

The Influence of Coronal Mass Ejection Characteristics on the Spread of Solar Energetic Particles

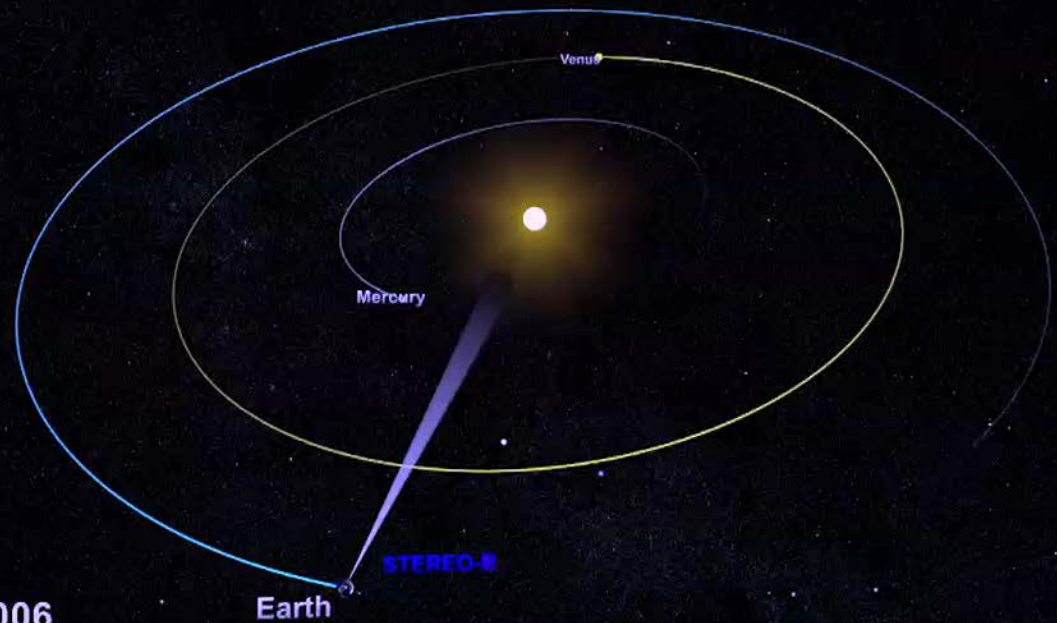
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Previous Work

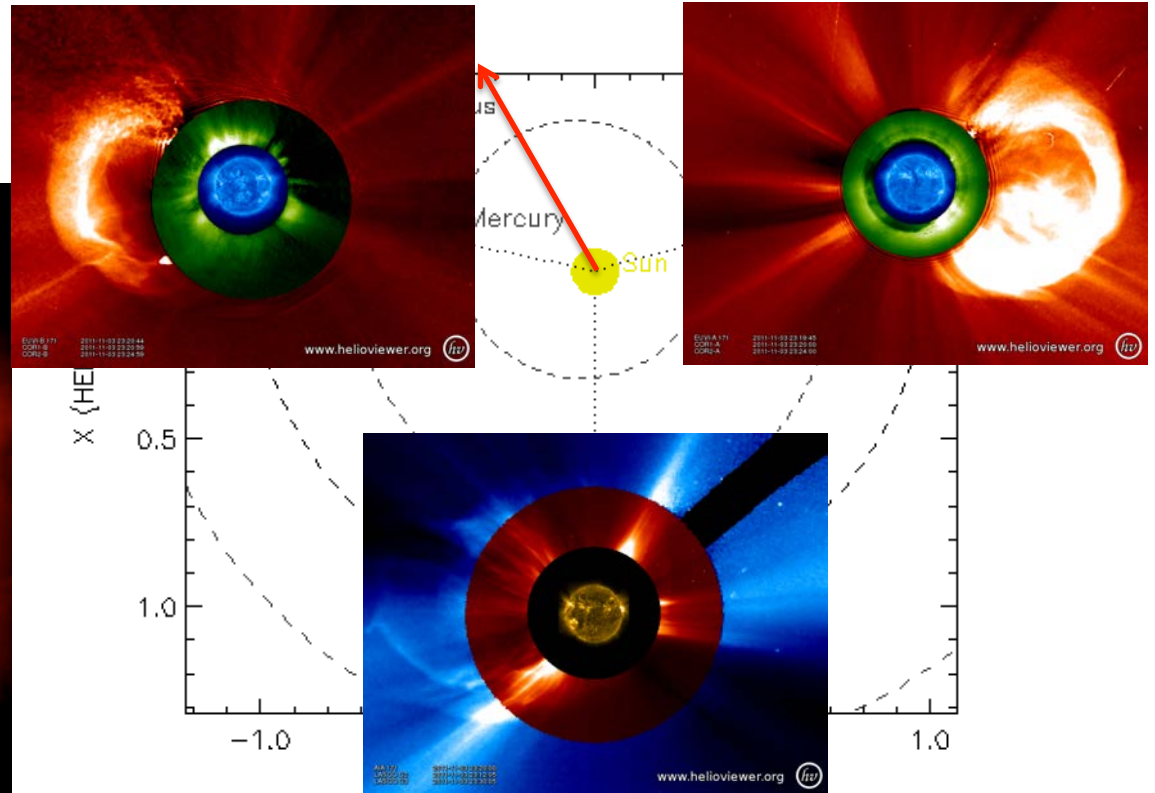
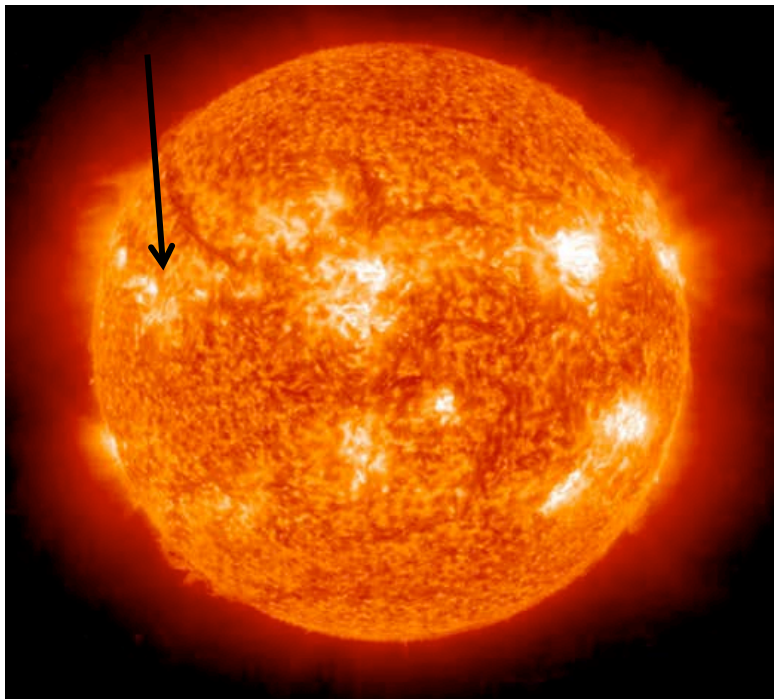
- STEREO was launched in 2006
- Direct longitude studies possible
- 2011-2014 had whole Sun view

