Objective 3: How do solar eruptions produce energetic particle radiation that fills the heliosphere?

Introductory remarks

Astrophysical sites throughout the solar system and galaxy have the universal ability to accelerate ions and electrons to high speeds, forming energetic particle radiation. Detected remotely from radio and light emission around supernovae remnants, the Sun, and planets, or directly from particles that reach our detectors, this radiation arises from the explosive release of stored energy that can cause magnetic fields to rearrange, or can launch shock waves which accelerate particles by repeatedly imparting many small boosts to their speed. The nearly universal occurrence of energetic particle radiation, along with the effects it can have on planetary environments, evolution of life forms, and space systems has fostered a broad interest in this phenomenon that has long made it a high priority area of investigation in space science. Since remote sites in the galaxy cannot be studied directly, solar system sources of energetic particles give the best opportunity for studying all aspects of this complex problem.

The Sun is the most powerful particle accelerator in the solar system, routinely producing energetic particle radiation at speeds close to the speed of light, sufficiently energetic to be detected at ground level on Earth even under the protection of our magnetic field and atmosphere. SEP events can severely affect space hardware, disrupt radio communications, and cause re-routing of commercial air traffic away from polar regions. In addition to large events, which occur roughly monthly during periods of high sunspot count, more numerous, smaller solar events can occur by thousands each year, providing multiple opportunities to understand the physical processes involved. In the following sections, we have divided in more detail three interrelated questions that flow down from this top-level question: How and where are energetic particles accelerated at the Sun? How are energetic particles released from their sources and distributed in space and time? What are the seed populations for energetic particles?

SAP meeting on Objective 3 (22 September 2016) presentations:

Àngels Aran: **SEP events characteristics and particle transport**

Angelos Vourlidas: **CME-associated SEP sources**

Sam Krucker: **Flare-associated SEP sources**

George Ho: **Suprathermal ions in the inner heliosphere**