

High Energy Solar Particles in the 6 November 1997 Ground Level Event

J.M. Ryan (1) and the Milagro Collaboration
(1) University of New Hampshire

The large 6 November 1997 GLE was detected and its intensity measured by many neutron monitor stations. Proton-initiated showers were also registered in the Milagro ground-level water-Cherenkov gamma-ray telescope. Atmospheric muons from solar energetic particles were detected within the 4800 square meter, 2650 m high pond over a period of several hours. The energy threshold for detecting a muon signal in Milagro is greater than detecting a neutron signal in the nearby Climax NM, being a convolution of both the geomagnetic and atmospheric cutoffs. We estimate the onset of the signal to be at 1207 UT \pm 6 minutes, the same as that measured with NMs within measurement error. Based on the signal detected in a scaler counting mode, we deduce from the relative signal strengths in neutron monitors and Milagro an interplanetary proton spectrum that is rapidly softening above 4 GV. The spectral index above 4 GV is -9.1 , as compared to that deduced purely from neutron monitors above 1 GV of -5.6 ± 0.4 (Lovell et al. 1999). Furthermore, we estimate that these protons and ions above 4 GV originated no lower (1 sigma) than 2 solar radii above the solar surface, suggesting the presence of intense shock at unusually low altitudes.