Physics of shocks generating high energy cosmic phenomena

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Two kinds of challenge raise in high energy astrophysics :i) the generation of very powerful spectra of suprathermal particles or photons, as for instance the Gamma Ray Burst emissions, ii) the generation of spectra of high energy particles that extend to Ultra High Energies (a few 1020eV). Strong collisionless shocks with turbulence, possibly accompanied by reconnection sites, are expected to be the sources of these phenomena, by developing a Fermi process through scattering off self-generating turbulence. From the point of view of physics, the main task is to understand and to quantify the triptych that involves the formation of a collisionless shock, the generation of suprathermal particles and the generation of turbulence interdependently. Non relativistic shocks and relativistic shocks have different properties in this respect and different efficiencies in accounting for the high energy challenges. Whereas the generation of MHD turbulence is expected at non-relativistic shocks, generation of intense micro-turbulence is expected at relativistic shocks (however with probably an MHD component also in the long term). A special focus on relativistic shocks with their micro-turbulence will be addressed, including a view on the nonlinear structure and an estimate of the radiative performance.