18-22 CM VLBA OBSERVATIONAL EVIDENCES FOR TOROIDAL B-FIELD COMPONENTS IN SIX AGN JETS

Juliana Cristina Motter[1,2], Denise Gabuzda[2]

[1] IAG – University of São Paulo – Brazil, [2] University College Cork - Ireland

The formation of relativistic jets in Active Galactic Nuclei (AGNs) is related to accretion onto their central supermassive black holes, and magnetic (**B**) fields are believed to play a central role in launching, collimating and accelerating the jet streams from very compact regions out to kiloparsec scales. We present Very Long Baseline Array (VLBA) linear polarization and Faraday rotation maps based on VLBA data obtained at 18–22 cm for six AGNs, which probe projected distances out to tens of parsecs from the observed core. We have identified statistically significant, monotonic transverse Faraday rotation gradients across the jets of some of these sources, indicating the presence of a toroidal **B** field, which may be one component of helical **B** fields associated with these AGN jets.

1. INTRODUCTION

•The synchrotron radiation detected from AGN jets is intrinsically linearly polarized up to 75%, and linear polarization observations provide information about the degree of order and the direction of the **B**-field in the emission region. Multiwavelength polarization observations provide information about Faraday rotation ocurring between the source and observer.

•In the presence of a helical **B**-field, transverse Faraday rotation measure (RM) gradients should be observed across AGN jets due to the systematic change in the line-of-sight component of the **B**-field [1].

•We present VLBA polarization and RM maps obtained at 18-22 cm for OJ 287, 3C 279, PKS 1510-089, 3C 345, BL Lacertae and 3C 454.3.

2. OBSERVATIONS AND DATA ANALYSIS

•Observations of all the MOJAVE-I sources were made at 1358, 1430, 1493 and 1665 MHz (22.1, 21.0, 20.1 and 18.0 cm) with the NRAO VLBA in 2010 at a total aggregate bit rate of 128 Mbits/s, observing each source in snapshot mode [2].

•The amplitude, phase, polarization and electric vector position angle (EVPA) calibrations were done in AIPS using standard techniques [2].

•All the mapping was done using standard procedures in AIPS. All the EVPA maps used to make the RM maps were convolved with the lowest frequency beam to match their resolutions.

