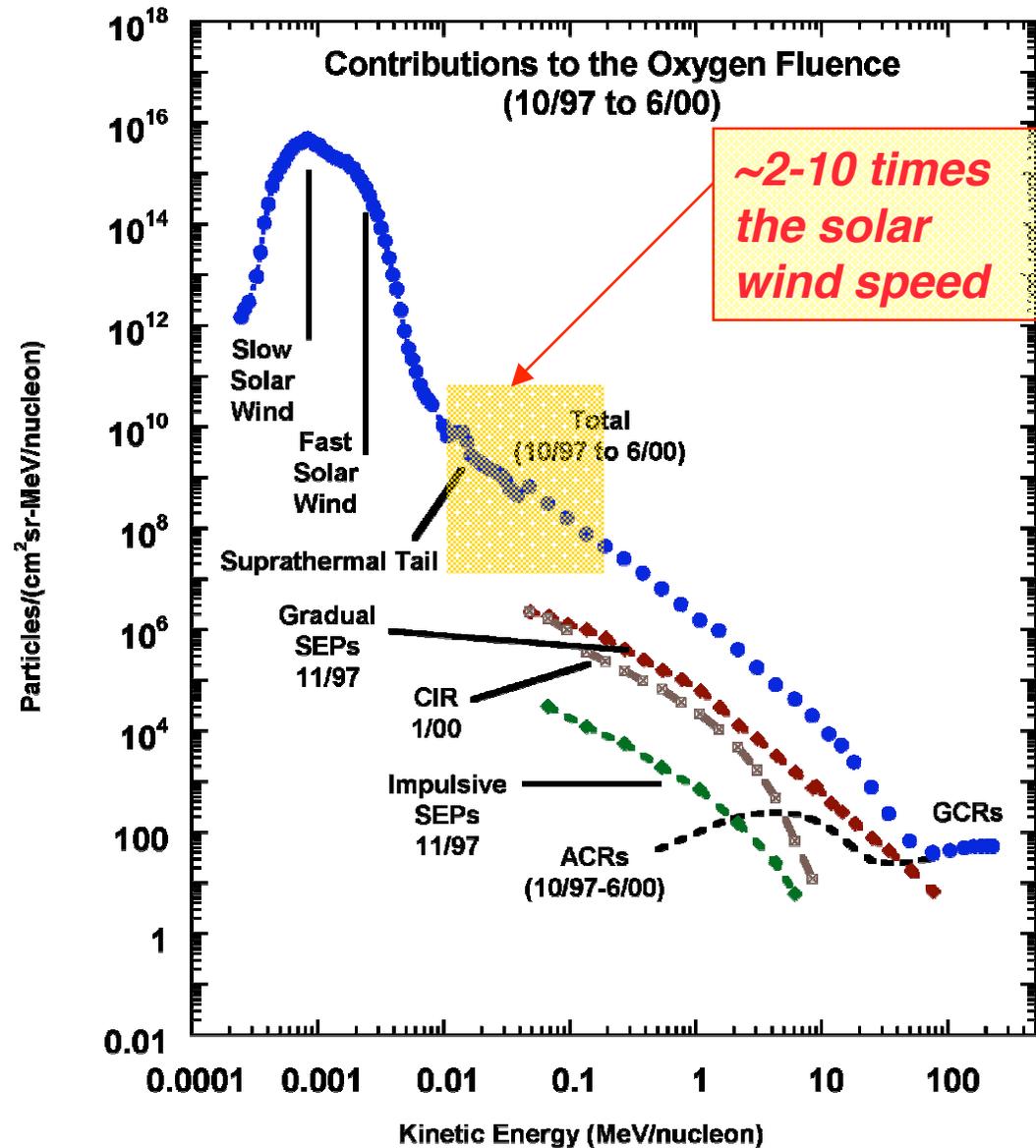


The Suprathermal Tail

Properties are not well understood; known contributors

- *Heated solar wind*
- *Interstellar and inner source pickup ions*
- *Prior solar and interplanetary activity*
- *Planetary bow shocks and magnetospheres*
- *Other?*



