# **Outstanding Issues**

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### **Origin of Flares**

- What active region evolution precedes flares and coronal mass ejections?
- What is the relationship between flares and filament eruptions?
- What is the relationship between flares and coronal mass ejections?

### Flare Intensity Distribution

- Does the distribution continue to lower intensities with the -1.8 power-law index?
- What is and what determines the highest "intensity" flare?
- Is coronal heating dominated by "nanoflares"?

### Flare Morphology

- Do single-loop flares exist?
- Do all flare loops or arcades have the cusp structure?
- Do the basic features of the "standard model" apply to all flares?
- Is the "magnetic breakout" model valid?
- Is multipolar magnetic structure necessary for flares?

### **Energetic Particles I**

- Exactly where are energetic particles injected into the flaring region?
- What is the highest particle energy in each flare?
- What are the lowest particle energies in each flare?
- What is the angular distribution of the particles?

### **Energetic Particles II**

- How are the energetic particles "seen" in microwaves related to those "seen" in hard X-rays?
- How can electron and ion produced sources be in different locations?
- What is the exciter of white light flares?

#### Energetic Particles III – Gamma Ray Results

- Relationship of impulsive SEPs and particles producing flare X-ray and gamma-ray emission.
- Energy content of the low-energy (<1 MeV) ions
- Composition (heavy element and <sup>3</sup>He enhancements) of the accelerated particles producing flare gammaray emission.
- Understanding the high-density(>10<sup>13</sup> cm<sup>-3</sup>)-hightemperature(>10<sup>5</sup> K) environment implied by the positron annihilation line observations.
- Explanation for how the coronal-like high-FIP enhancements implied by gamma-ray line observations can already be present at chromospheric densities.

#### **Particle Acceleration**

- Is there one dominant particle acceleration mechanism? If so, what is it?
- Is particle acceleration confined to a region high in the corona, or is it more distributed?
- What is the efficiency of particle acceleration?

### **Flare Energetics**

- What is the relative amount of energy injected directly into plasma heating vs. particle acceleration?
- What is the relative amount of energy injected into electrons vs. ions?
- What is the relative amount of energy injected directly into cooler plasma vs. "hot" plasma?
- What is the relative amount of energy contained in the flare vs. the CME
- What is the total magnetic energy released in each flare?

### **Coronal Mass Ejections**

- Are there reliable precursors? Can we predict CMEs?
- How are CMEs initiated and why?
- How do CMEs affect the large-scale corona?
- What is the relationship between CMEs, flares, and filaments?
- What is the 3-D structure of CMEs?
- Where do shocks develop?

# **Outstanding SEP issues**

- What is the seed population for large SEP events?
  - does the composition depend on energy?
  - what are the relative contributions of solar wind, coronal, and flare material?
- Do flare particles escape large flaring regions when associated with large/fast CMEs and if so, how?
- Do perpendicular shocks have a higher injection threshold energy than parallel shocks?

- How low in the corona can CME-driven shocks form and accelerate particles?
  - to what energies?
  - over what time scales?
- What does the energy dependent charge states in impulsive events mean?
  - in terms of seed population for flare acceleration
  - in terms of stripping in the corona
  - in terms of where the acceleration is taking place

## **Outstanding SEP Issues**

- Why do so many interplanetary shocks not accelerate particles?
- What is the flare acceleration mechanism and can it explain the high enhancements of ultra-heavy ions in impulsive events?
- What does the different spectral shapes of <sup>3</sup>He in impulsive events tell us?
  - about the acceleration process
  - about the transport process