Nov 2006



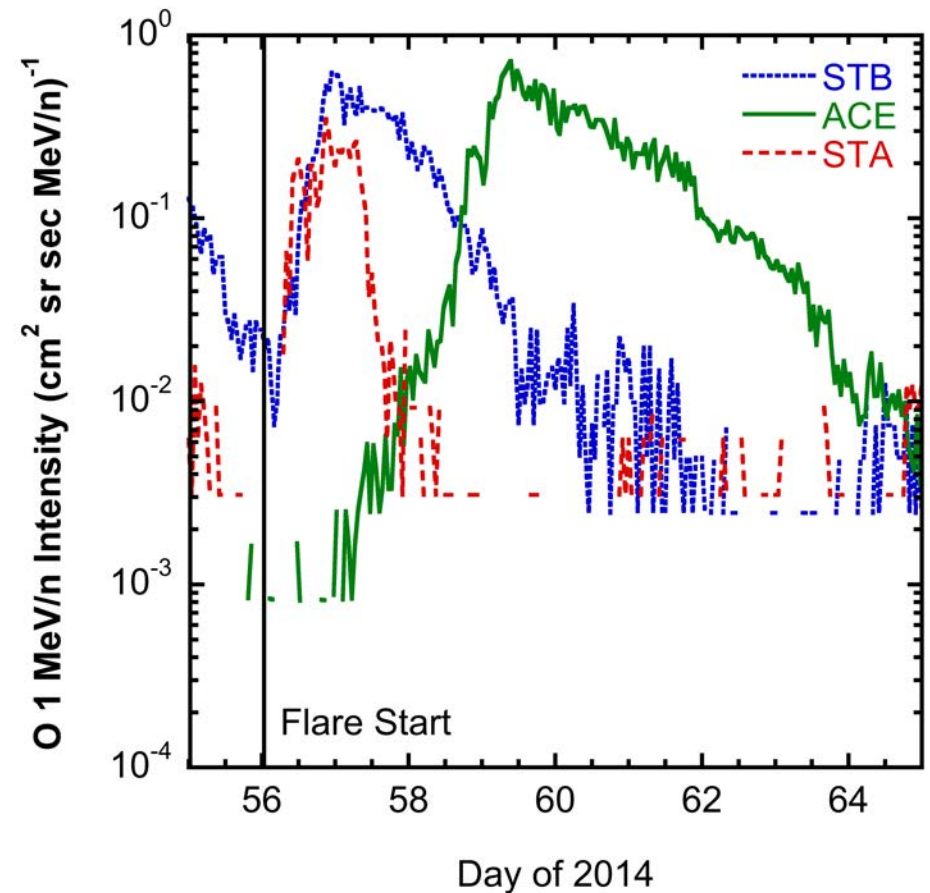
Previous Work

- Multi-spacecraft events



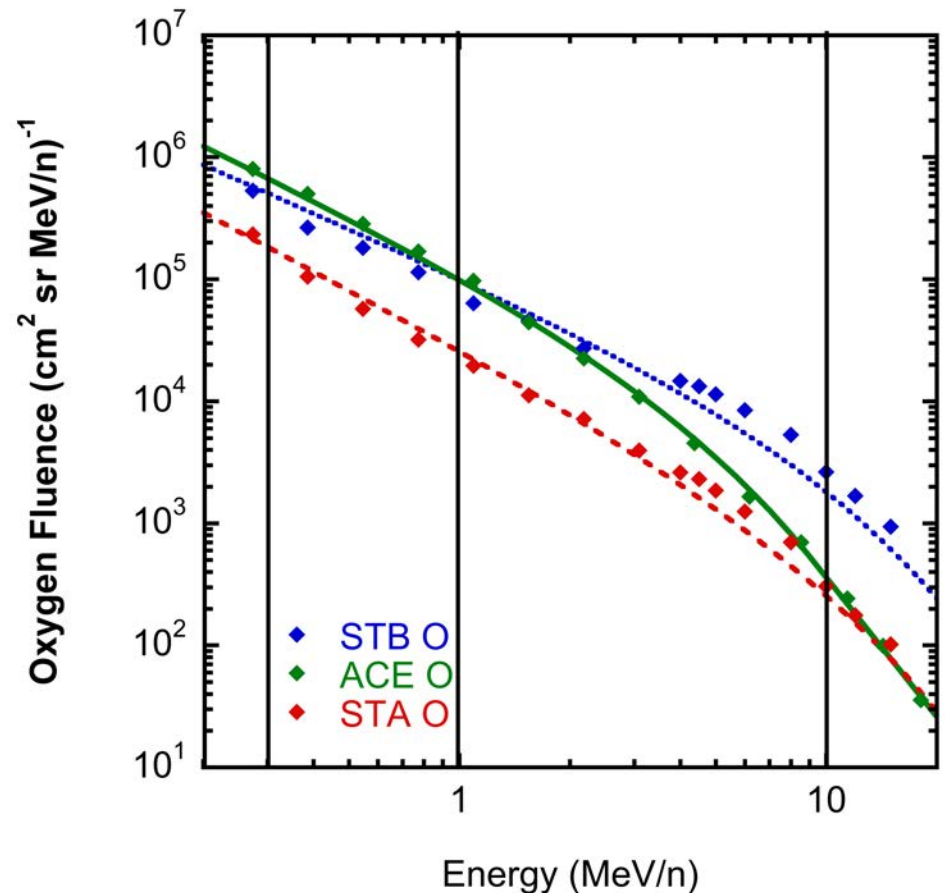
Previous Work

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 - Cohen et al. 2017 selected 41 events, 11 were 3-s/c events



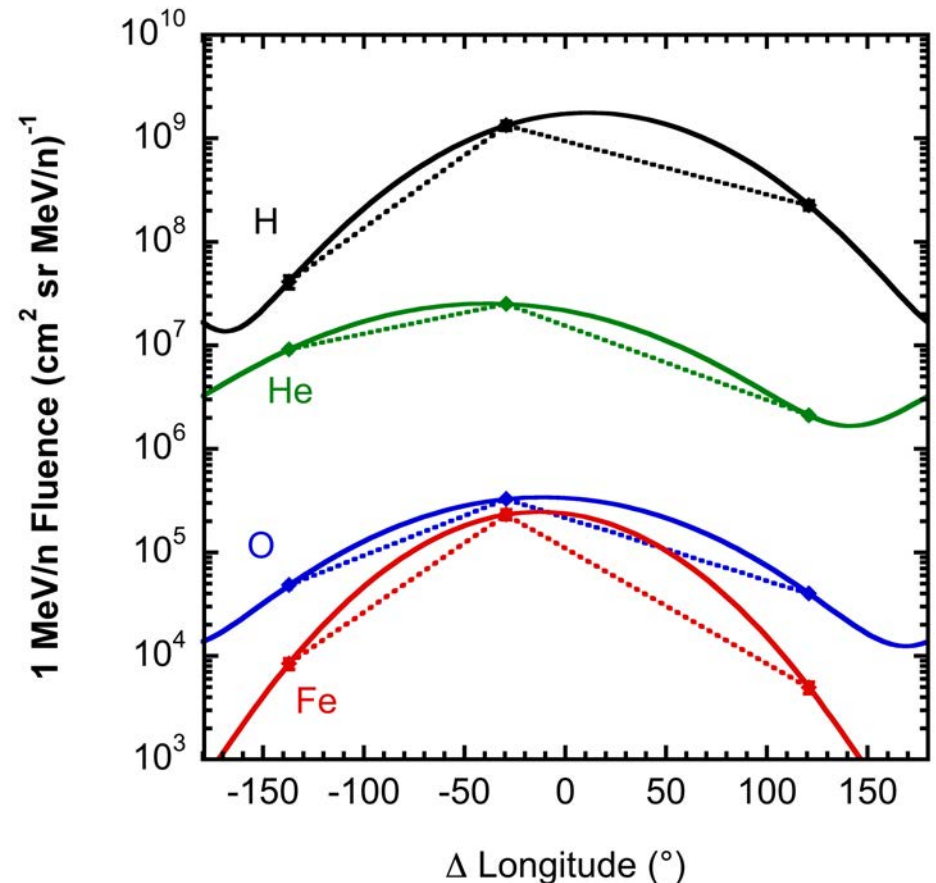
Previous Work

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- Calculated longitude spreads at 0.3, 1, 10 MeV/n for H, He, O, Fe



