Energetic particle production and magnetic field amplification in protostellar jets

A. Araudo[1], M. Padovani[2], A. Marcowith[3]

[1] *Astronomical Institute of the Academy of Sciences, Prague, Czech Republic*

[2] *INAF-Osservatorio Astrofisico di Arcetri, Firenze, Italy*

[3] *Laboratoire Univers et Particules de Montpellier (LUPM) Université Montpellier, Montpellier, France*

Supersonic and collimated bipolar jets are launched from the inner regions of accretion discs in forming stars. Jets from young stellar objects are well known thermal emitters due to the presence of radiative shocks. However, non-thermal radio emission from a handful of protostellar jets has been reported in the last years thanks to the improved sensitivity of radio interferometers [1]. The detection of synchrotron radiation indicates the presence of relativistic electrons and magnetic fields of $\sim$0.1 mG. We study diffusive shock acceleration and magnetic field amplification in protostellar jets with velocities $\sim$500 km s^{-1}. We show that the jet magnetic field can be amplified by non-resonant hybrid instabilities excited by the streaming of cosmic rays [2]. The maximum energy that electrons and protons can achieve is constrained by radiative losses and damping of scattering waves, where the ionization of the plasma plays an important role. In the case that particles being accelerated can circumvent these limits and achieve energies greater than a GeV, they can emit gamma rays in their interaction with photon and matter fields. The detection of this radiation by the Fermi satellite and the forthcoming Cherenkov Telescope Array will open a new window to study the stellar formation, as well as diffusive acceleration and magnetic field amplification in astrophysical shocks with velocities of about 500 km s^{-1}.

References

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