Suprathermal Tails in Solar Wind Fe and O

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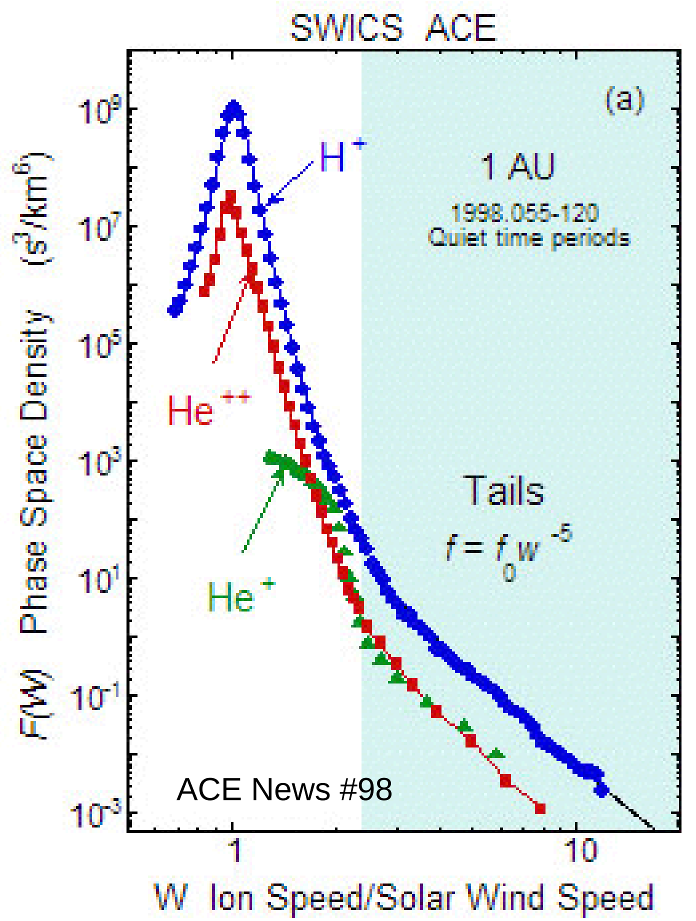
Suprathermal Tails in H & He

- 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.
- Using STEREOPLASTIC:
  - Obtain the energy spectrum of O and Fe from periods of high and low speed solar wind



