THE PROTON-AIR INELASTIC CROSS SECTION AT E - 0.3 EeV

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Abstract

The Fly's Eye detectors are designed to observe the interactions between the highest energy cosmic rays and the atmosphere (Baltrusaitis et al 1985). Indirectly, one can observe the results of interactions at center of mass energies exceeding those proposed for the SSC.

Of particular interest is the behavior of the total proton-proton cross section at these energies. The Fly's Eye detectors, through their observation of the showers produced by protons interacting with air molecules, are able to shed light on the proton-air inelastic cross section (ó(p-air)), a quantity that can be related, through calculations, to the important total p-p result (Baltrusaitis et al 1984).

Ideally, a measurement of ó(p-air) would involve the determination of the distribution of first interaction depths for protons on air. This distribution would be exponential with a slope parameter ë, the proton air interaction length. Unfortunately, no appreciable light is emitted at this stage of the shower, and instead we must turn to the distribution of a measurable quantity, the depth of shower maximum, X_{max}. This distribution also has an exponential tail and it has a slope which is related to ë.

The data discussed here were collected in the period since November 1986 by the two Fly's Eye detectors operating in stereo mode. In this paper we describe the procedure followed in the measurement and calculation of ó(p-air), including the study of the effect of triggering efficiencies and detector resolution on the X_{max} distribution. We present the inelastic proton-air cross section at an energy of 0.3 EeV.

References
Baltrusaitis, R.M. et al 1984, Phys.Rev.Lett., 52, 1380.
Baltrusaitis, R.M. et al 1985, Nucl.Instr.Meth., A240,410.