(Mewaldt et al., 2001 AIP conference Proceedings 598, 165)

**WG3 Session#1 Sources of Suprathermal Ions in the Solar Corona
Monday PM: and the Interplanetary Medium**

Zurbuchen et al - ACE/ULYSSES/Wind

- **Suprathermal Tails, ion composition, and FIP effects are different in slow, fast, and CME-related solar wind**
- **FIP effect in SEPs is quite distinct from that in solar wind**
- **Presence of suprathermals is not enough for shock acceleration**

Hill et al - CASSINI

- **Beyond Earth orbit, pickup ions are a dominant source of material for CME-driven shocks but their contribution remains constant**

Ho et al - ACE

- **Ion spectra are difficult to reconcile with simple shock acceleration models that inject a mono-energetic stable solar wind population as the seed population**

WG3 Session#1
Monday PM:

**Sources of Suprathermal Ions in the Solar Corona
and the Interplanetary Medium**

Schwadron -

- **Statistical acceleration/transit-time damping could produce suprathermal tails in the IP medium with constant He⁺ abundance beyond 5 AU**
- **Application of solar wind scaling law - low-energy or thermal plasma remains bound while suprathermals can escape**

Fisk -

Consequence of diffusion of magnetic field lines on the Sun

- **Statistical acceleration occurs continuously on coronal loops and produce power-law suprathermal tails without compositional enhancements that could serve as a seed population for CME-driven shocks**

**WG3 Session#1 Sources of Suprathermal Ions in the Solar Corona
Monday PM: and the Interplanetary Medium - Challenges**

Goal 3:

Develop CME shock acceleration models with better predictions?

Theory:

- **Inject a more realistic seed population**
- **Define the necessary conditions for shock acceleration**

Observations:

- **Prescribe realistic seed populations near the Sun**
 - **Difficult with current spacecraft but situation should improve significantly with STEREO, Sentinels, and solar orbiter**
- **Understand why many shocks do not accelerate particles despite the presence of suprathermals**

**WG3 Session#1 Sources of Suprathermal Ions in the Solar Corona
Monday PM: and the Interplanetary Medium - Challenges**

Goal 2:

Understand the cause and effect of spatial and temporal variations in the suprathermal tail?

Observations:

- 1. Identify and characterize properties of various ion sources**
- 2. Quantify their relative contributions to the suprathermal tail**
- 3. Investigate their relationship with CME-related particle events over radial distance and solar cycle**

Theory:

- 1. Coronal models must produce suprathermal tails with composition like SEPs and not the solar wind**
- 2. Heliospheric models need to account for the fact that the He⁺/He⁺⁺ ratio remains constant beyond ~2-3 AU**

**WG3 Session#1 Sources of Suprathermal Ions in the Solar Corona
Monday PM: and the Interplanetary Medium - Challenges**

Goal 1:

Understand why the suprathermals are favored over the more abundant solar wind ions - the so-called injection problem?

Theory:

- 1. Is it simply a threshold effect, i.e., higher speed ions can outrun the shock and/or**
- 2. Is it because suprathermals have isotropic distributions?**

Observations:

