Suprathermal Tails in Solar Wind Oxygen and Iron

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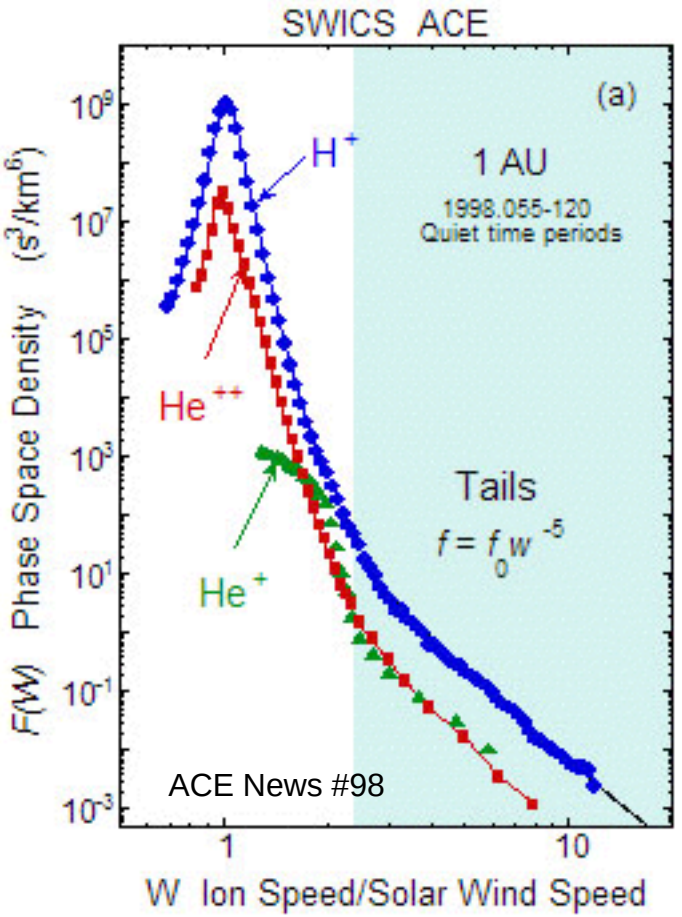
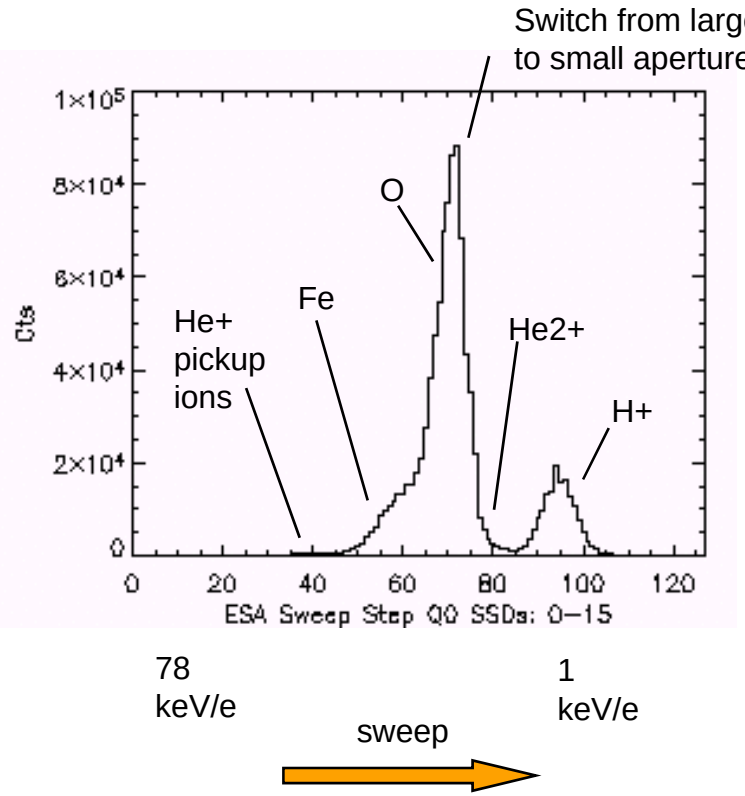
Solar Wind Heavy Ion S/T Tails

