

those associated with supernovae blast waves, will also be discussed.

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Particle acceleration and injection problem in relativistic and nonrelativistic shocks

Acceleration of charged particles at the collisionless shock is believed to be responsible for production of cosmic rays in a variety of astrophysical objects such as supernova, AGN jet, and GRB etc., and the diffusive shock acceleration model is widely accepted as a key process for generating cosmic rays with non-thermal, power-law energy spectrum. Yet it is not well understood how the collisionless shock can produce such high energy particles. Among several unresolved issues, two major problems are the so-called "injection" problem of the supra-thermal particles and the generation of plasma waves and turbulence in and around the shock front. With recent advance of computer simulations, however, it is now possible to discuss those issues together with dynamical evolution of the kinetic shock structure. A wealth of modern astrophysical observations also inspires the dynamical shock structure and acceleration processes along with the theoretical and computational studies on shock. In this presentation, we focus on the plasma wave generation and the associated particle energization that directly links to the injection problem by taking into account the kinetic plasma processes of both non-relativistic and relativistic shocks by using a particle-in-cell simulation. We will also discuss some new particle acceleration mechanisms such as stochastic surfing acceleration and wakefield acceleration by the action of nonlinear electrostatic fields.

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Pulsar Wind Nebulae in TeV gamma-ray emission

In this presentation we review the observational properties of pulsar wind nebulae (PWN) detected at VHE gamma-ray energies. Whereas we have evidence for dynamic plerions in binary systems, we will focus on those which resulted from supernova explosions, leaving an expanding pulsar driven bubble and a supernova shell. For these we see two types: (1) The younger Crab-like PWN, which are mostly unresolved and composite and (2) the evolved Vela-like PWN which show resolved, but offset morphologies. A shell is seldom seen. We also notice an evolution in the ratio of X-ray to VHE fluxes from PWN. A general theoretical framework will also be presented within which these observations can be understood.

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PRadiation dominated relativistic current sheets

Relativistic Current Sheets (RCS) feature plasma instabilities considered as potential key to magnetic energy dissipation and non-thermal particle generation in Poynting flux dominated plasma flows. We show in a series of kinetic plasma simulations that the physical nature of non-linear RCS evolution changes in the presence of incoherent radiation losses: In the ultra-relativistic regime (i.e. magnetization parameter $\sigma = 10^4$ defined as the ratio of magnetic to plasma rest frame energy density) the combination of non-linear RCS dynamics and synchrotron emission introduces a temperature anisotropy triggering the growth of the Relativistic Tearing Mode (RTM). As direct consequence the RTM prevails over the Relativistic Drift Kink (RDK) Mode as competitive RCS instability. This is in contrast to the previously studied situation of weakly relativistic RCS ($\sigma \sim 1$) where the RDK is