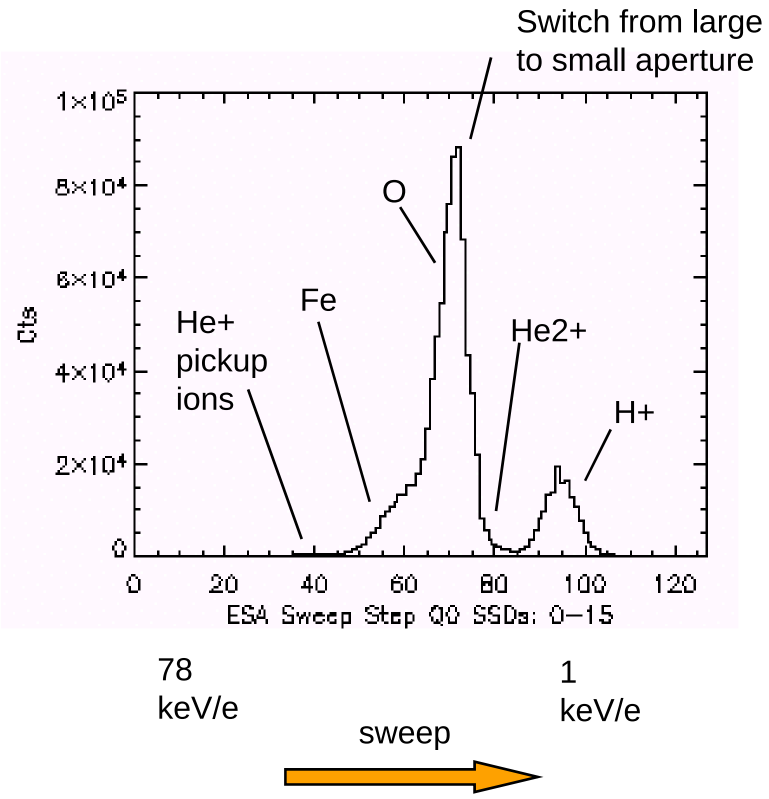
Suprathermal Tails in H & He

Fisk & Gloeckler, 2007

- Spectral index is:
  - ✓ -1.5 for differential energy spectra
  - ✓ -5 for spectra plotted as a distribution function in velocity space.
- Model uses:
  - stochastic acceleration
  - compressional turbulence
  - thermal isolation (needed to form the constant spectra).
- There is no dissipation of turbulence which would cause a net increase in the energy of the particles - turbulence just transfers energy from low energy core to tail.
- The highest energy particles develop gyro radii that exceed the scale sizes of the compressions, and:
  - no longer become accelerated, and
  - leave the acceleration region. These escape particles take energy away - the model assumes this is a negligible part.

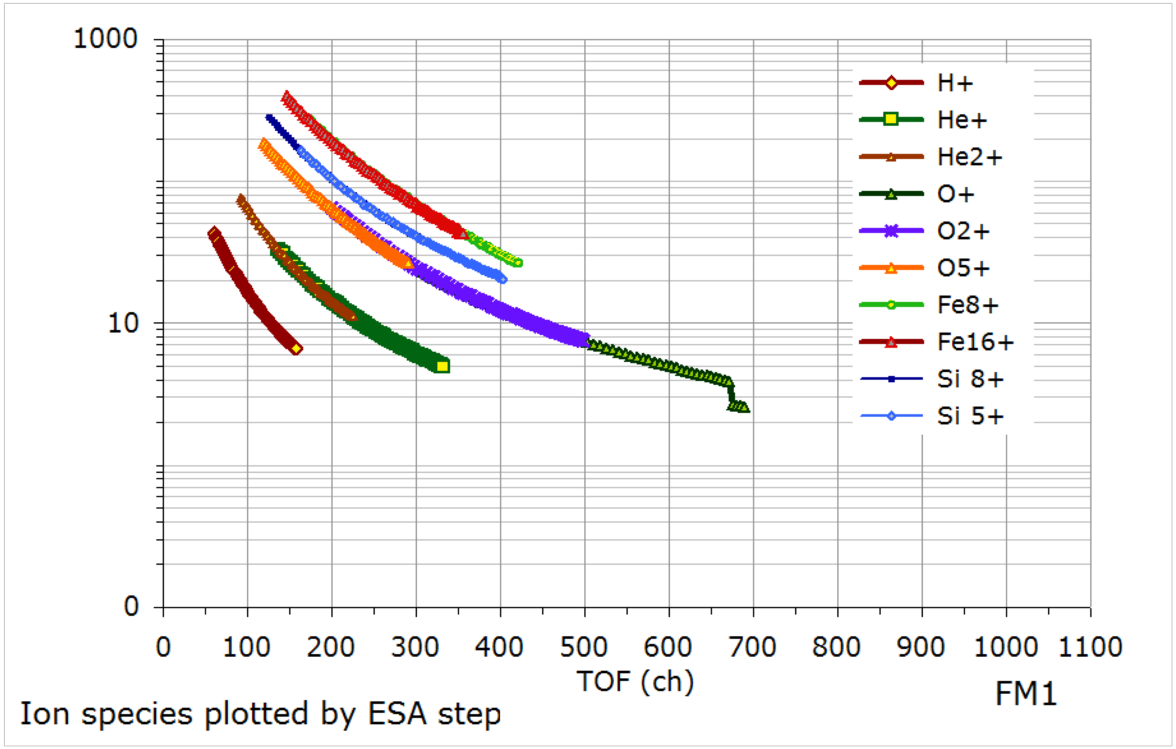
STEREO/PLASTIC
Heavy Ion Measurements

- Energy range:
  - 0.3 - 78 keV/e one-minute cadence sweep
- Selection: E/q
- Measurements:
  - Time of Flight,
  - Residual Energy (SSD)
- All ions are counted and classified (priority rates)
- Sample pulse height events are brought down
- Identify ions by pulse height
- Obtain ion-specific rates by combining pulse height count with priority rates