- High speed tails have been observed in solar wind H+ and He++, as well as in pickup He+ (Gloeckler, Gloeckler & Mason).
- Tails have implications for particle injection into the shock acceleration process.
- Investigate heavy ion speeds; characterize possible tails in ions heavier than He.
- Energy spectrum of solar wind O and Fe shown here from day 2007/059 (Feb. 28)
  - Counts vs. Energy/charge
  - Preliminary estimate of Fe charge state composition -> extract speed from Energy/charge spectrum.



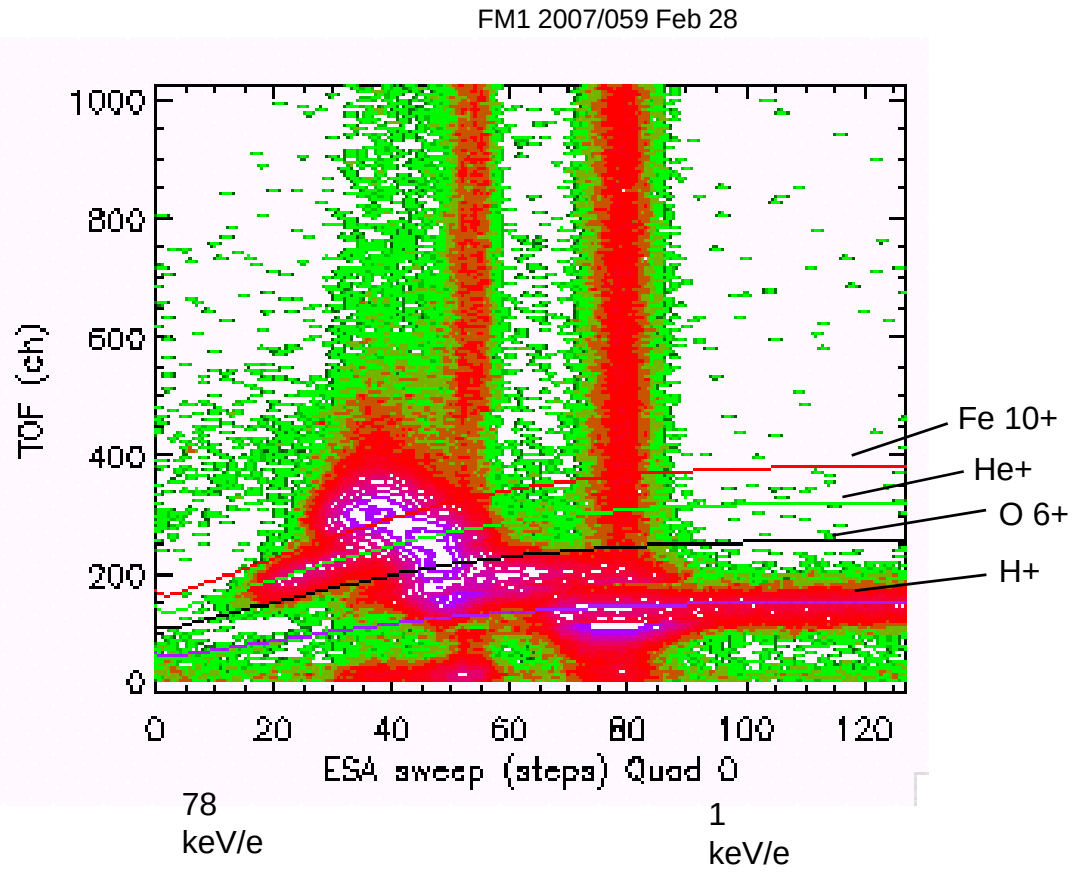
PLASTIC: Detection of Heavy Ions

- PLASTIC heavy ion detection makes use of:
  - E/Q selection (ESA, electrostatic analyzer)
  - Time of flight
  - Energy (ssd)
- Measurements:
  - **Energy, mass, ionic charge**
- One minute cycle
  - A voltage is applied to the ESA, thereby selecting the E/e ratio of incoming ions
  - ESA voltage is swept from high to low in a one minute cycle.
  - This selects the highest energy/charge ions first, then progressively lower energy/charge ions
  - Heavy ions appear in sweep in order of E/q.
- Data flow
  - All ions are counted and identified.
  - Selected event data are telemetered to ground based on a priority system.



