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TeV particles in protostellar jets

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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.
However, non-thermal radio emission from a handful of protostellar jets has been reported in the last years. The detection of synchrotron radiation indicates the presence of relativistic electrons and magnetic fields of about 0.1 mG. Protons can be accelerated as well.
Below certain conditions, non-resonant hybrid (Bell) instabilities can be excited by the streaming of protons being accelerated and the magnetic field is amplified.
We study diffusive shock acceleration and magnetic field amplification in protostellar jets with velocities ~500 km/s. The maximum energy that electrons and protons can achieve is constrained by escape and radiative losses, as well as damping of scattering waves, where the ionization of the plasma plays an important role. We find that both electrons and protons can be accelerated up the TeV domain and therefore emit gamma rays in their interaction with photon and matter fields. The detection of this radiation by the forthcoming Cherenkov Telescope Array will open a new window to study the formation of massive stars, as well as diffusive acceleration and magnetic field amplification in astrophysical shocks with velocities of about 500 km/s.

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