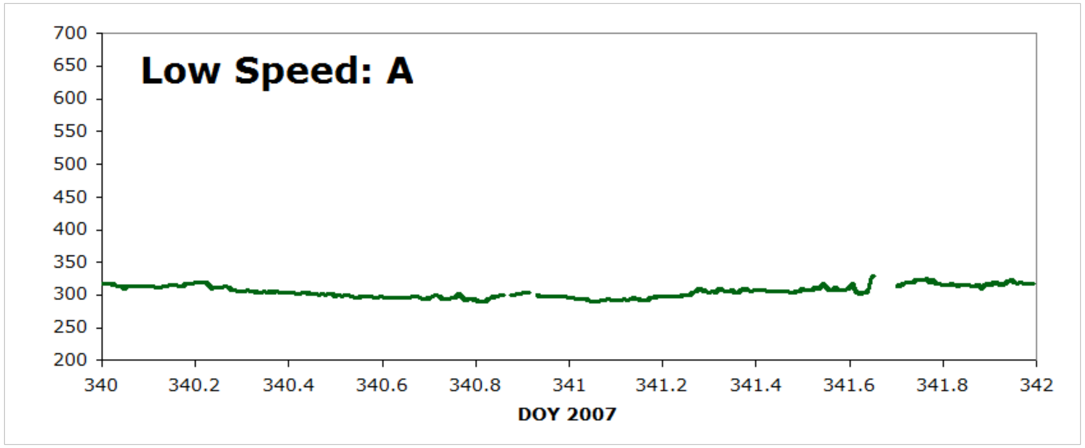
Solar Wind Ions: Essd vs. TOF

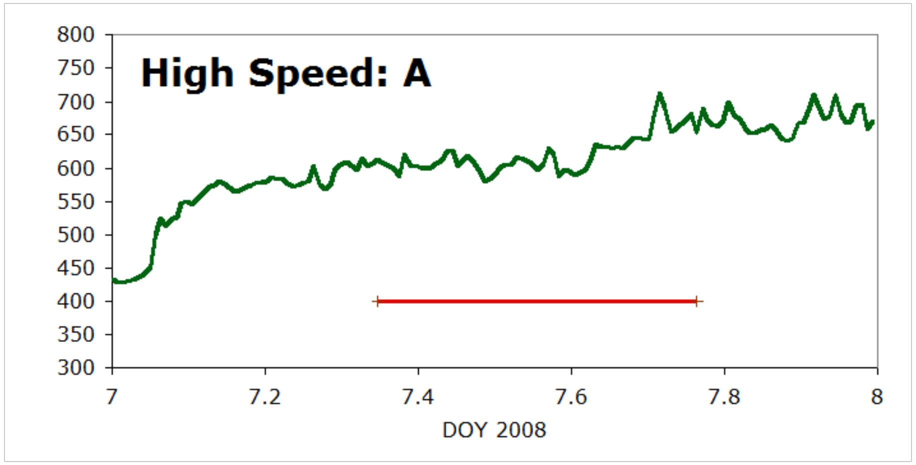
- Ion species may be separated by plotting E_{ssd} vs. Time of Flight
- Each element forms a characteristic trail, regardless of charge state and energy



