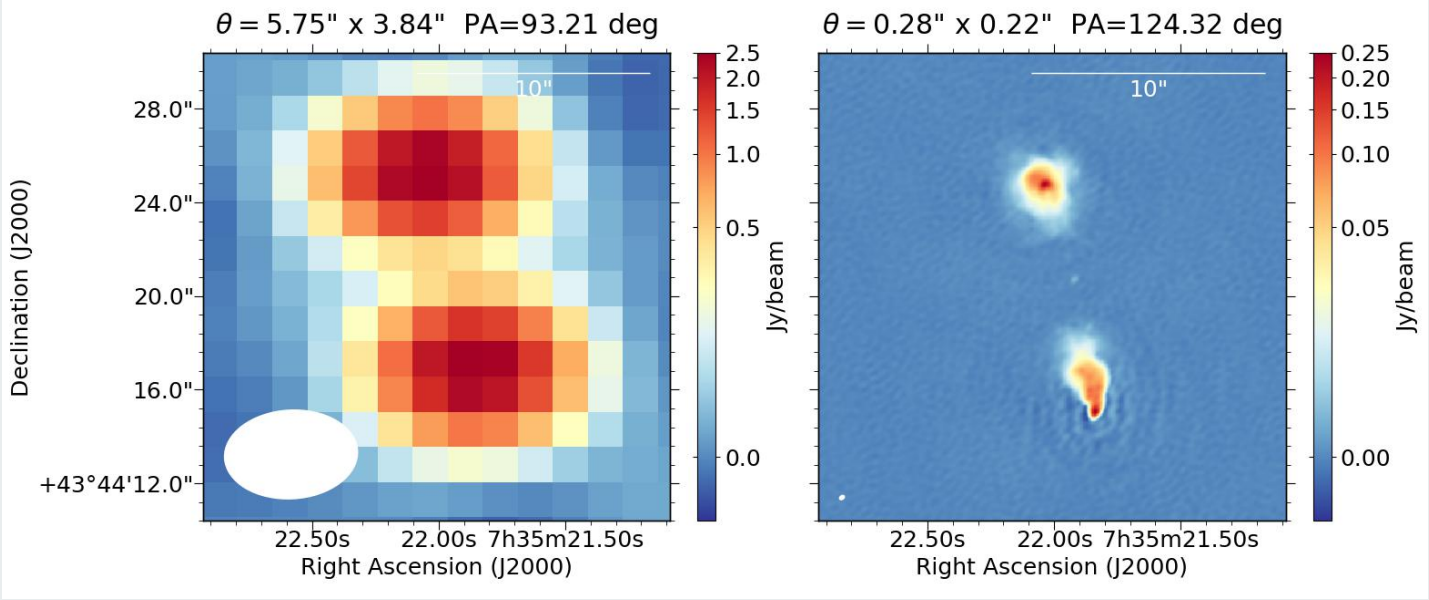
Morabito+2016

- Powerful radio galaxy at z=2.429 (8.3 kpc / arcsec) , $L_{143\ MHz}$ = 2×10^{29} W Hz^{-1}
- Selected as ultra-steep spectrum source: α = -1.1 (325 - 1400 MHz)
- Follow up to Morabito+2016
  - Add 120-166 MHz data and study spatial distribution of spectra
  - Using LOFAR 55 MHz and 143 MHz + VLA 4.7 GHz and 8.1 GHz



Motohara+2000, Morabito+2016

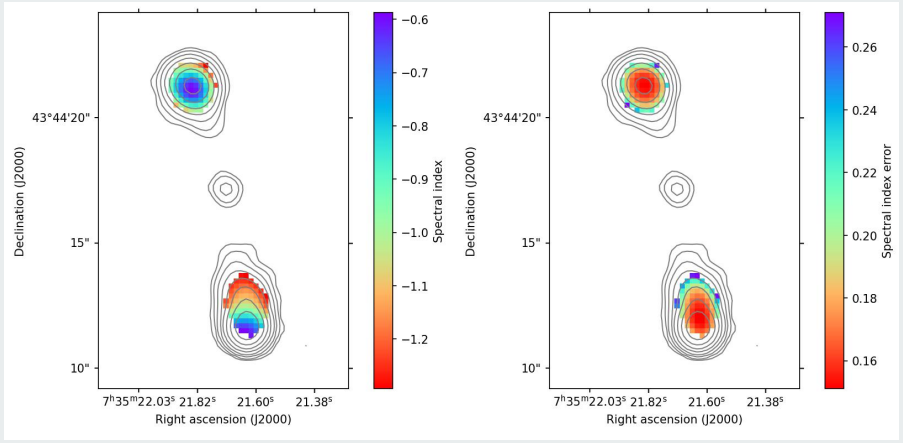
Results


θ = 5.75" x 3.84" PA=93.21 deg
10"
28.0"
24.0"
20.0"
16.0"
+43°44'12.0"
Declination (J2000)
22.50s
22.00s
7h35m21.50s
Right Ascension (J2000)
2.5
2.0
1.5
1.0
0.5
0.0
Jy/beam
θ = 0.28" x 0.22" PA=124.32 deg
10"
22.50s
22.00s
7h35m21.50s
Right Ascension (J2000)
0.25
0.20
0.15
0.10
0.05
0.00
Jy/beam

Results

- Strong magnetic field, but close to CMB
  - B = 5.2 nT and B_{CMB} = 3.7 nT
- Spectral index (top) and age (bottom) distribution at 0.9'' resolution

	North	South
Injection index	-0.8	-0.7
Spectral age [Myr]	0.81 +/- 0.06	0.90 +/- 0.6
Advance speed [*c*]	0.14	0.17



Conclusions

- Spatially resolved spectral index/age maps at low frequencies and high redshift
- Injection indices and advance speeds consistent with literature values
- 4C 43.15 supports the idea of increased inverse Compton losses as a driver behind the α-z correllation
    - Powerful sources are rare
    - Strong B-field close to $B / B_{CMB} = 1.5$

Thank you! Questions?