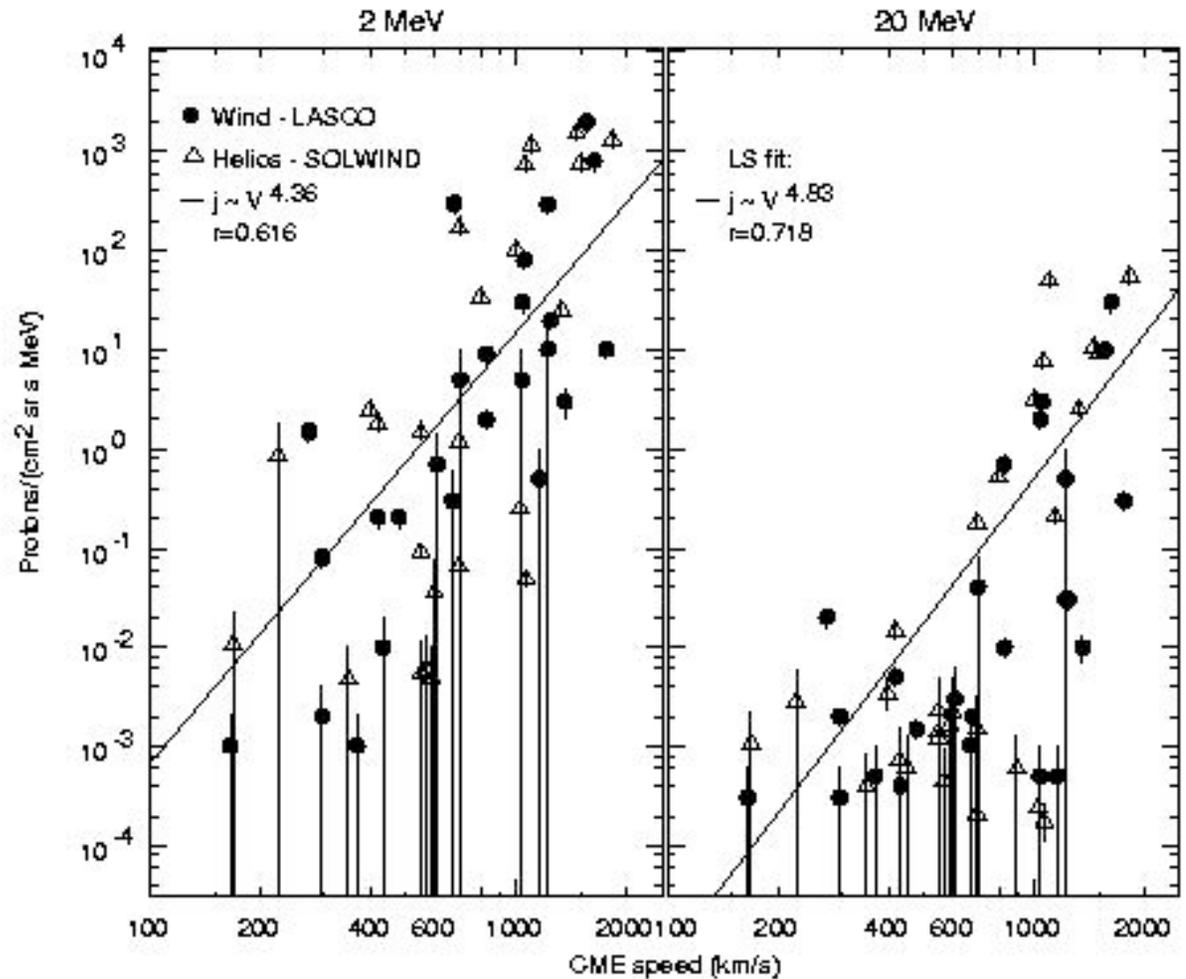
KILL the Theory

WG3 Session#1
Monday PM:

