

Local alignments of parsec-scale AGN radiojets

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Image adapted from ESA/C. Carreau/ATG medialab

Alignments of Optical Polarization Angle (PA)

- Hutsemékers (1998)
- Hutsemékers & Lamy (2001)
- Hutsemékers et al. (2005)

Polarization vs quasar group direction

- Hutsemékers et al. (2014) (Optical)
- Pelgrims & Hutsemékers (2015) (Radio)

Alignments of Radio PA

- Joshi et al. (2007)
- Tiwari & Jain (2013)
- Pelgrims & Hutsemékers (2015)

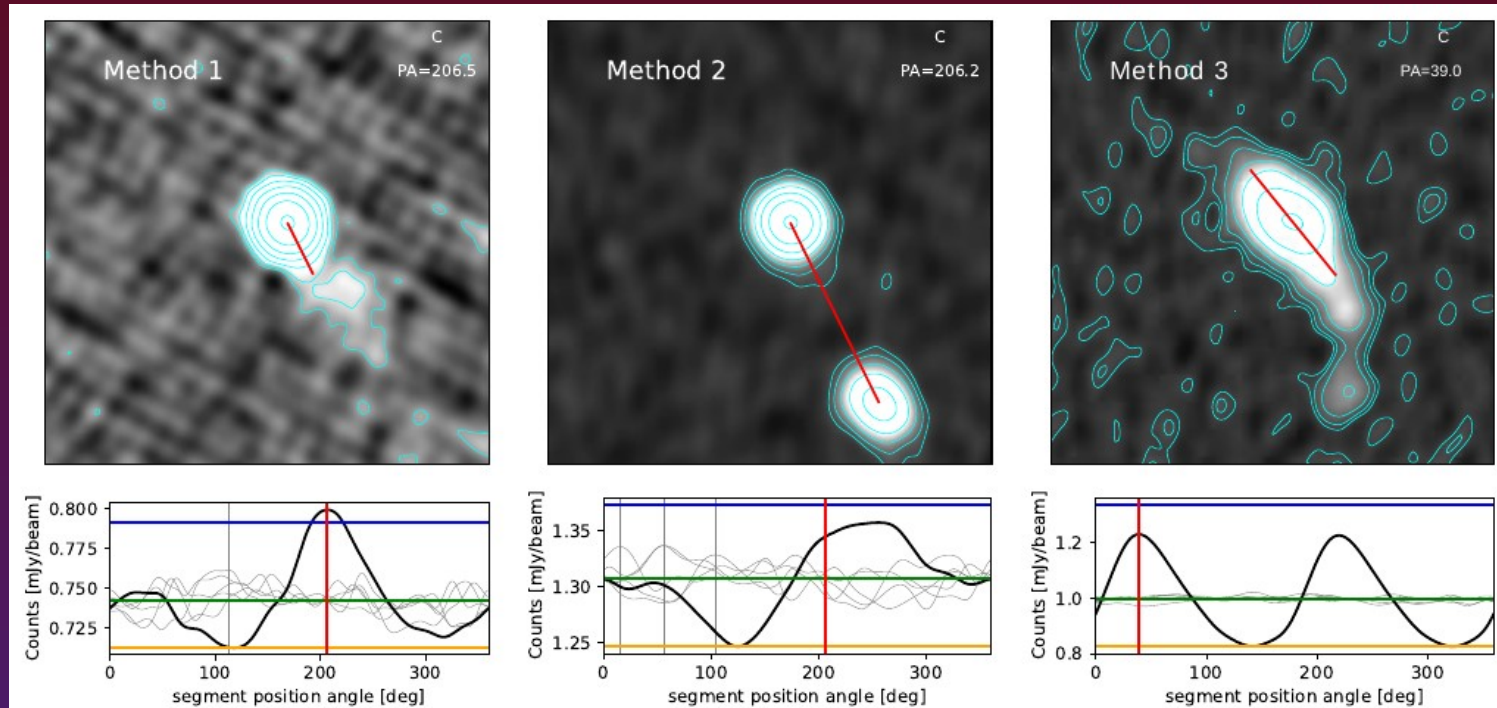
Alignments of radio sources (kpc jets)

- Joshi et al. (2007)
- Taylor & Jagannathan (2016)
- Contigiani et al. (2017)
- Panwar et al. (2020)
- Osinga et al. (2020)

Global alignments of parsec-scale AGN radio jets and their polarization planes: Blinov et al. (2020)

Local alignments of parsec-scale AGN radiojets: Mandarakas et al. (2021) – Accepted for publication (A&A)

