

**Cluster Accretion Shocks as Possible Acceleration Sites
for Ultra High Energy Protons**

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Three-dimensional hydrodynamic simulations of large scale structure in the universe have shown that accretion shocks form during the gravitational collapse of one-dimensional caustics, and that clusters of galaxies formed at intersections of the caustics are surrounded by these accretion shocks. Estimated speed and curvature radius of the shocks are $1000-3000 \text{ km s}^{-1}$ and about 5 Mpc, respectively, in the $\omega=1$ CDM universe. Assuming that energetic protons are accelerated by these accretion shocks via the first-order Fermi process and modeling particle transport around the shocks through Bohm diffusion, we suggest that protons can be accelerated up to 10^{20} eV during the age of the universe, provided the mean magnetic field strength in the region around the shocks is at least of order a microgauss. We have also estimated the proton flux at earth from the Virgo cluster. Assuming (1-10)% of the ram pressure of the infalling matter would be transferred to the cosmic-rays, the estimated spectral form and flux above $\sim 10^{19}$ eV are consistent with observations, so that such clusters are plausible sources of the UHE CRs.

**Gamma Ray and Neutron Emission During the 1990/05/24 and the
1991/03/22 Solar Flares**

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We carried out analysis of γ ray data obtained from the GRANAT satellite and neutron monitor data of two X-class flares, the 1990/05/24 limb flare and the 1991/03/22 disk flare. In this analysis, we made use of information of magnetic structure of the flaring regions which we derived from the optical and microwave data obtained at Big Bear solar observatory and Owens Valley radio observatory, respectively. From H α images and microwave spectra, we propose that a combination of a compact source with a length scale of $\sim 2 \times 10^4$ km and an extended source with $\sim 2 \times 10^5$ γ rays at 57-110 MeV and at 2.2 MeV than a single source model assumed in other works. We also investigated vector magnetograms over the 1991/03/22 flare region to find that inclination angles of magnetic fields in the region are relatively high in spite of its location close to the solar disk center. It is thus concluded that the smaller number of neutrons detected during the 1991/03/22 flare as compared with that