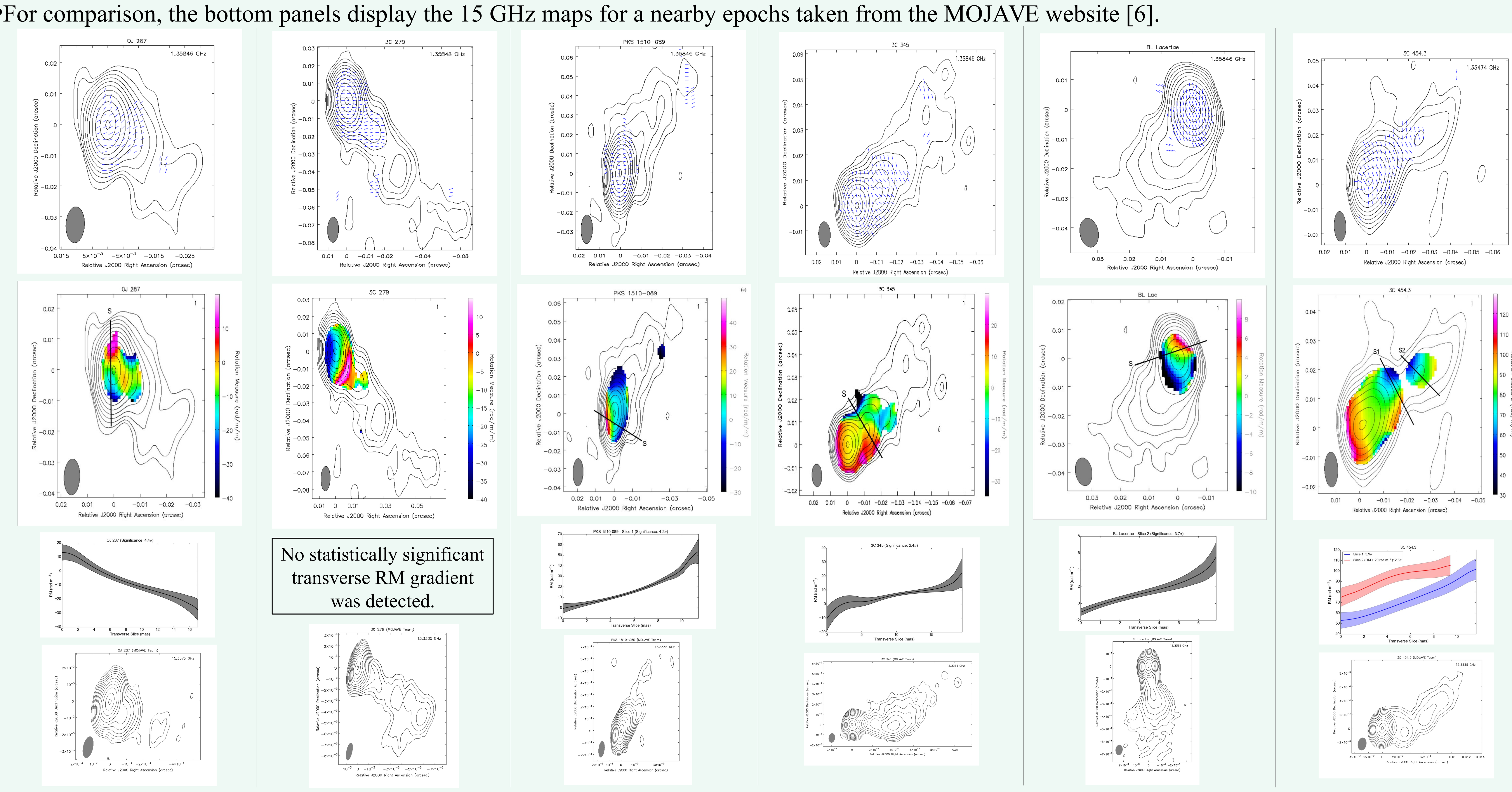
•We removed the effect of integrated Galactic foreground RM [4,5] before constructing the Faraday RM maps, and used the results of [3] when estimating the RM uncertainties.

3. RESULTS

•The top panels present 1358 MHz I contours with EVPAs (blue ticks) superimposed, corrected for the Galactic foreground RM. The contour levels in all maps increase in steps of a factor of two and the gray ellipse in their lower-left corners depicts the convolving beam.

•The middle panels show the RM maps superimposed on the 1358 MHz contours, along with slices where transverse RM gradients were detected, shown below the RM maps.

•For comparison, the bottom panels display the 15 GHz maps for a nearby epochs taken from the MOJAVE website [6].



4. CONCLUSIONS

•The intensity and polarization structures seen in the 18-22 cm images are consistent with those observed on smaller scales in the MOJAVE maps.

•We detected monotonic statistically significant (> 3σ) transverse RM gradients in 4 out of 6 sources: OJ 287, PKS 1510-089, BL Lacertae and 3C 454.3, as well as a tentative transverse RM gradient in 3C 345 (2.4σ).

•Smoothly varying, monotonic, transverse RM gradients indicate the presence of a toroidal field component, which may be associated with helical **B**-fields threading these AGN jets.

5. REFERENCES

[1] Blandford 1993, Astrophys. and Space Science Library, 103, 15.

[2] Coughlan et al. 2011, Proc. 10th EVN Symposium.

[3] Hovatta et al. 2012, AJ, 144, 105.

[4] Rusk 1988, PhD Thesis, University of Toronto.

[5] Taylor et al. 2009, ApJ, 702, 1230.

[6] MOJAVE website. (http://www.physics.purdue.edu/MOJAVE/)