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Opening Address

Our understanding of relativistic jets has improved significantly since Heber D. Curtis found in 1918 a mysterious "ray" emanating from the center of M87. It took, however, more than half a century until Marin Rees realized in 1971 that the mysterious "ray" in fact corresponds to a permanent channel, or jet, along which mass and energy are conveyed at relativistic speeds. The development of very long baseline interferometric (VLBI) observations, for which Martin Ryle obtained the Nobel price in 1974, provided the first images of relativistic jets with unprecedented angular resolution, confirming Rees' hypothesis of the relativistic nature of active galactic nuclei (AGN) jets through the detection of superluminal motions by Whitney et al. in 1971. Relativistic jets are usually associated with AGN, but they are in fact far more common than previously thought, being also present in other multiple astrophysical systems, like microquasars, gamma-ray bursts, tidal disruption flares, pulsars, supernovae, etc. A session of the meeting was devoted to the study of jets in stellar-mass objects, looking for synergies with their overweighted AGN cousins.

First polarimetric VLBI observations were performed in the early 70's by the Brandeis University group, followed by direct imaging of the polarization in the jet discrete emission features (components). A key aspect in our understanding of relativistic jets is whether their are threaded by helical magnetic fields, which may appear naturally through the rotation of the accretion disk or black hole ergosphere from which jets are lunched, having therefore an important role in the actual formation, collimation, and acceleration processes. Robert Laing in 1981 first suggested that is possible to detect the presence of helical magnetic fields by looking for a stratification in Faraday rotation (as well as in total and linearly polarized intensity) across the jet width. First observational indication for gradients in Faraday rotation were obtained by Keiichi Asada in 2002 in the jet of 3C273, followed by similar observations in other sources by Denise Gabuzda and other authors. One of the main topics of the meeting was the study of the magnetic field structure in jets, for which two sessions were devoted.

Numerical simulations have played a key role in our understanding of jet physics. In the last decades we have witnessed an impressive development in the simulation of jets, from the early relativistic hydrodynamical and emission simulations in the 1990's, to the recent 3D GRMHD simulations capable of simulating the jet formation. A session of the meeting was devoted to study the jet dynamics, structure and stability through numerical simulations.

Locating the sites and establishing the mechanisms for the high energy emission in blazars has become one of the most active topics in jet physics. Multi-wavelength monitoring programs, including *Fermi*, Cherenkov telescopes, X-ray, optical, millimeter and radio-wavelengths observations, combined with VLBI monitoring (from the Boston University group and MOJAVE team, among others) are allowing to address these questions for the first time. Multi-wavelength observations are also providing information about the acceleration and collimation zone, suggesting the existence of helical fields and the possibility that the radio core is a recollimation shock, leading to gamma-ray flares when new components pass by, as suggested by Alan Marscher. Two sessions of the meeting were devoted to analyze the emission across the electromagnetic spectrum, one of the main topics of the meeting.

Finally, imaging the acceleration and collimation zone, determining the distance between the central black hole and the upstream end of the jet (the radio core), and ultimately imaging the black hole silhouette remain on the main challenges in the study of relativistic jets. In the past decade we have witnessed a great progress in our understanding of the innermost jet regions through numerical simulations, multi-frequency phase-reference and mm-VLBI observations. The inclusion of ALMA in mm-VLBI arrays and the space-VLBI program *RadioAstron* hold great expectations for future imaging of the innermost jet regions, as discussed during the meeting.

A summary of the meeting, wrapping up the results presented during the symposium and identifying the most important challenges that our field faces for the next years, was presented by Alan Marscher, and closes these proceedings.

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