ULTRA-HIGH ENERGY COSMIC RAY ACCELERATION BY ACCRETION-INDUCED COLLAPSE PULSARS IN THE LOCAL UNIVERSE

E.M.de Gouveia Dal Pino (1) and A.Lazarian (2)
(1) Astronomy Department - Instituto Astronomico e Geofisico - Universidade de Sao Paulo - Brasil
(2) Astronomy Department - University of Wisconsin - Madison - USA

We have recently suggested that the ultra-high energy cosmic rays (UHECRs) observed above the GZK limit could be mostly protons accelerated in magnetic reconnection sites just above the magnetosphere of newborn millisecond pulsars originated by accretion induced collapse (AIC-pulsars). We have found that the observed total flux of UHECRs can be produced by the integrated contribution from all AIC-pulsars of the local distribution of galaxies within a distance which is unaffected by the GZK cutoff (< 50 Mpc) (e.g., de Gouveia Dal Pino & Lazarian, ApJ, 536, L31, 2000). We here examine the potential acceleration mechanisms in the reconnection site and find that first-order Fermi acceleration cannot provide either sufficient efficiency or the expected spectral index for the UHECR particle spectrum. To prevent synchrotron losses, only very small deflection angles of the UHECRs would be allowed in the strong magnetic fields of the pulsar, which is contrary to the requirements for efficient Fermi acceleration. This leaves the one-shot acceleration via an induced electric field within the reconnection region as the only viable process for UHECR acceleration. We find that AIC-pulsars with surface magnetic fields 10^-10^ G, and spin periods ~ 1 - 60 ms, are able to accelerate particles to energies larger than 10^ eV, but the magnetic field just above the Alfven surface must be predominantly toroidal for the particles to be allowed to escape from the acceleration zone without being deflected. Synchrotron losses impose important constraints on the magnetic field topology in any UHECR accelerators involving compact sources with strong magnetic fields (de Gouveia Dal Pino \\& Lazarian 2001.