Theory and Simulation of Relativistic Jet Formation: Towards a Unified Model

David L. Meier

Jet Propulsion Laboratory,
California Institute of Technology

I will review recent progress in the theory of relativistic jet production. The presently-favored mechanism is an electrodynamic one, in which charged plasma is accelerated by electric fields that are generated by a rotating magnetic field. The most pressing issues of current interest are understanding what factors control the jet power, its speed, its degree of collimation, and its stability, and how these properties determine the type of jet observed and its effect on its environment.

A number of observations and physical models now indicate that galactic relativistic jet sources (microquasars, pulsars, supernovae, gamma-ray bursts) may be intimately related, both physically and astrophysically. In addition, there is strong indication that black hole jet sources of stellar-mass in the Galaxy (microquasars) behave in a manner very similar to extragalactic, supermassive black hole jet sources (AGN and quasars). I therefore explore the questions of to what extent these objects can be unified, and what important issues must be resolved before proposed grand unified schemes can be adopted. We are now at the point in the study of relativistic jets where significant progress can be made in the understanding of all sources, but only if there is considerable cross-fertilization among all these separate communities, particularly between those that study Galactic and extragalactic jet sources.