Highlights of Spanish Astrophysics XII, Proceedings of the XVI Scientific Meeting of the Spanish Astronomical Society held on July 15 - 19, 2024, in Granada, Spain. M. Manteiga, F. González Galindo, A. Labiano Ortega, M. Martínez González, N. Rea, M. Romero Gómez, A. Ulla Miguel, G. Yepes, C. Rodríguez López, A. Gómez García and C. Dafonte (eds.), 2025

The physics of AGN jets revealed by full-Stokes monitoring at mm and cm wavelengths

Ioannis Myserlis[1,2], Ivan Agudo[3], Clemens Thum[1], Ramprasad Rao[4], Daniel Homan[5], Svetlana Jorstad[6], Alan Marscher[6], Alexander Kraus[2], and Emmanouil Angelakis[7]

[1] Institut de Radioastronomie Millimétrique, Avenida Divina Pastora, 7, Local 20, E–18012 Granada, Spain
[2] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany
[3] Instituto de Astrofísica de Andalucía-CSIC, Glorieta de la Astronomía, E-18008, Granada, Spain
[4] Center for Astrophysics | Harvard & Smithsonian, 60 Garden Street, Cambridge, MA 02138, USA
[5] Department of Physics and Astronomy, Denison University, Granville, OH 43023, USA
[6] Institute for Astrophysical Research, Boston University, 725 Commonwealth Ave., Boston, MA 02215, USA
[7] Orchideenweg 8, 53123 Bonn, Germany

Abstract

Jets of Active Galactic Nuclei (AGN) comprise the most energetic, long-term phenomenon in the Universe. They emerge from the vicinity of Super Massive Black Holes (SMBHs) and propagate with relativistic velocities, as high as 0.9998c, to distances much greater than their host galaxies, even > 1 Mpc. In the case of blazars, these jets are closely aligned to our line of sight ($< 5°$), which results in extreme boosting of their emission, making them ideal targets to study the jet physics in detail. Magnetic fields are thought to play a key role in the jet production, acceleration and collimation and they are also responsible for the observed linear and circular polarization.

In addition, blazars exhibit flaring events across the electromagnetic spectrum with timescales ranging from months down to minutes. The mechanisms that have been proposed to explain this variability, e.g. relativistic shocks or magnetic reconnection, predict distinct polarization variability characteristics. Therefore, dense monitoring of the linear and circular polarization emission from AGN jets is a powerful tool to disentangle these processes and study the physical conditions in AGN jets.

Here I will give an overview of blazar variability at mm and cm wavelengths, both in total flux and polarization, as revealed by dedicated, long-term, high-cadence monitoring programs running at several large radio facilities around the globe. I will discuss the challenges involved to achieve robust calibration and deliver high-precision, multi-frequency, full-Stokes radio data trains and showcase the jet physical conditions and variability mechanism characteristics that can be constrained using them. Finally, I will present selected examples of time domain studies of AGN jets and demonstrate how they are augmented by the combined analyses using high angular resolution radio images and concurrent observations in other bands.

My poster in zenodo.org can be found here