SOLAR ENERGETIC PARTICLES: PHYSICS AND FORECASTING POSSIBILITIES

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Solar Flares and Coronal Mass Ejections peak in 11 year cycles. Some of these events release fluxes of high energy particles which can reach earth and interact with orbiting satellites and earth's atmosphere, causing extreme conditions of the space weather. In the 1999 report on space weather, the US National Security Space Architect finds that during the preceding 20 years about one or two satellites per year have suffered either total or partial mission loss due to space weather (Space Studies Board, 1999).

The use of large-area detectors which nowadays can only be accommodated at earth surface is vital for measuring the low fluxes of high energy particles accelerated in the vicinity of the sun due to solar flares and coronal mass ejections. The high energy particles from the most severe events which can cause damage arrive to earth earlier than the abundant "killer" medium energy particles, thus providing an opportunity to establish an early warning system to alert the client about the potential damage to satellites, the Space Station, space personnel, and flights scheduled over the poles (Dorman, 1999). Taking into account that only very few of a great number of solar flares and CME's produce dangerous ion fluxes, it is not only critical to alert clients about the arrival of the most severe radiation storms, but also to minimize the number of false alarms against events which are not severe enough to cause damage. *We can accomplish both goals by detecting secondary fluxes, generated by the high-energy particles in the earth's atmosphere by surface detectors located at mountain altitudes and low latitudes.*

Because the high energy particles are so few in number only coherent measurements of all secondary fluxes (neutrons, muons, and electrons) can help to make unambiguous forecast and estimate the energy spectra of the upcoming dangerous flux. Lev Dorman demonstrates in numerous papers that detecting at least two or three cosmic ray components at one, or better, two stations will make it possible not only to reconstruct the solar ion flux outside the earth's atmosphere, but also to estimate the energy spectra of upcoming solar particle flux (Dorman et. al., 1993a and 1993b).

Multidimensional statistical methods of analysis of the data and timely delivery of the alert are also of utmost importance. All of the requirements to deliver timely, accurate, and reliable alerts to the end user against the danger caused by particle fluxes directed toward the earth can be accomplished from the Aragats Space Environmental Center (**ASEC**) located on Mt. Aragats (Geographic coordinates: 40°30'N, 44°10'E, altitude 2000 and 3200 m., Rigidity: ~7.6 GV).

References

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Invited talk