Ion Trails in Time of Flight and Energy Step

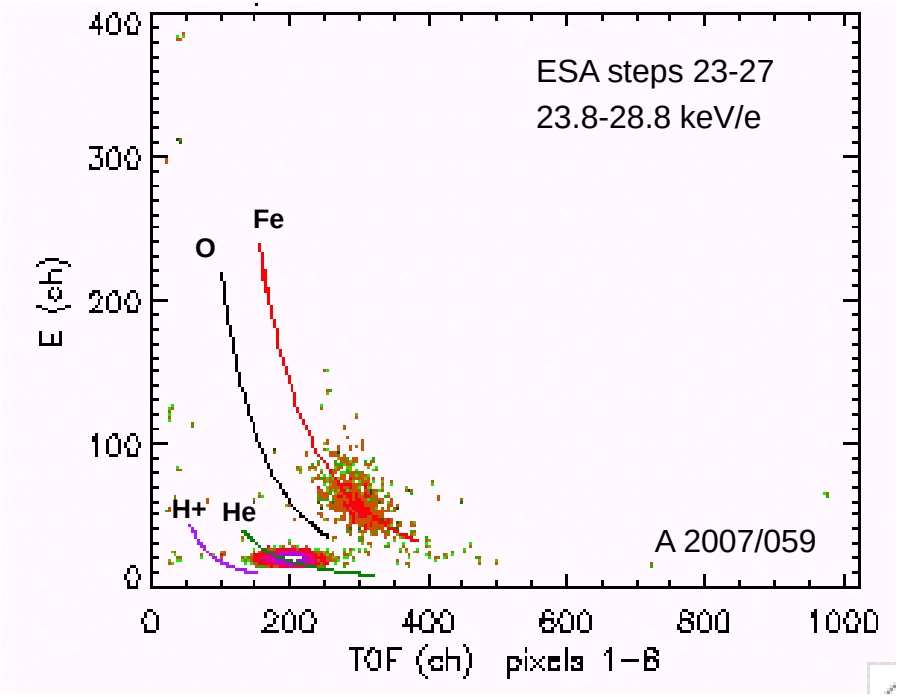
- Ion data shown for 2007/059 A
- Pulse height data plotted in Time of Flight (TOF) vs. ESA step (E/e).
- Traces show expected trails of Fe10+, O6+, He+ and H+
- Vertical red bars represent high count rates for He2+ and H+
- Aperture switch occurs at the first high intensity step to manage high rates.