Fast and Slow S/W Selection

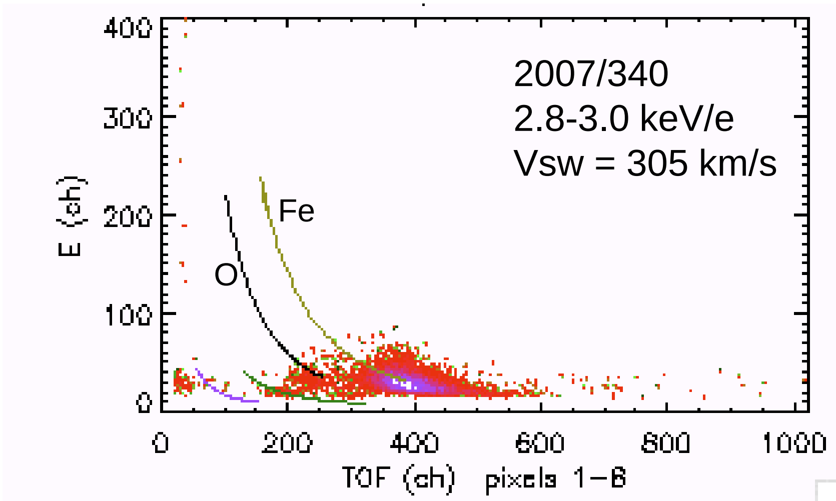
- Select examples of fast and slow solar wind
- Obtain the energy spectrum of Fe and O
- Three days
  - Fast:
    - 2008/007 (<V_{sw}> = 621 km/s)
  - Slow:
    - 2007/340 (Dec 6)
    - 2007/341 (<V_{sw} = 305 km/s)
- Get counts/energy step
- Use Q state to get counts/speed step



