28th Texas Symposium on Relativistic Astrophysics

Contribution ID: **137** Type: **Talk**

Stability of relativistic two-component jets

Monday 7 December 2015 17:59 (20 minutes)

Several observations of astrophysical jets show evidence of a structure in the direction perpendicular to the jet axis, leading to the development of "spine & sheath"models of jets.

Two-component jets have been already examined (e.g. Meliani & Keppens 2007, Meliani & Keppens 2009) for relativistic hydrodynamic jets and relativistic magnetized jets with poloidal magnetic field. These studies focused on a two-component jet consisting of a highly relativistic inner jet and a slower - but still relativistic - outer jet surrounded by an unmagnetized environment. These jets were susceptible to a relativistic Rayleigh-Taylor-type instability, depending on the effective inertia ratio of the two components.

This work is now extended by taking into account the presence of a non-zero toroidal magnetic field. We examine analytically the stability of this configuration and also perform numerical simulations, using MPI-AMRVAC, to compare with the previously studied cases. Depending on the configuration, the toroidal magnetic field might stabilize the previously mentioned case or trigger instabilities on a different time scale. Furthermore, the introduction of a toroidal magnetic field component allows examining different types of relativistic jets (Poynting dominated or matter dominated) by modifying the magnetization parameter. Thus, we can investigate different combinations of matter/ Poynting dominated two-component that will end up (un)stable.

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Session Classification: 14 - Disks and jets