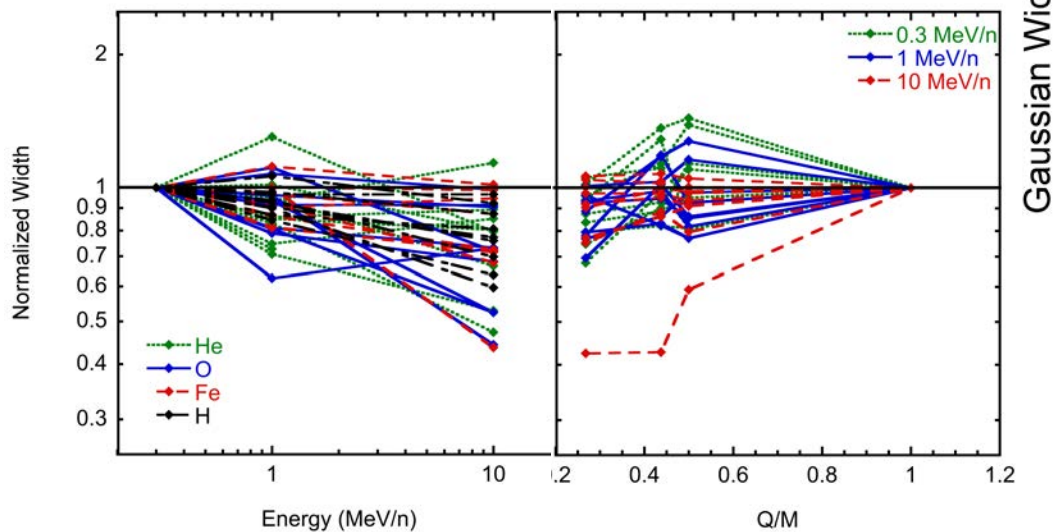
Previous Work

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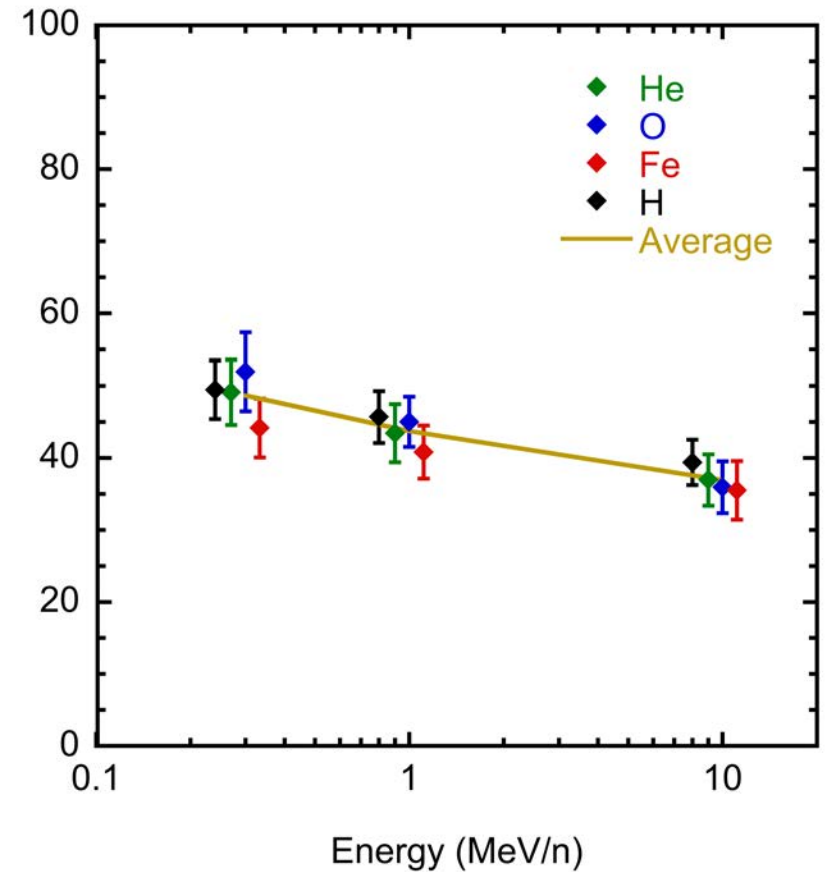