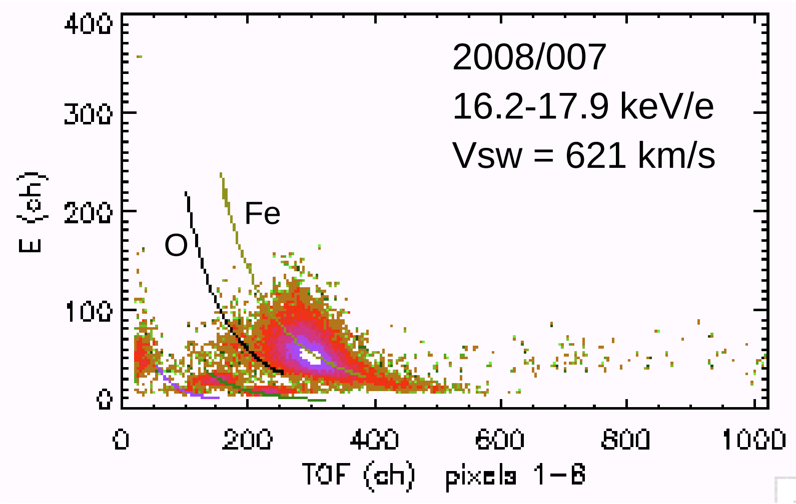


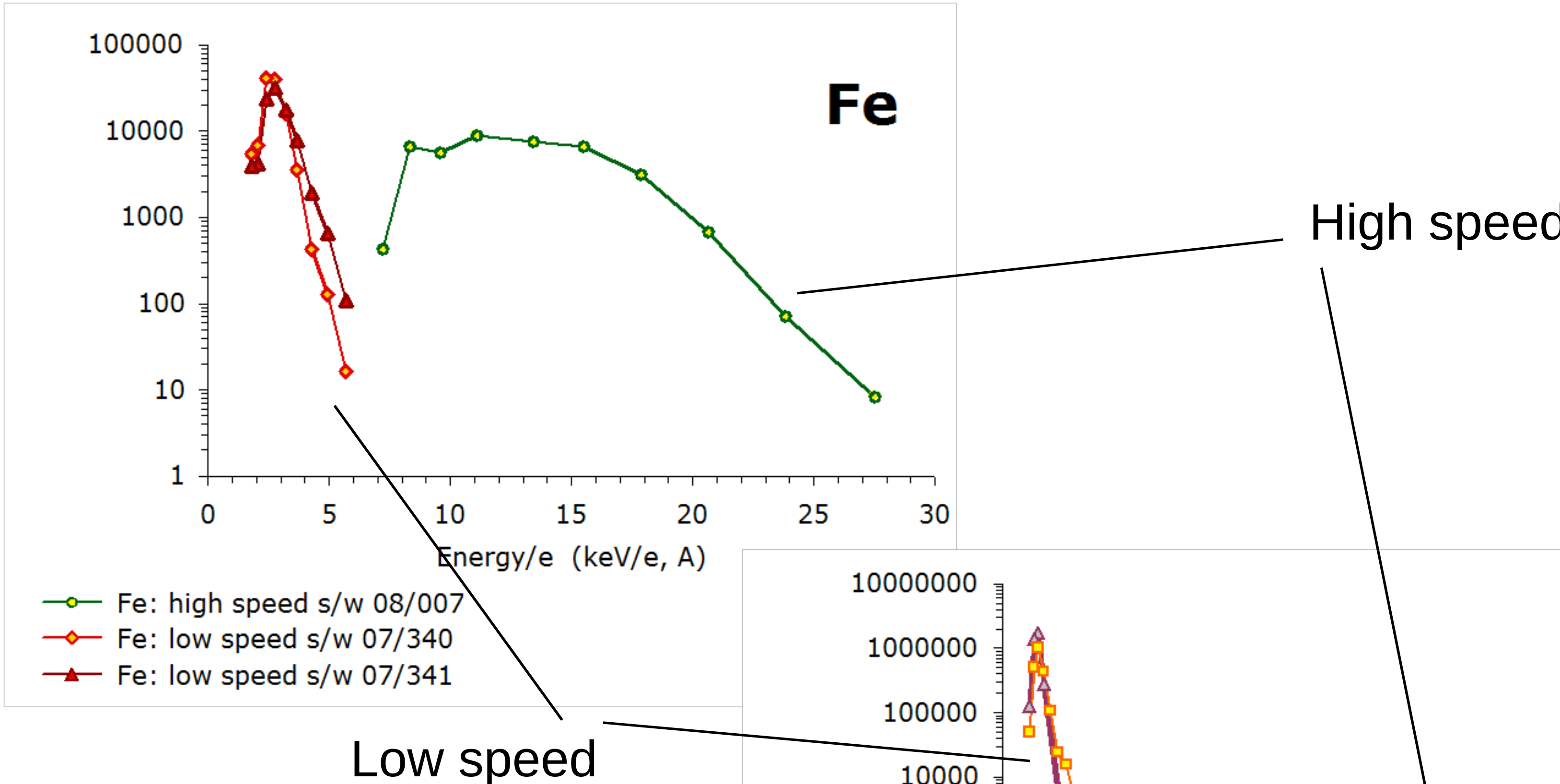
Fe for Fast and Slow S/W Periods

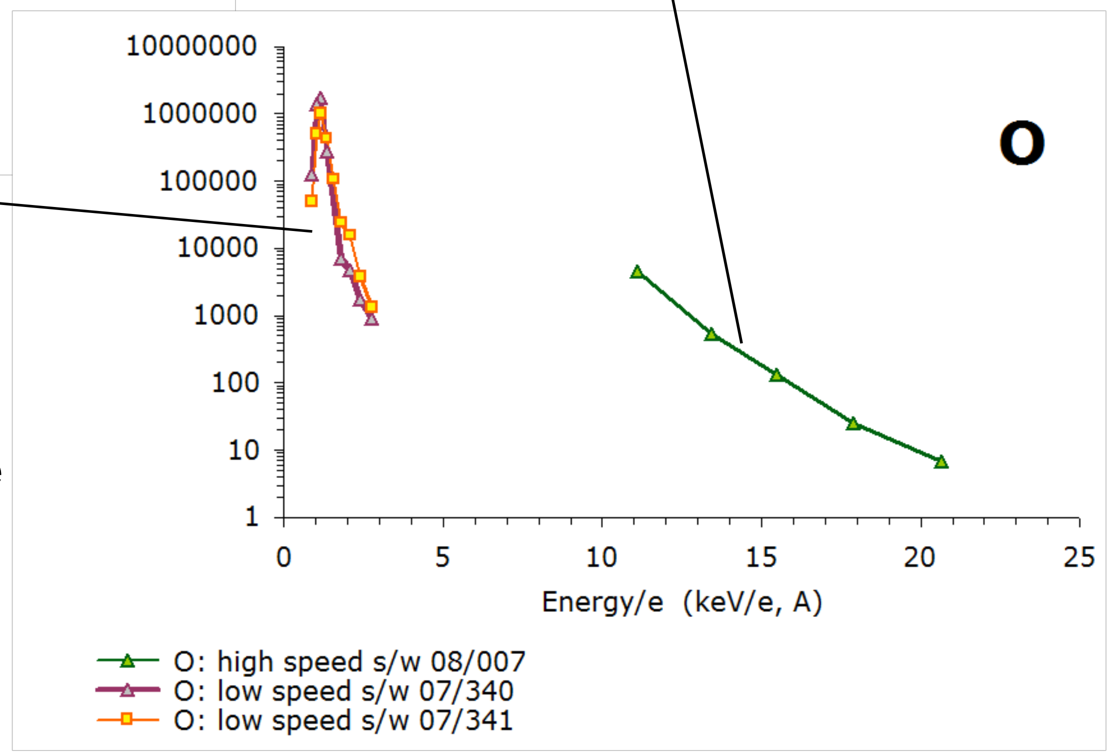
