

**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  $\gamma$  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 $\alpha$  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  $\sim 2 \times 10^5$  km  $\gamma$  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

of the 1990/05/24 flare cannot be solely due to their locations on the disk but partly due to fewer protons produced during the 1991/03/22 flare. In these two events shock waves were clearly seen as bright fronts of Ha emission that propagated with a speed of  $\sim 1500\text{km/s}$  and started preceding the maximum of microwaves by 20-30s and that of  $\gamma$  rays by 40-50s. Such a shock speed and its relatively timing indicate that high energy electrons and protons emitting those radiations could have been accelerated by the shock waves.

## ASCA Spectra of the X-ray Faint S0 Galaxy NGC4382

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NGC 4382 is one of the E and S0 galaxies detected with the lowest X-ray to optical luminosity ratio. These galaxies have a peculiar X-ray(0.1-3keV) spectrum, with a significant excess of counts in the lowest spectral channels relative to the spectral count distributions of X-ray brighter E and S0 galaxies. Analyzing the ROSAT PSPC observations of NGC 4382(Fabbiano, kim, and Trinchieri 1994), it was unclear whether this soft excess were due to a real very soft component in a multi-component spectrum, or reflected an extremely low metal abundance in a isothermal hot gas. Our ASCA observations show that the low-abundance single-temperature model does not fit well the X-ray spectrum, in agreement with our previous suggestions. A better explanation is a composite spectrum with a very soft component( $\sim 0.3\text{keV}$ ) in addition to a hard, likely stellar, component( $\sim 5\text{keV}$ ). However, other more complex spectral models cannot be excluded. Simulations and re-analysis of observations of X-ray bright elliptical galaxies also suggest that the recent reports of significantly sub-solar metal abundances in these galaxies may be premature.

### 보현산 천문대 도약망원경

천무영, 장정균, 박병곤, 육인수, 김강민, 전영범, 성현철, 경재만, 문일권, 오병렬  
보현산 천문대/천문대

보현산 천문대 도약망원경(이하 도약망원경이라 칭함)은 구경 1.8m인 국내 최대 관측망원경으로서 보현산 천문대(해발고도 1124m)에 설치되어 시험관측중이다.

도약망원경의 특징으로는

- o 경위대식
- o 2개의 부경(f/8, F/15)과 하나의 초점(카세그레인 초점)
- o i 960을 이용한 one-board controller와 초당 30번을 수행하는 디지털 서보 제어루프
- o 편리하면서 손쉽게 수정할 수 있는 관측자용 망원경 제어 프로그램