3D SIMULATIONS OF MAGNETIZED ASTROPHYSICAL JETS

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Cosmic jets appear as a common phenomena in the universe. In the galactic scale, they are observed to emerge, for example, from protostars. In the extragalactic scale they are associated to active galactic nuclei. Magnetic fields with intensities of the order to 10^{-6} – 10^{-5} G have been detected in these jets. In previous papers (e.g., Gouveia Dal Pino & Benz 1993, 1994; Gouveia Dal Pino et al. 1996), purely hydrodynamical three-dimensional numerical simulations of astrophysical jets were performed using the smoothed particle hydrodynamical (SPH) technique. In the present work, we solve the MHD equations in the SPH formalism in order to investigate the effects of the magnetic field on the structure and evolution of the astrophysical jets.

We assume two different configurations for the initial magnetic field, with the constraint that the maximum plasma beta parameter not exceed the value for equipartition of energy. In our case, these correspond to 8.3×10^{-5} G. We find that both helical and longitudinal configurations can be efficient to promote the appearance of internal oblique shock waves along the beam in the adiabatic calculations. These shocks are promoted by the magnetic pinch and kink instabilities which can eventually cause the destruction of the beam close to the head. With the inclusion of radiative cooling, these effects are inhibited and in some cases disappear. In the beginning of all calculations, the strength of the bow and jet shocks are clearly diminished by the magnetic field, in agreement with one dimensional analytical predictions. Several models with distinct Mach numbers and density contrasts are investigated and a summary of these results can be found in Gouveia Dal Pino & Cerqueira (1996).

Gouveia Dal Pino, E.M., & Benz, W. 1993, ApJ 410, 686

Gouveia Dal Pino, E.M., & Benz, W. 1994, ApJ 435 261

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DYNAMICAL IMPLICATIONS OF THE FUNDAMENTAL PLANE AND GALAXY FORMATION

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As we go from the virial plane to the fundamental plane (of normal ellipticals) and then to the fundamental plane of evolved ellipticals, the change of the slope is such that the exponent of the surface brightness (projected density) remains nearly constant, while that of the velocity dispersion (kinetic temperature) changes by about 0.5 from the virial to the fundamental plane and again by about 0.5 during the transition to the fundamental plane of evolved ellipticals (cf., Chatterjee 1992, A&AS 196, 283). Following Magalinsky (1972, AZh 49, 1017 – Sov. Astron.-AJ, 16, 830), if we use the Vlasov equation to study small perturbations (considering them to be protogalaxies) to the exact solution corresponding to a spatially homogeneous medium in expansion, we find that the condensation attains a finite size proportional to the ratio of the square of the projected density, such that it is expected to fall on the virial plane. If the further evolution of the condensation has the same trends as its formation process, we find that its scale length evolves in proportion to the ratio of the kinetic temperature to the projected density, such that it is expected to fall on the fundamental plane of evolved ellipticals.

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RECURRENT PATTERNS IN AGN LIGHT CURVES

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Optical-UV variability has long ago been established as a fundamental property of AGN and has riddled us ever since. To date, the nature of the continuum variations is yet to be understood. Inspecting the optical light curves of NGC 4151 (1970–1990) and NGC 5548 (1989–1993) we found some intriguing coincident patterns in the variations. One of these coincidences is illustrated below, where we superpose the B-band light curves of NGC 4151

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