# Polarization Evolution of Parsec-scale Jets in Active Galactic Nuclei

Matthew L. Lister and the MOJAVE Collaboration
Department of Physics and Astronomy, Purdue University, 525 Northwestern Avenue, West Lafayette, IN 47907

We discuss findings from the MOJAVE program, which is studying the total intensity and polarization evolution of a large number of bright, compact radio jets in the northern sky. These jets are powered by supermassive black holes in active galactic nuclei (AGN), and show rapid structural changes in multi-epoch, milliarcsecond-resolution 15 GHz VLBA images. The monitoring sample includes two complete flux-density-limited radio and gamma-ray selected AGN samples, as well as over 100 hard gamma-ray spectrum AGN detected by the *Fermi* LAT instrument. As such, it encompasses a large range of redshift ($0.004 < z < 3.64$), radio luminosity ($10^{23} < L < 10^{29}\,\mathrm{W\,Hz^{-1}}$) , synchrotron peak frequency ($10^{12} < \nu_{\rm peak} < 10^{17}$ Hz), and optical classification (27 radio galaxies, 5 narrow line Seyfert Is, 265 flat-spectrum radio quasars, 125 BL Lac objects, and 15 optically unclassified AGN). The publicly available MOJAVE data archive (http://www.astro.purdue.edu/MOJAVE) includes 8000 VLBA images (5700 of which have full polarization information), and time-lapse movies, spanning more than two decades (1994 – 2017).

The scientific results of the MOJAVE survey have been published in a series of papers, the most recent of which contains over 5000 VLBA linear polarization images of 421 AGNs (typically 5–15 images per source) at 15 GHz. Our multi-epoch analysis of the unresolved core features (associated with the optically thick region near the base of the parsec-scale radio jet) shows that they are typically weakly fractionally polarized ($m < 5\%$), with radio galaxies showing very little polarization ($m < 0.5\%$). The most strongly fractionally polarized cores (up to $m \sim 10\%$) are found in the weak-lined, lower jet power BL Lac objects, with a general trend of weaker core polarization with increasing synchrotron peak frequency. The most polarized cores also have a trend of electric vector position angle (EVPA) aligned with the jet direction, which could either be a signature of strong transverse shocks in the flow, or a predominantly helical magnetic field configuration. Roughly 40% of the jet cores show a stable EVPA direction over time, with BL Lacs having more stable EVPAs than quasars. Unlike the BL Lacs, the quasars show no preferred direction of core EVPA with respect to the jet. We find no significant differences in the core polarization properties of *Fermi*-gamma-ray detected vs. non-*Fermi* detected AGN. The jet fractional polarization tends to increase with distance downstream of the core, in all optical AGN classes, indicating a general increase in field order. The BL Lac jets reach higher polarization levels ($m \sim 20\%$) than the quasars ($m \sim 10\%$), and have EVPAs more aligned with the jet direction at de-projected distances of $\sim 10$ parsecs from the core. These EVPAs tend to remain aligned with the local jet direction even in bright features that move superluminally on curved trajectories.