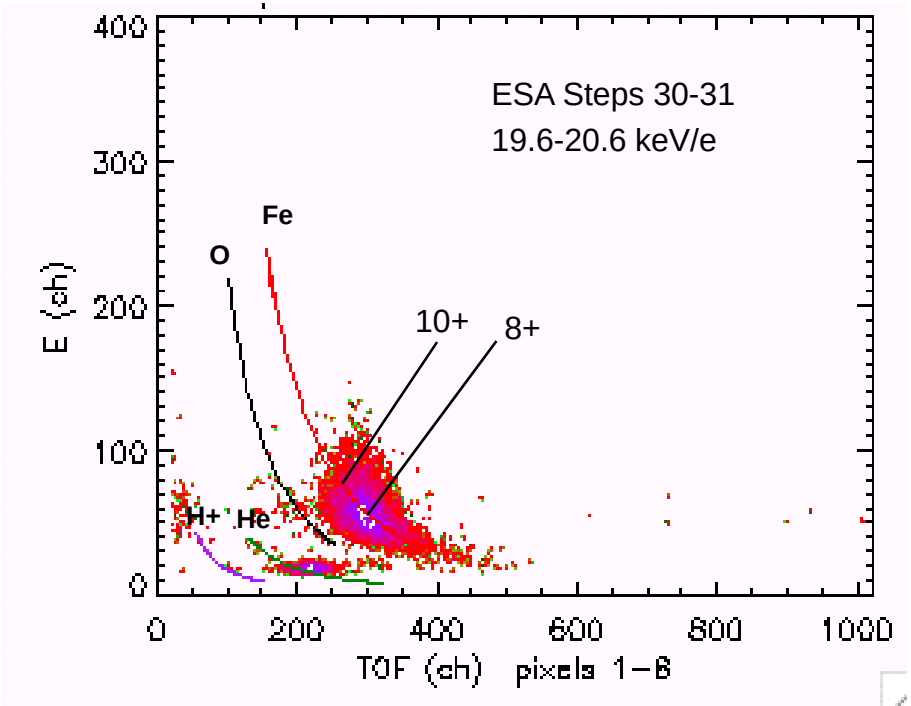


Example: Solar Wind Fe Ions

2007/059

- Pulse height data are shown from high energy E/e steps in Time of Flight (TOF) vs. Energy (E)
- He+ and Fe ions are detected in these steps.
- Average Fe charge state appears to be approximately 8+ (*preliminary*).
- Obtain energy spectrum of heavy ions:
  - Count Fe pulse height events
  - Reconstruct the incoming ion count, using pulse height count and rate data.

