Contribution ID: **388** Type: **Talk**

First-order Fermi acceleration at pulsar wind termination shock.

Saturday 5 December 2015 17:15 (20 minutes)

The Pulsar Wind Nebulae (PWNe) PSR B1259-63 has been observed to emit periodic GeV flares, whose power can be comparable to the total pulsar spin-down luminosity. Because of the short timescale involved, these photons are likely to be produced via inverse Compton scattering of stellar photons or Synchrotron radiation by a population of very energetic electrons (from GeV to TeV energies) in proximity of the wind termination shock (TS). This perpendicular shock is created by the interaction between the magnetised, relativistic, electron-positron wind launched by the pulsar with the companion star outflow. When the rotational frequency of the pulsar is greater than the local plasma frequency in the wind, a shock precursor forms ahead of the TS, where the Poynting flux is dissipated. This condition is satisfied at the TS in a gamma-ray binary when the system is far from periastron, but not necessarily when the stars are in close proximity to each other (Mochol & Kirk 2013). It is stll unclear whether and how this structure can accelerate electrons to high energies. We investigate this in a two-step procedure. Firstly, a 1-dimensional, relativistic, 2-fluid code is used to reproduce the turbulent fields in the equatorial plane at the location of the TS. We numerically integrate test particle trajectories in the background fields of a steady configuration of the precursor realised for an upstream Lorentz factor $\Gamma = 40$ and a magnetisation parameter $\sigma = 10$. We follow each particle until it either escapes downstream after transmission or upstream after reflection. We find that $\sim 50\%$ of the incoming particles are reflected upstream by the turbulent fields for these parameters. Secondly, we simulate Fermi-like acceleration by supplementing magnetic fluctuations with prescribed statistical properties both in the pulsar wind upstream of the shock, and in the nebula downstream of the shock, where the field is assumed to have been dissipated. The resulting stochastic trajectories are numerically integrated (Achterberg & Kruells 1992). We compare the power-law index and the angular distribution of accelerated particles with the same quantities obtained with a numerical simulation where the average magnetic field is null on both sides of the shock and the only source of deflection

for energetic particles is the scattering off magnetic irregularities (Achterberg et al. 2001).
We argue that the proposed scenario is relevant for PWNe in γ-ray binaries such as PSR B1259-63.

Author: Mr GIACCHE', Simone (Max-Planck Institute for Nuclear Physics)

Co-authors: Prof. KIRK, John (Max-Planck Institute for Nucear Physics); Dr AMANO, Takanobu (Department of Earth and Planetary Science, University of Tokyo)

Presenter: Mr GIACCHE', Simone (Max-Planck Institute for Nuclear Physics)

Session Classification: 18 - Gal. accel. & pulsars