Low Speed



High Speed

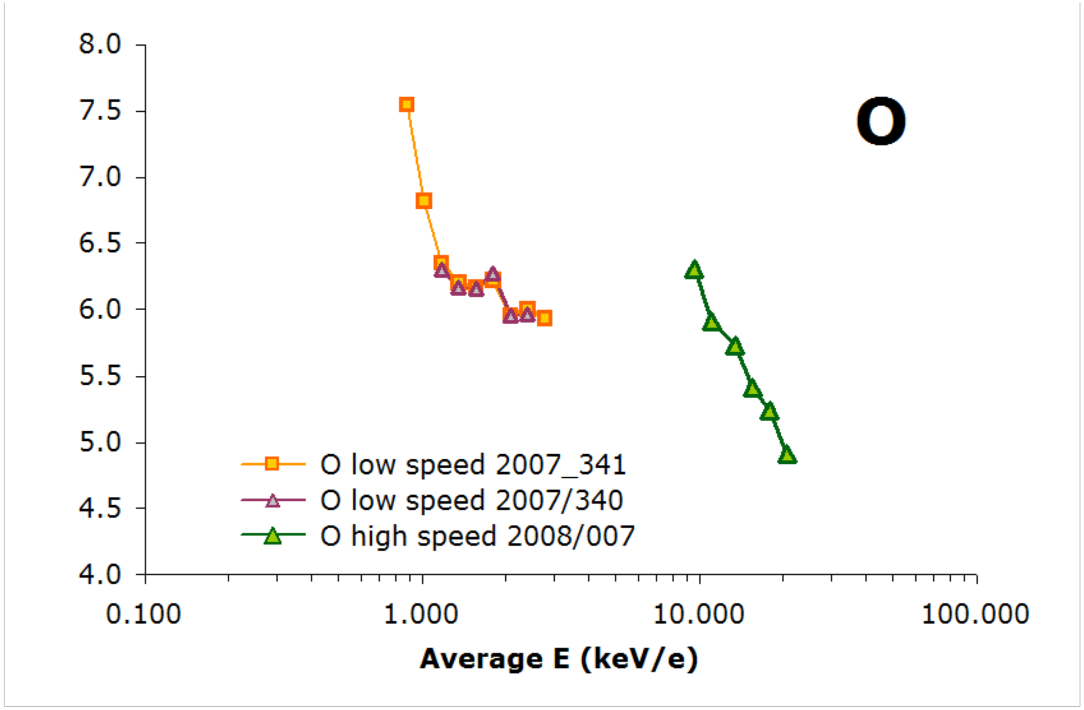






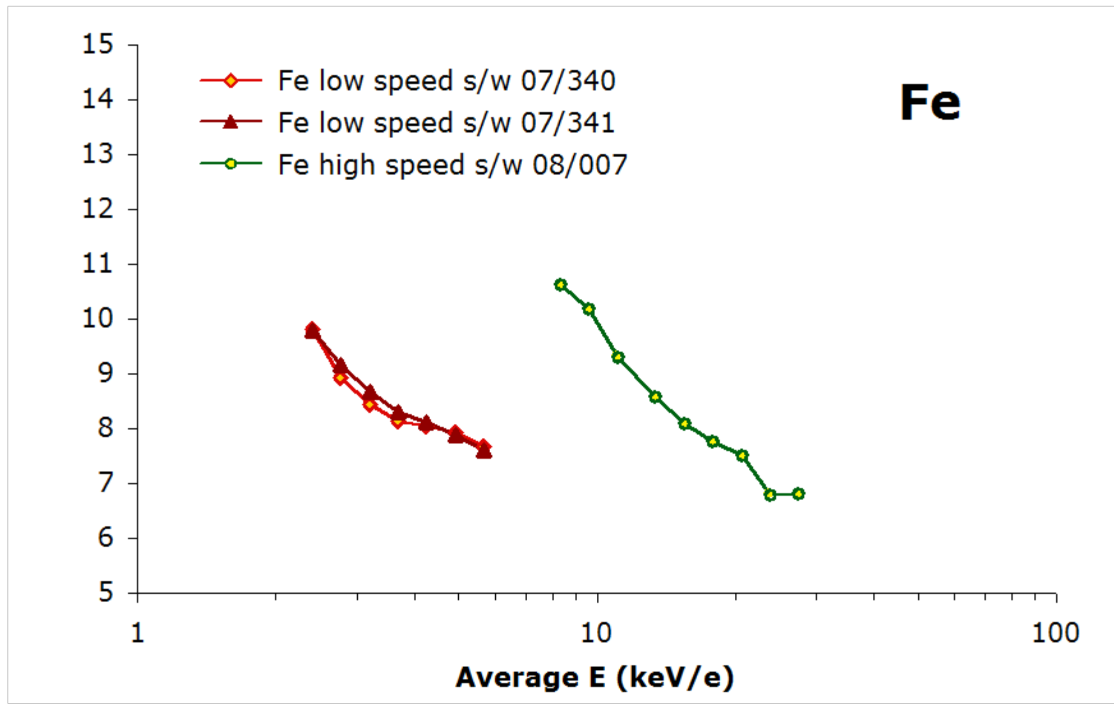
Fe and O counts vs. Energy/charge

