CURRENT SCIENCE AND IMPACT OF GROUND BASED ENERGETIC PARTICLE MEASUREMENTS. P. A. Evenson, Department of Physics & Astronomy and Bartol Research Institute, University of Delaware, 217 Sharp Laboratory, Newark, DE 19716. (evenson@udel.edu)

Introduction: Variations in the spectrum and anisotropy of Cosmic Ray (CR) particles above 100 MeV are nearly all due to the so called "Solar Modulation" of the constant flux of Galactic Cosmic Rays (GCR) that surrounds the heliosphere in the local interstellar medium. The essential interaction is with magnetic structures embedded in the expanding solar wind. Quasi periodic variations result from the 11 year activity (sunspot) cycle, the 22 year magnetic reversal cycle, and the 27 day cycle of encounters with the heliospheric current sheet. Aperiodic variations result from local disturbances in the solar wind, often the result of Coronal Mass Ejections (CME). The most common manifestation is a sudden reduction in intensity, generically termed a "Forbush Decrease". Both variations in the spectral shape and the energy dependent anisotropy of the GCR are diagnostic of these magnetic structures. Since CR of relevant energies are rare, large detectors are required to get statistical precision on appropriate timescales.

Historically, only ground based detectors have been large enough. Recently PAMELA and AMS have been able to make such measurements directly from space. Presumably at some point in the not too distant future, ground based observations will again be the only option. It is important to use this period of simultaneous observation to understand ground based measurement better and to develop new techniques for the future and to secure the continued operation of the detectors.

Techniques: With the exception of some observations of direct Cherenkov light in the upper atmosphere, all ground based techniques observe secondary particles in cascades induced by CR incident on the atmosphere. Response of the detectors begins at approximately 1 GeV and extends to several tens of GeV. The most prominent detectors are neutron monitors, ionization muon detectors and water/ice Cherenkov detectors of the muon and electromagnic component.

Networks: Charged particles in this energy range have gyro-radii in typical heliopheric magnetic fields ranging from earth-moon distances to a large fraction of an astronomical unit. They interact with magnetic structures on length scales that cannot be probed by individual spacecraft or currently available spacecraft clusters. Networks of detectors with different energy response and viewing direction continuously measure the three dimensional particle distribution function. The behavior of this distribution function, often complemented by local magnetic field measurements, is used to understand magnetic structures on these large distance scales.

Conclusions: Ensuring continuity in tracking variations in the cosmic ray distribution function requires maintaining the ground based network, improving it with hardware employing the latest techniques and adding stations in geographically strategic locations.