SIMULATIONS OF GAMMA-RAY BURST AFTERGLOWS

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Gamma-ray bursts (GRBs) are the most luminous events observed in the universe. GRBs originate from relativistic plasma jets that are launched by supernova explosions or collisions between two compact objects (black holes or neutron stars). A typical GRB is followed by afterglow emission at lower energies. The afterglow is believed to arise from the interaction between the jet and the interstellar medium, and the emission extends from radio up to X-ray and possibly even GeV energies. GeV emission has been observed in connection with several GRBs in recent years, but its origin is still under debate ([1],[2],[3]). Several features in afterglow light curves, such as the commonly appearing flat sections in X-ray light curves, also lack a satisfactory explanation (e.g., [4]).

Motivated by the mysterious features discovered in GRB afterglows, we have developed a numerical code that simulates afterglow spectra and light curves at a wide range of wavelengths extending from radio to TeV energies. The code has already been applied to look into the possible origin of the GeV emission and flat sections in X-ray light curves [5]. The spectra and light curves are obtained by solving the so-called kinetic equations that govern the behaviour of the electron and photon distributions inside the relativistic jet [6]. This approach ensures an exact treatment of all the relevant radiation processes: synchrotron radiation, Compton scattering and electron-positron pair production. However, the code is unable to follow the propagation of particles within the emitting region. This is why we are now developing a new code that applies the Monte Carlo method and is able to both deal with the radiation processes in detail and track the paths of the electrons and photons inside the jet.

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