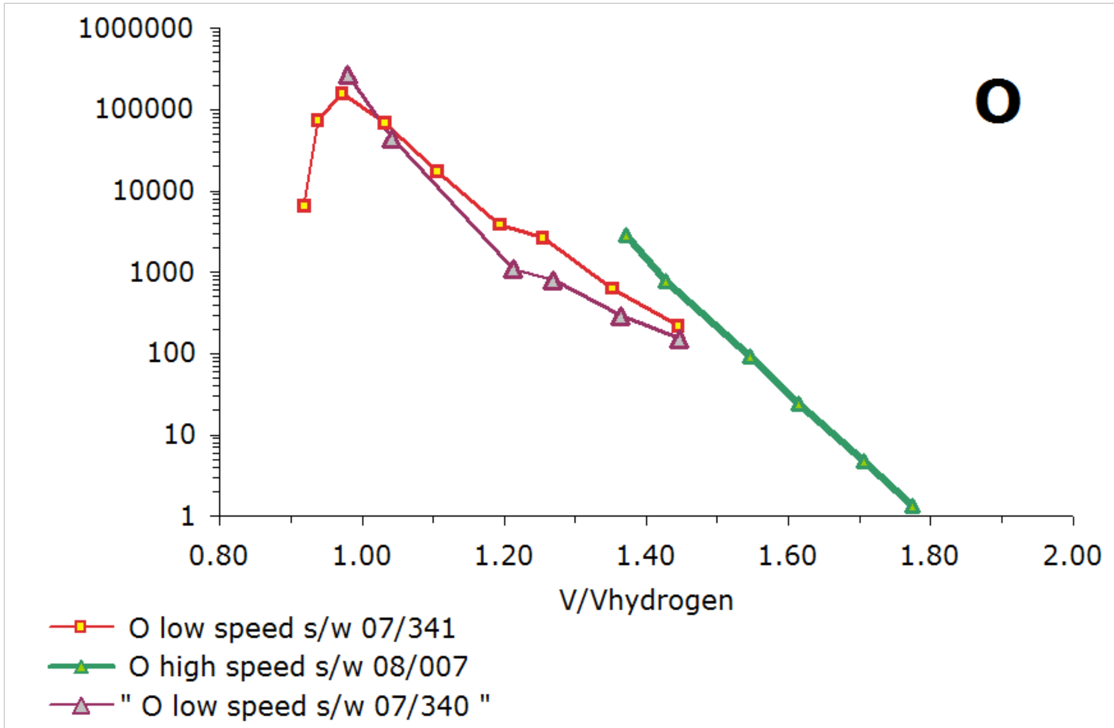
- We have spectra in energy/charge
- Now extract ionic charge states and get energy from energy/charge…