Previous Work

- Width depended on
 - Energy
 - Not species

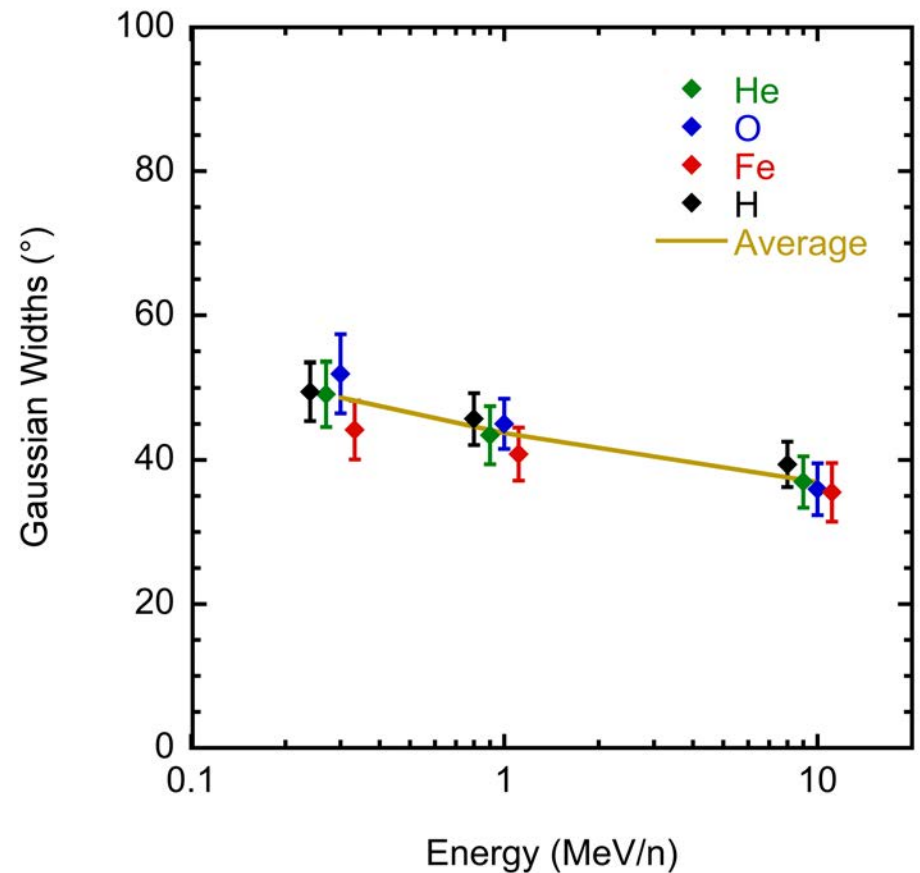


Gaussian Widths (°)



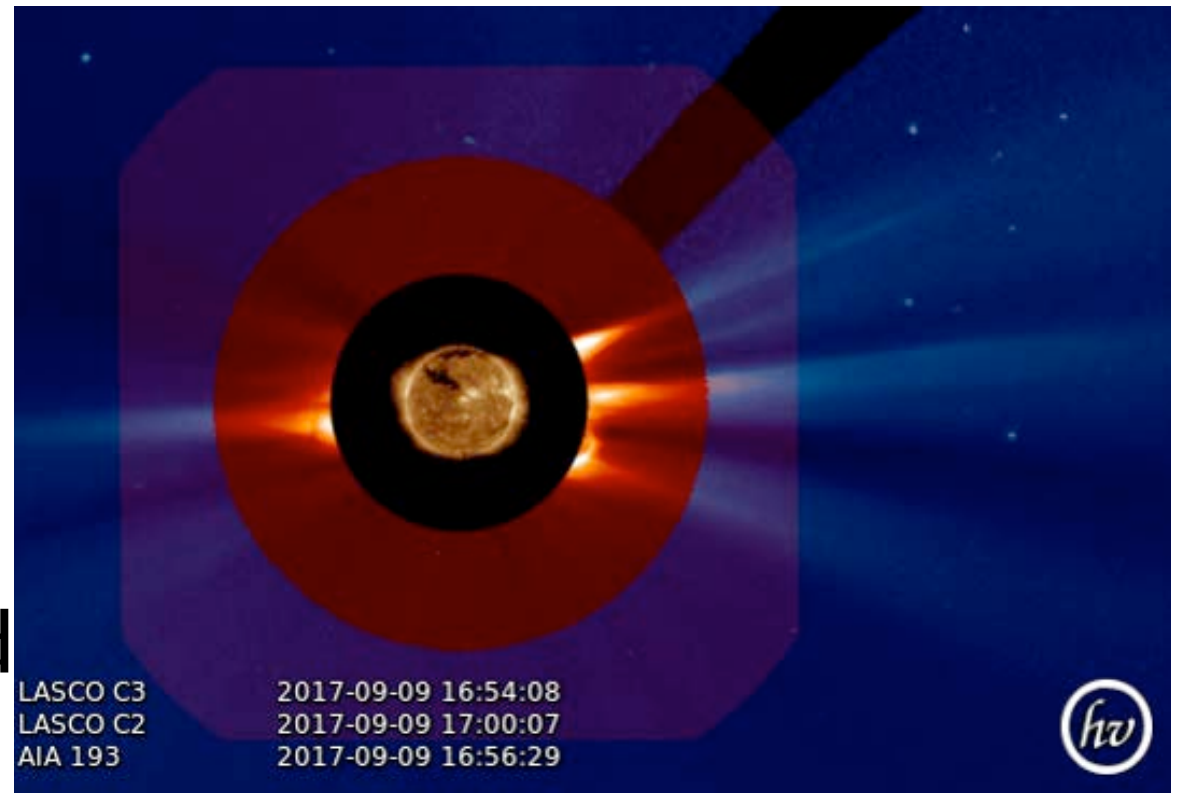
Previous Work

- Width depended on
 - Energy
 - Not species
- Other factors examined
 - Interplanetary CMEs
 - Local shock increases
 - Reservoirs
 - Footpoint calculations



