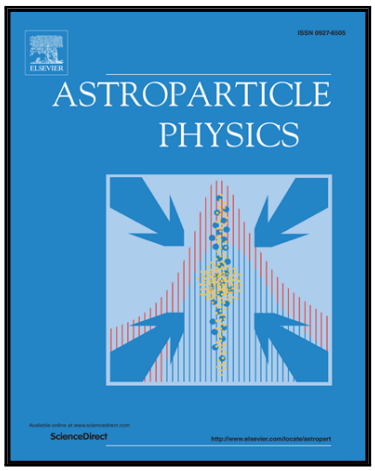

Efficiency of Centrifugal Mechanism in Producing PeV Neutrinos From Active Galactic Nuclei

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Efficiency of Centrifugal Mechanism in Producing PeV Neutrinos From Active Galactic Nuclei

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ABSTRACT

A several-step theoretical model is constructed to trace the origin of ultra high energy (UHE) $[1-2]$PeV neutrinos detected, recently, by the IceCube collaboration. Protons in the AGN magnetosphere, experiencing different gravitational centrifugal force, provide free energy for the parametric excitation of Langmuir waves via a generalized two-stream instability. Landau damping of these waves, outside the AGN magnetosphere, can accelerate protons to ultra high energies. The ultimate source for this mechanism, the Langmuir-Landau-Centrifugal-Drive (LLCD), is the gravitational energy of the compact object. The LLCD generated UHE protons provide the essential ingredient in the creation of UHE neutrinos via appropriate hadronic reactions; protons of energy 10^{17}eV can be generated in the plasmas surrounding AGN with bolometric luminosities of the order of 10^{43}ergs s^{-1}. By estimating the diffusive energy flux of extragalactic neutrinos in the energy interval $[1-2]$PeV, we find that an acceptably small fraction 0.003% of the total bolometric luminosity will suffice to create the observed fluxes of extragalactic ultra-high energy neutrinos.

Subject headings: neutrinos – (ISM:) cosmic rays – galaxies: active – plasmas – magnetohydrodynamics (MHD)

1. Introduction

The recent discovery of the ultra high energy (UHE) extra-solar neutrinos by the Ice Cube collaboration (Aartsen et al. 2013) is particularly interesting. The neutrino trajectories, in contradistinction to those of the UHE charged particles, are unaffected by the galactic magnetic field, and can lead the observer back to the origin of the emanation.

In the Ice Cube announcement, two events - neutrinos of energies 1.04PeV and 1.14PeV with a high significance of observations are emphasised. An analysis of the observational data between 2010 and 2013 also shows an event that corresponds to even higher energy of 2PeV (Aartsen et al. 2014). The IceCube observations are very significant not only for studying the origin of the UHE neutrinos but in general for exploring the astrophysical origin of cosmic rays.

It is usually assumed that the UHE neutrinos are generated via interactions of UHE protons, during which, approximately 4% of the initial proton energy is imparted to the neutrinos, (Murase et al. 2013):

$$E_\nu \approx 0.04E_p \simeq 2PeV\epsilon_{p,17}\frac{2}{1+z}, \qquad (1)$$