Sources of Suprathermal Ions in the Solar Corona and the Interplanetary Medium

Peak proton intensities in SEP events do not correlate well with CME speeds

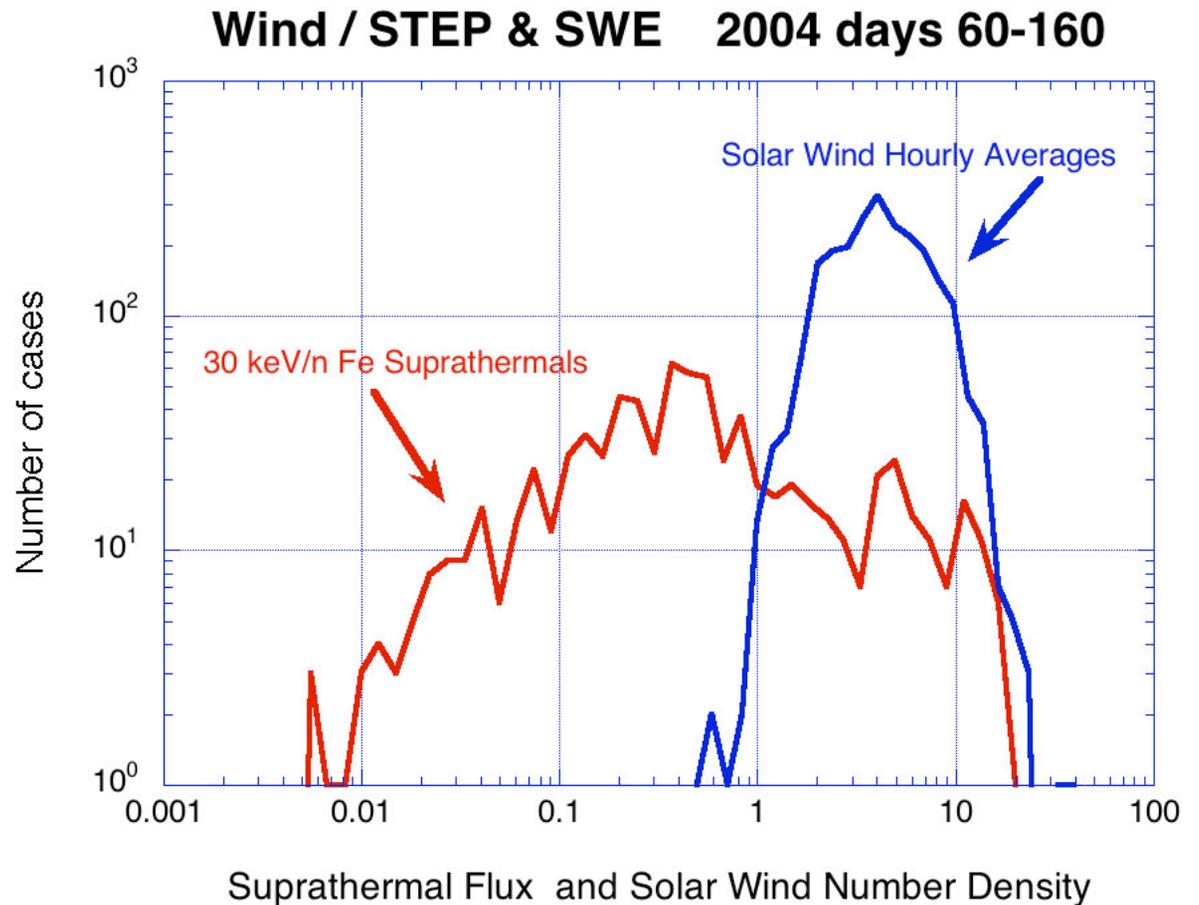
Critical issue for CME/SEP models LWS and Exploration Initiative



WG3 Session#1
Monday PM:

**Sources of Suprathermal Ions in the Solar Corona
and the Interplanetary Medium?**

***Suprathermals show
~100 times more
variation in intensity than
solar wind density --
may be an important
factor in CME-shock
acceleration***



(Mason et al., 2005; Desai et al., 2005)

**WG3 Session#1 Sources of Suprathermal Ions in the Solar Corona
Monday PM: and the Interplanetary Medium**

- **What are the main sources of ions in the suprathermal tail?**
- **How do the relative contributions of these sources vary in time and space?**
- **What causes these variations?**
- **How do these variations affect CME-related ESP and SEP events?**
- **What measurements and theoretical studies are needed to make further progress?**

Invited Speakers:

- **Matthew Hill**, *University of Maryland*
- **George Ho**, *Johns Hopkins University/Applied Physics Laboratory*
- **Thomas Zurbuchen**, *University of Michigan*
- **Nathan Schwadron**, *Southwest Research Institute*
- **Lennard Fisk**, *University of Michigan*