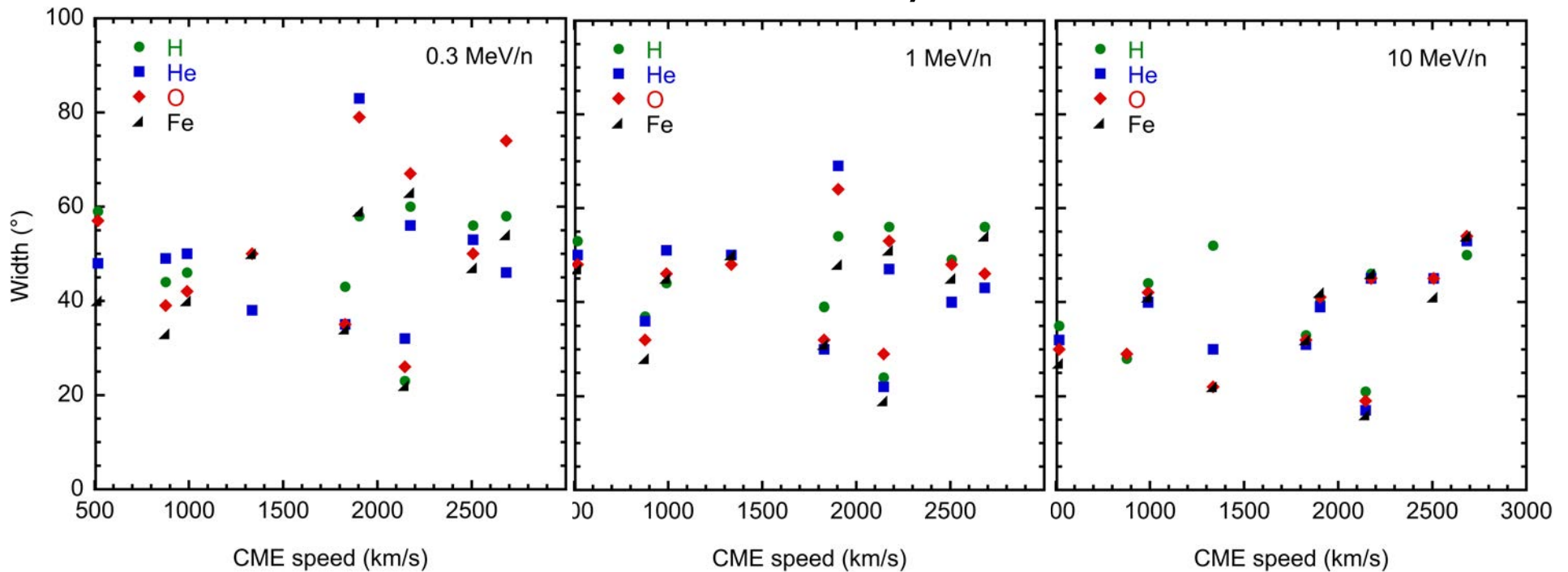
Influence of CME Characteristics

- LASCO catalog
 - Speed, Width*, Mass, Kinetic Energy, Acceleration
 - Projection effects not corrected for
- Widths correlated for 3-s/c events