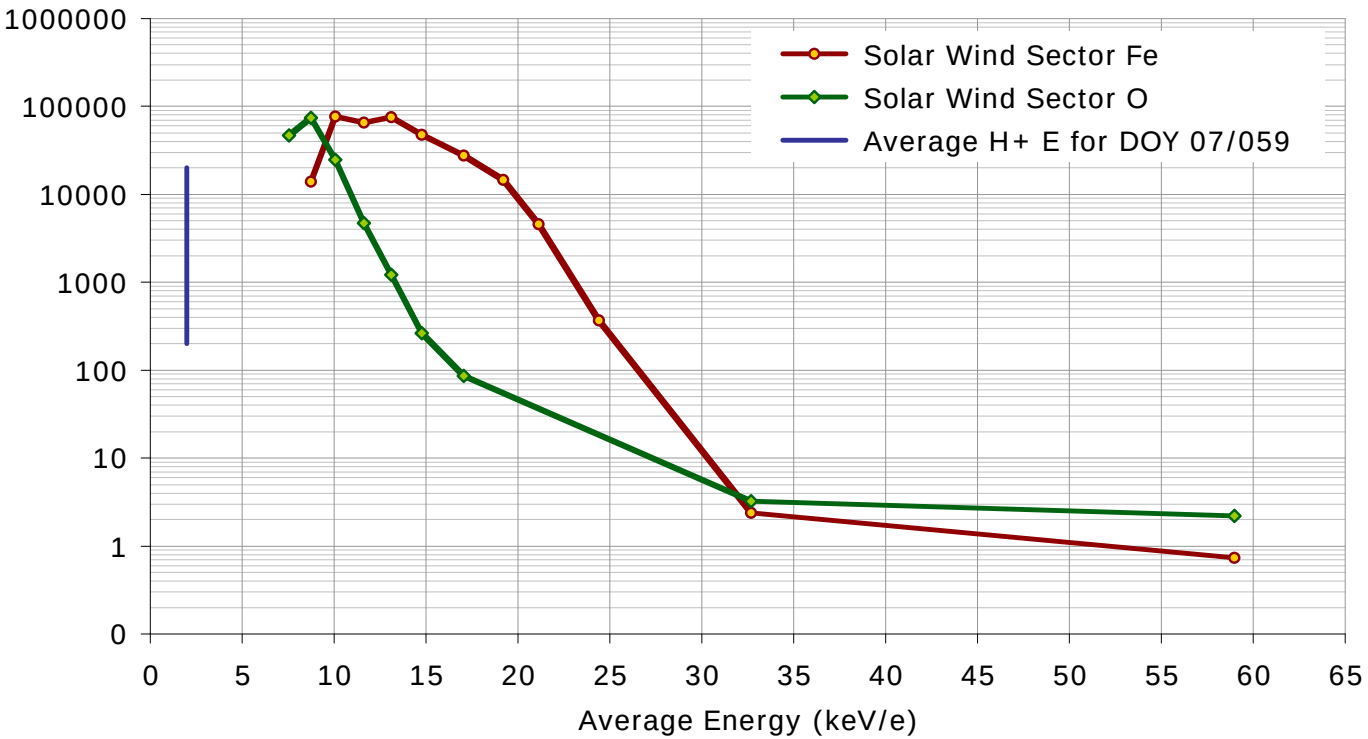




Energy/charge Spectrum of Solar Wind O and Fe

Ahead 2007/059 Feb 28

- O and Fe counts are shown vs. Energy/charge.
- The average H+ energy was 2 keV/e (~650 km/s)
- If all solar wind ions travel at approximately the same speed,
  - A 9+ Fe ion would have an energy/e of 12.4 keV/e.
  - A 6+ O would have an energy of 5.3 keV/e.
- Although the O and Fe have speeds similar to the solar wind H, both display high energy tails.
- Add charge state information to estimate ratio of heavy ion speed to H speed

