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Adiabatic-radiative shock systems in non-relativistic astrophysical jets: a key to enhance the gamma-ray emision

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Of all the processes in the Universe, the bipolar ejection of collimated plasma outflows from the inner regions of the accretion disc around a central object are among the most remarkable. The shocks that form in highly supersonic jets are ideal sites for particle acceleration. By combining multi-wavelength observational data, numerical simulations, and plasma physics we study diffusive shock acceleration and gamma-ray emission in jets in protostars and supersonic outflows in classical novae. The coexistence of an adiabatic and a radiative shock is expected in the jet termination region, being this scenario very promising for particle acceleration and high-energy emission. Particles accelerated in the adiabatic shock can radiate through proton-proton collisions and relativistic Bremsstrahlung in the dense layer separating the adiabatic and radiative shock downstream regions. We find that protostellar jets can reach detectable levels of gamma-ray emission in this framework, not detected to date. Nova outflows have been detected in the gamma-ray domain, and we propose here an alternative scenario to explain the high-energy emission. Furthermore, the parameters for scaled laboratory experiments are very much in line with plasma conditions achievable in high-power laser facilities opening the door to new means for studying novae outflows never considered before.

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