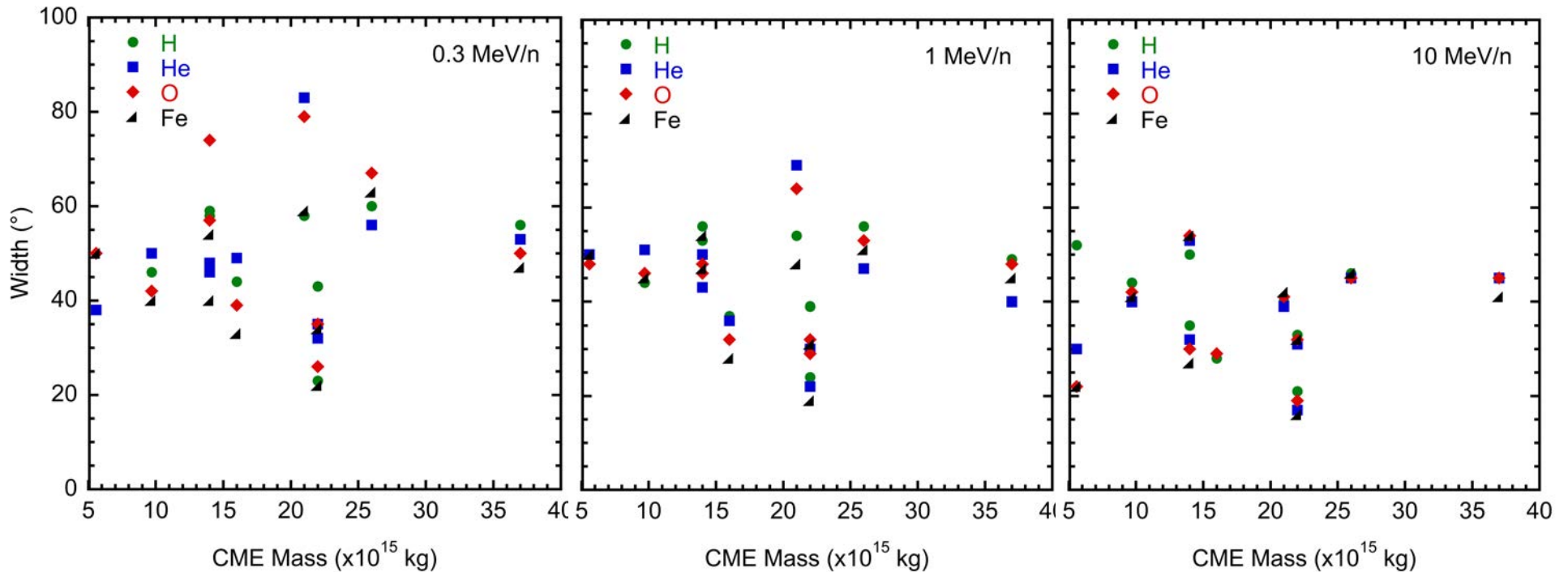
Correlations

- Widths vs CME speed
- Maybe correlation at 10 MeV/n



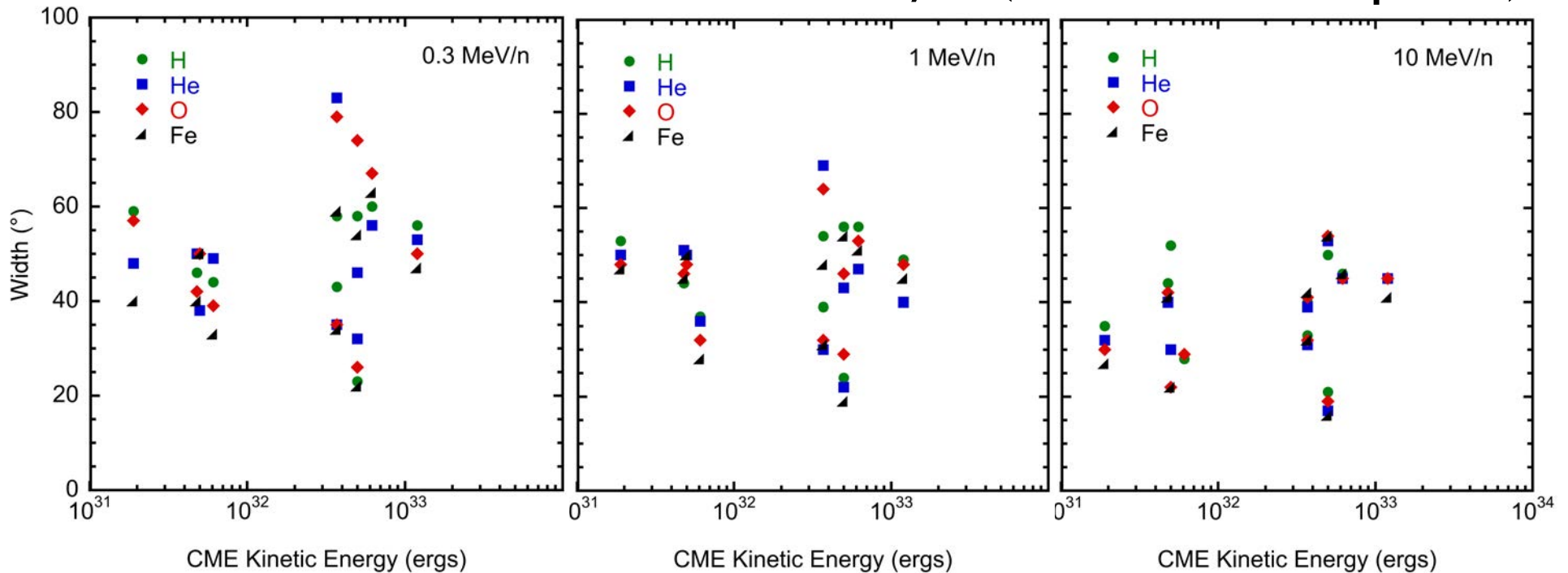
Correlations