- Images from Astrogeo VLBI FITS image database (astrogeo.org/vlbi_images/)
- Redshift info from OCARS catalog (Malkin 2018)
- Automated jet detection with 3 methods
- Eyeballing
- Jet directions for **7290 sources**



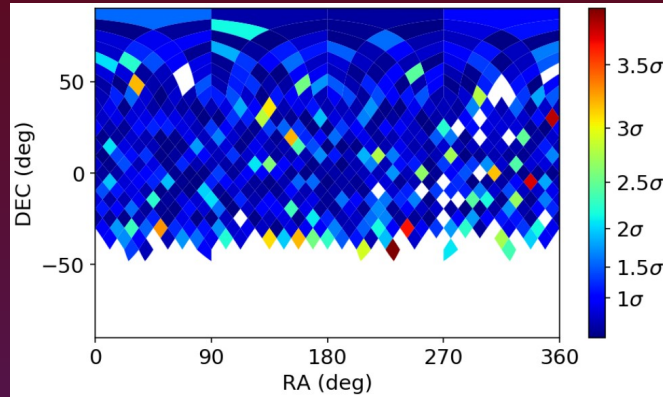
All images are from the VLBA Imaging and Polarimetry Survey (VIPS, Helmboldt et al. 2007). Images used under permission.

Search for alignments

Bin 3D space

- HEALPix
- Meridians/Parallels grid
- Redshift slices

Calculate alignment
significance level (S.L.)



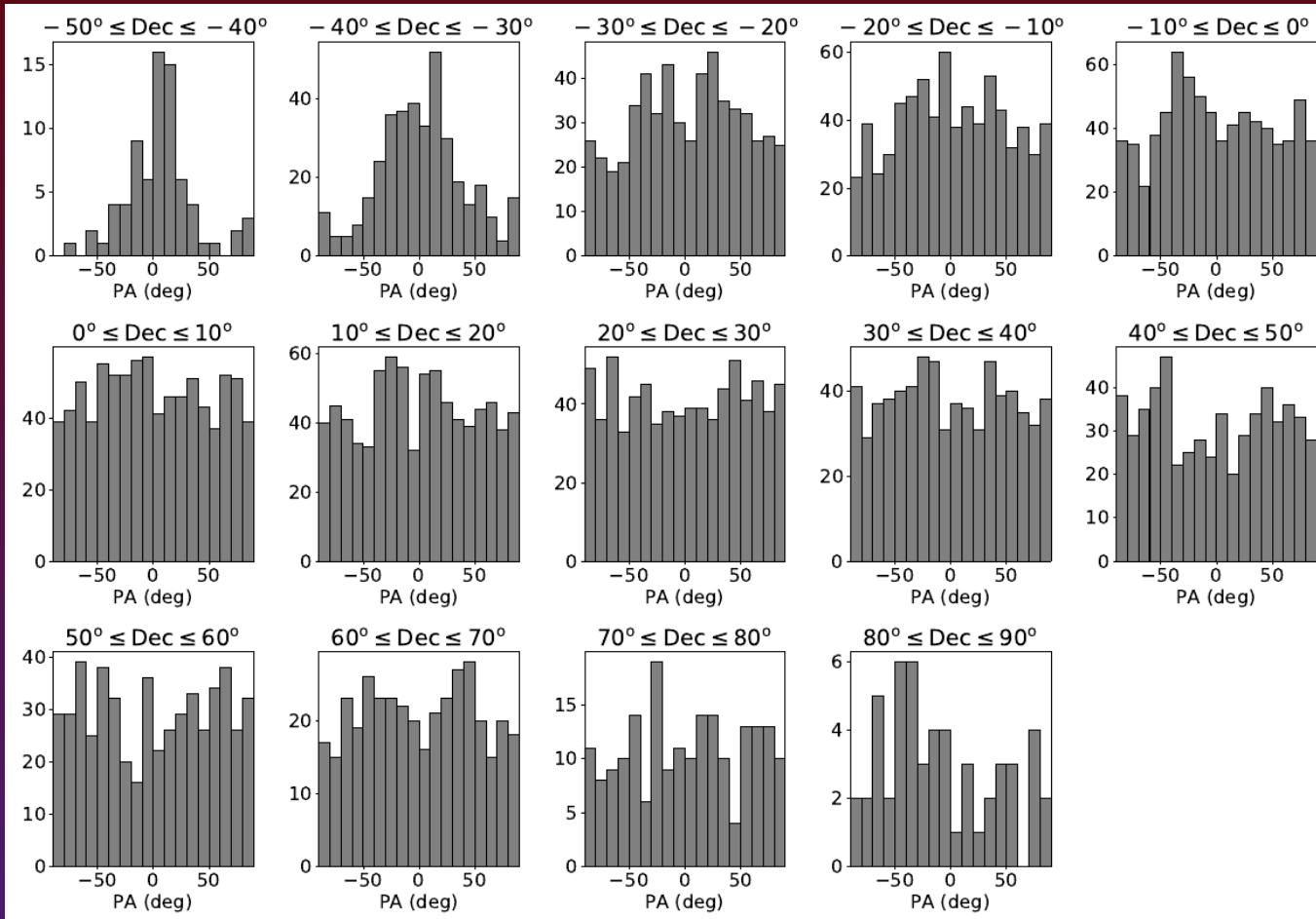
Optimization of each region
so that S.L. is maximum

