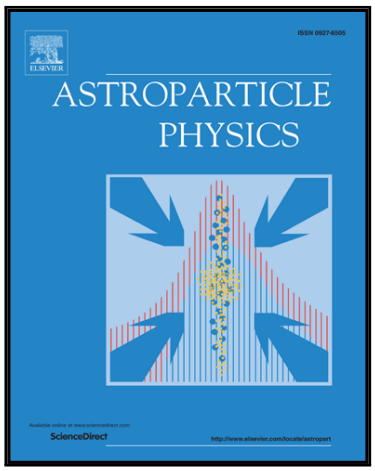

Acceleration of particles to high energy via gravitational repulsion in the schwarzschild field

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ACCELERATION OF PARTICLES TO HIGH ENERGY VIA GRAVITATIONAL REPULSION IN THE SCHWARZSCHILD FIELD

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Abstract

Gravitational repulsion is an inherent aspect of the Schwarzschild solution of the Einstein-Hilbert field equations of general relativity. We show that this circumstance means that it is possible to gravitationally accelerate particles to the highest cosmic ray energies.

Keywords: acceleration of particles, gravitation, cosmic rays

1. INTRODUCTION

It is widely believed that there are only two sources of energy available to accelerate cosmic particles to relativistic velocities - magnetic field energy, which accelerates through magnetic connection and kinetic energy, which accelerates through Fermi acceleration (see Drury 2012 for a review). However, the recent discovery of pulsed TeV photons from the Crab pulsar contradicts current models of relativistic cosmic particle formation (Ansoldi et al. 2016). Here we point out that there is a third energy source - gravitational energy, which is capable of accelerating particles to the highest cosmic ray energies observed ($\sim 10^{20}$ eV).

It is well known that special relativity leads to space, time and mass dependency on velocity. It is however, not so well known, that Einstein's theory of gravitation, general