- Widths vs CME mass
- No correlation



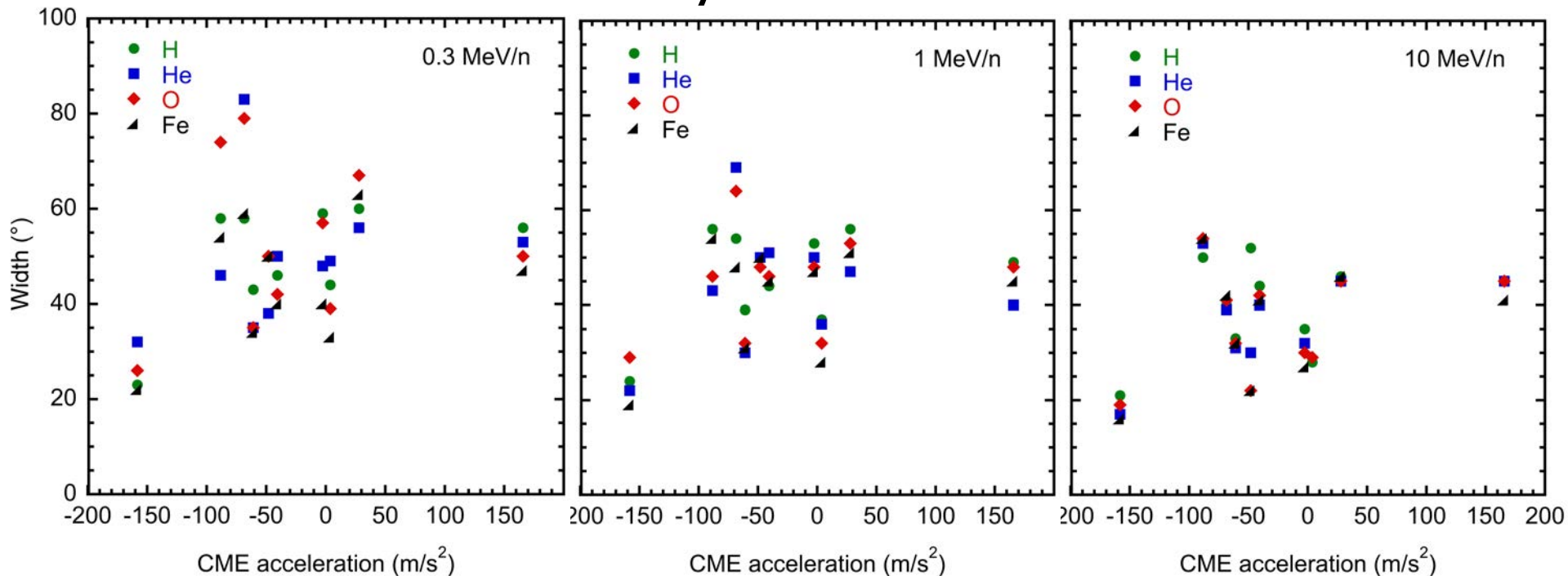
Correlations

- Widths vs CME kinetic energy
 - Maybe correlation at 10 MeV/n (because of speed)