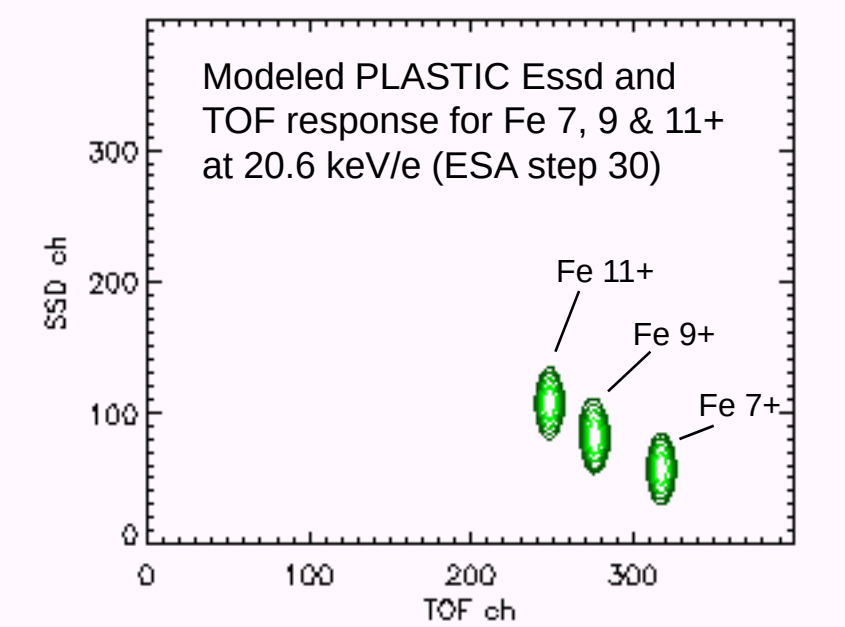


STEREO PLASTIC A: 2/28/07 DOY 207/059

Avg H peak energy: 2 keV/e

Preliminary Fe Charge State Composition

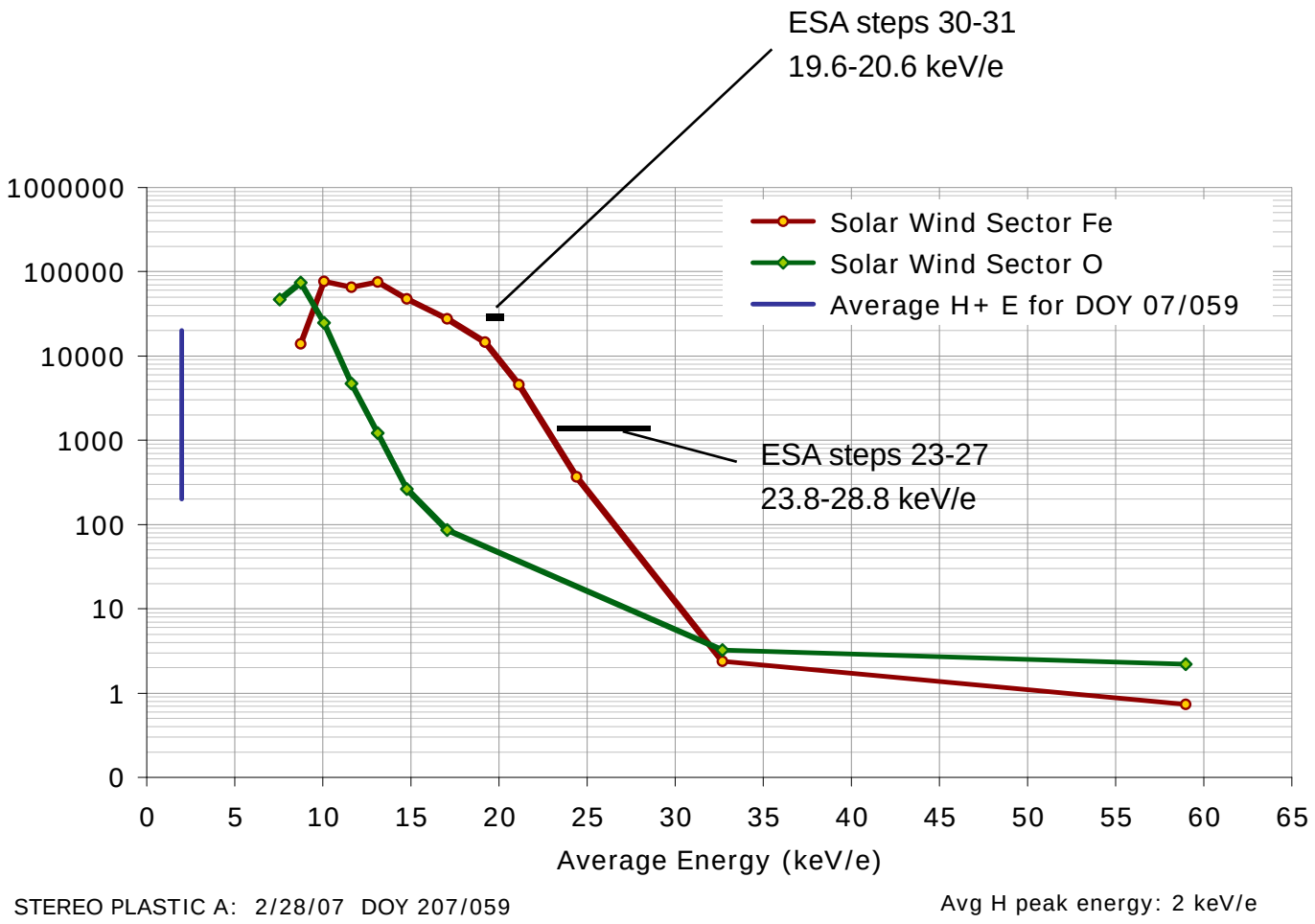
- Model a single Fe ion in TOF and Essd
- Include effects of:
  - Energy loss and as ion goes through carbon foil
  - Scattered flight path after foil
  - Pulse height defect in SSD
  - Energy (ssd) and TOF calibration
- Preliminary charge state estimate for Fe in ESA step 30-31 range: **8+**