Q vs. E/charge

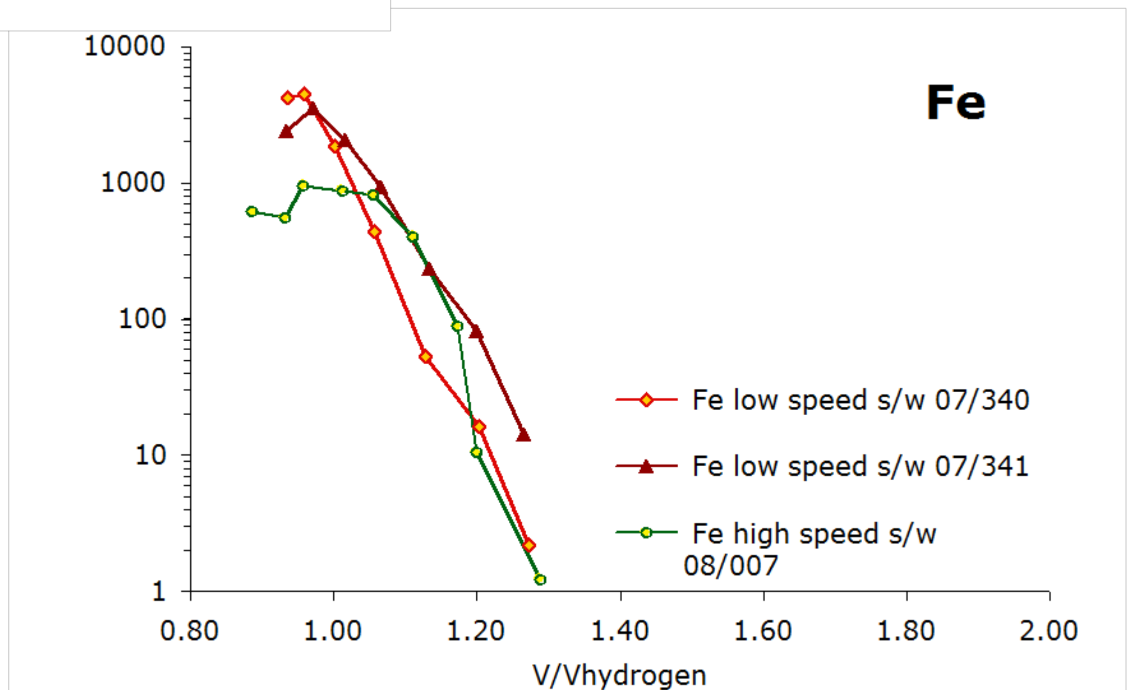
- Average charge states shown for each ESA step range: Q(E).
- Charge state tends to decrease with increasing energy.
- Use charge state and ESA step energy to provide average energy.





Cts/keV vs. V/V_H

- Fe and O counts/keV vs. S/W speed ratio shown
- Variations are apparent in intensity rollover near peak
- High speed O tends to fall off faster than low speed O.
- Rollover is broader in high speed Fe.



Summary

- The energy spectra of solar wind O and Fe have been calculated for low and high speed periods.
- Both O and Fe count spectra display tails above the H+ solar wind speed.
- Spectral variation appears to take place in both ion species
  - Variations are apparent in intensity rollover near peak; rollover is broader in fast solar wind Fe example.
  - High speed O tends to fall off faster than low speed O.
- Next steps:
  - Energy spectra need to be extended to $>2V_H$ … combine more days to improve statistics.
  - Instrument efficiencies will be applied to convert counts to fluxes
  - Transfer results to solar wind frame.