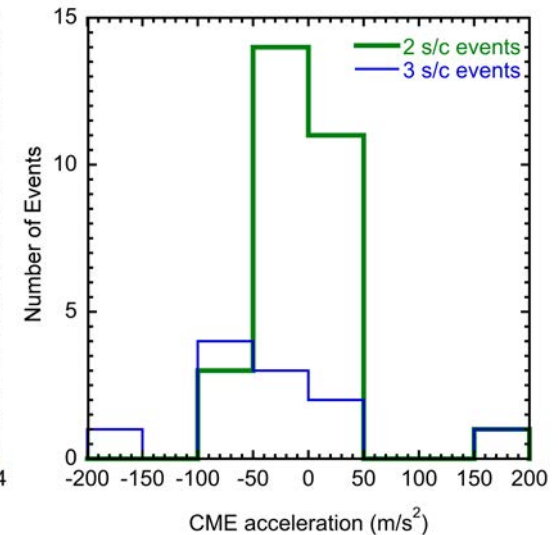
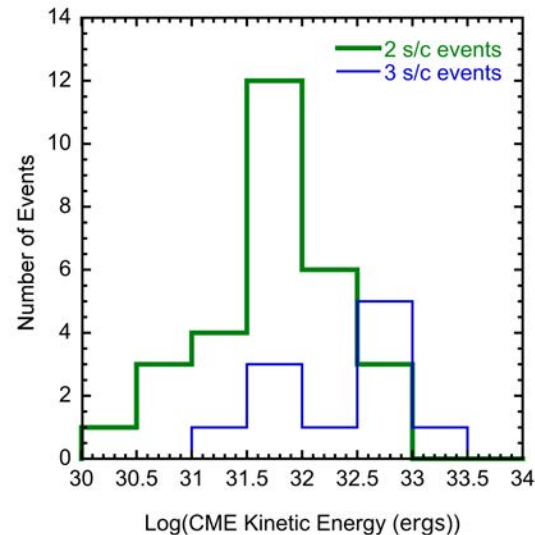
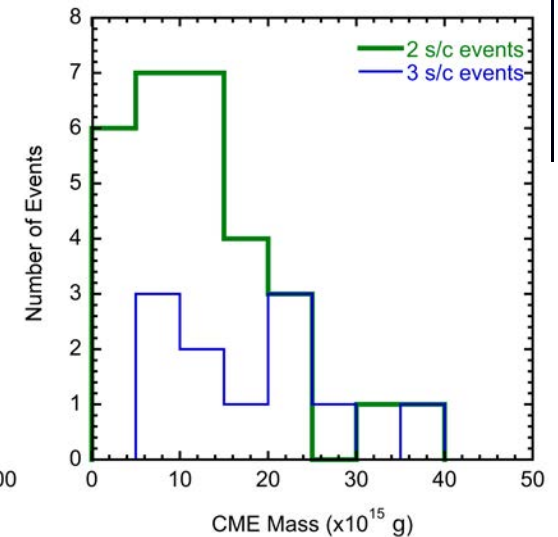
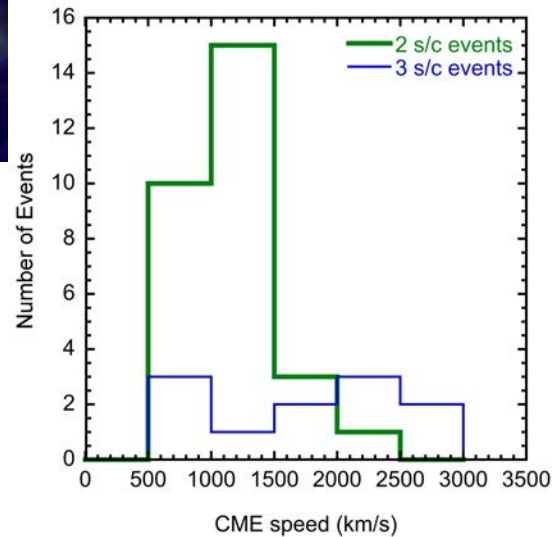
Correlations

- Widths vs CME acceleration
- Correlations primarily because of one event



2 S/C vs 3 S/C

- Individual widths are not possible for 2-s/c events
- Compared distributions of CME characteristics
- 3-s/c events are faster, more massive/energetic/ deceleration



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CME Parameter	Mean 2-S/C Events	Means 3-S/C Events
Speed	1160 km/s	1740 km/s
Mass	1.2×10^{16} g	1.8×10^{16} g
Kinetic Energy	1.1×10^{32} ergs	3.5×10^{32} ergs
Acceleration	-5.6 m/s ²	-30.1 m/s ²

Summary/Future Work

- SEP widths dependences
 - weakly on CME speed
 - not on mass or acceleration
- CMEs of 3-s/c events
 - 50% faster, more massive
 - 3x energetic
 - 6x more deceleration

Future

- 3D modeling of CMEs
 - Correct for projection
 - Give better characteristics
- Examine H-only 3-s/c events
 - Additional events

A vibrant, multi-colored nebula or galaxy core, featuring a bright green starburst or lens flare on the right side. The colors range from deep blue and purple to bright yellow and orange, with a prominent green starburst on the right edge.

Thank You