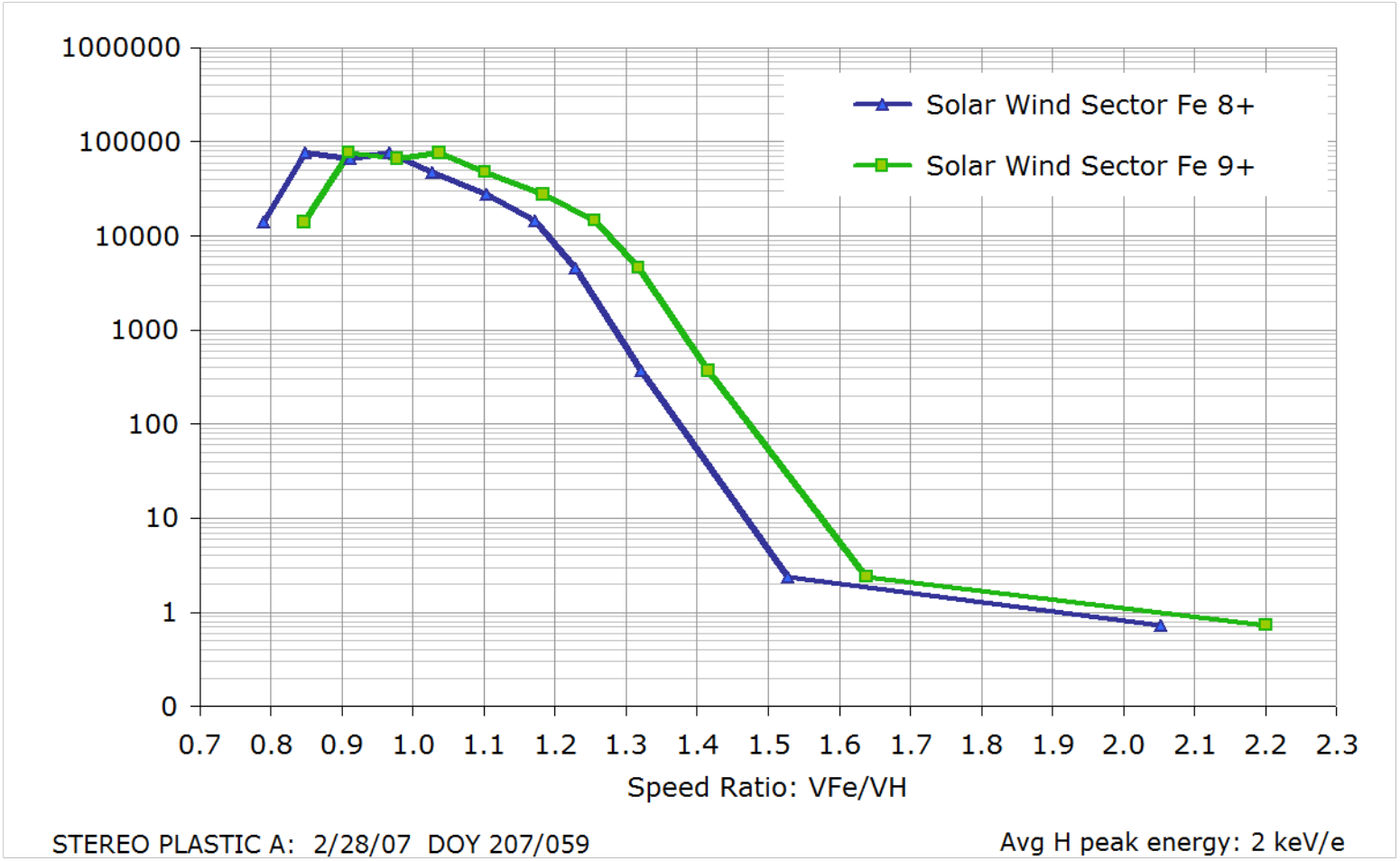
Fe Charge State Estimation

The solar wind Fe charge state was calculated in two energy ranges:

- 19.6-20.6 keV/e (ESA steps 30-31
- 23.8-28.8 keV/e (ESA steps 23-27)



Solar Wind Speed Ratio: V_{Fe}/V_H



Summary

- The energy/e spectrum of solar wind O and Fe has been calculated for 2007/059 (Feb. 28)
- Both O and Fe count spectra display tails above the H+ solar wind speed.
- An estimate of Fe charge state composition indicates that the solar wind Fe is present at speeds up to 1.3 to 1.5 times the H+ speed. Longer accumulations can extend the speed range for study.