- Adjust radius of region
- Adjust center of region
- Adjust redshift limits of region

Resulting regions with
high alignment S.L.

Check for Bias

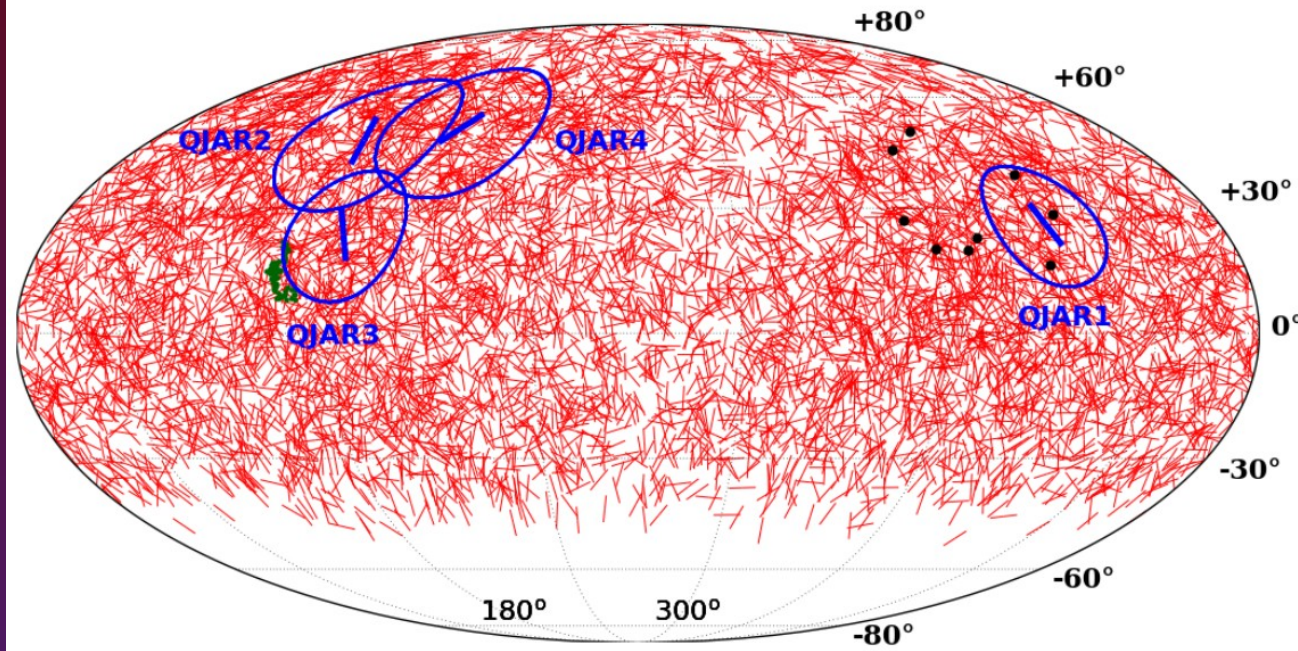
Check for Bias



Due to the locations of the radio antennas, the radio beam for southern sources is elongated in the North-South direction, introducing bias.

Summary

ID	RA deg	DEC deg	Radius deg	z_{\min}	z_{\max}	S.L. σ	PA_{avg} deg
QJAR1	36.18	25.95	14.82	0.02	1.53	5.54	-16.9
QJAR2	168.75	47.54	18.11	0.36	1.89	6.74	-17.7
QJAR3	180.15	23.56	16.07	0.29	0.65	5.72	-25.6
QJAR4	201.83	50.97	18.27	0.07	0.35	5.38	37.6



Black: Giant GRB Ring (Balázs et al. 2015)

Green: Huge-LQG (Clowes et al. 2013)

- Derived pc-scale jet directions for 7290 AGN
- Search for regions with high significance of alignment.
- Check against bias

Found 4 regions with alignment S.L. $> 5\sigma$

- Overlap with alignments regions found by Hutsemékers (1998) and Pelgrims & Hutsemékers (2015)
- Overlap with Giant GRB Ring