

Spatial Offsets of Interplanetary Ion and Electron Source Regions

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The diagram illustrates magnetic reconnection on the solar surface. At the bottom, a solid orange horizontal band represents the solar surface. From this surface, four magenta lines representing magnetic field lines extend upwards. The two lines on the left curve towards the right, and the two lines on the right curve towards the left, eventually crossing each other in the center. A black rectangular box is positioned in the middle of the diagram, overlapping the point where the magnetic field lines cross. Inside this box, the text "Magnetic reconnection. Particles are accelerated." is written in yellow. The background of the diagram is a dark brown gradient with a fine, diagonal hatched pattern.

**Magnetic reconnection.
Particles are
accelerated.**

Solar Surface

“The centroid of the ion source ... is significantly displaced from the electron-bremsstrahlung source(s).”

Dominated by electron bremsstrahlung

Hydrogen neutron-capture line

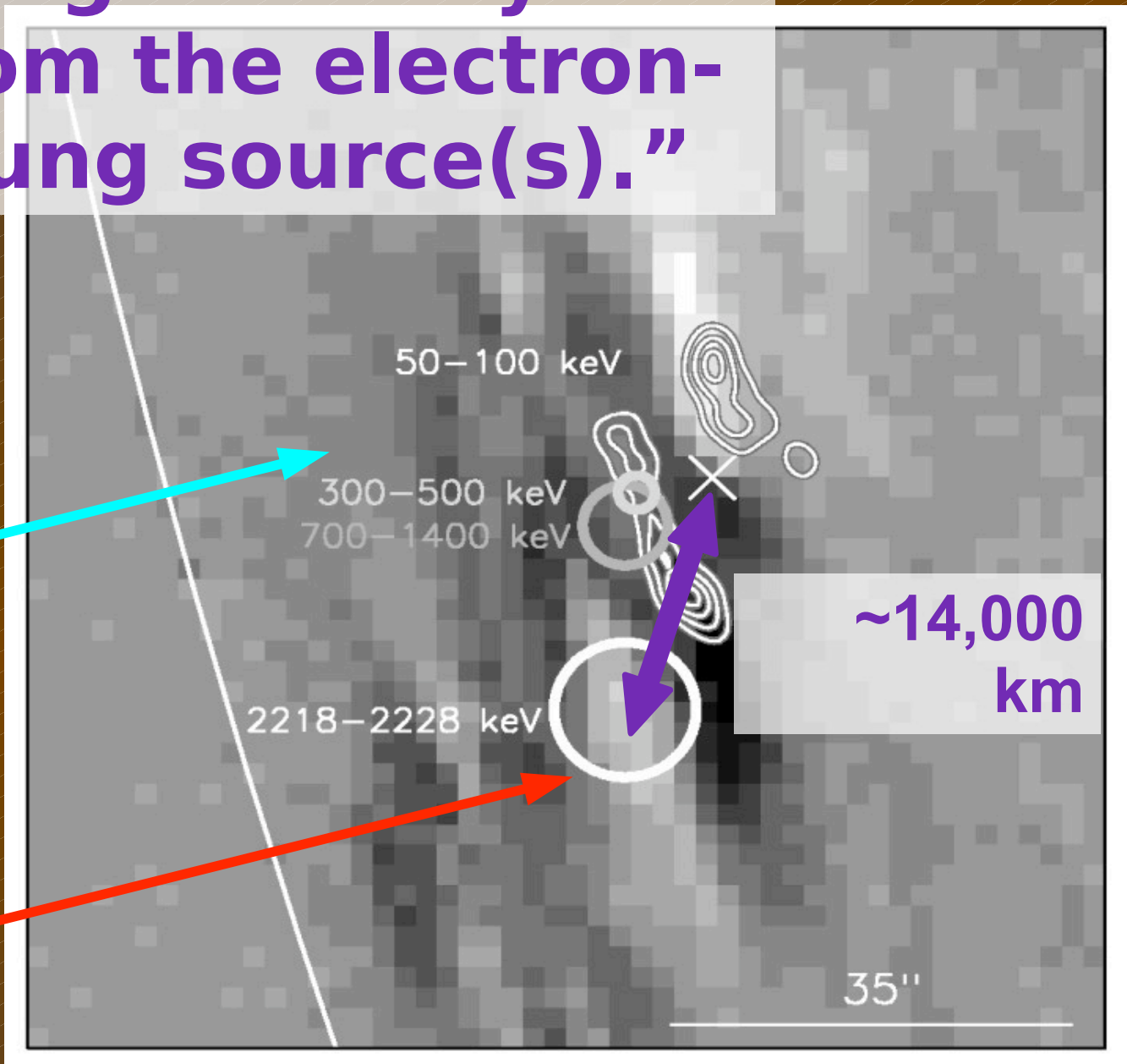
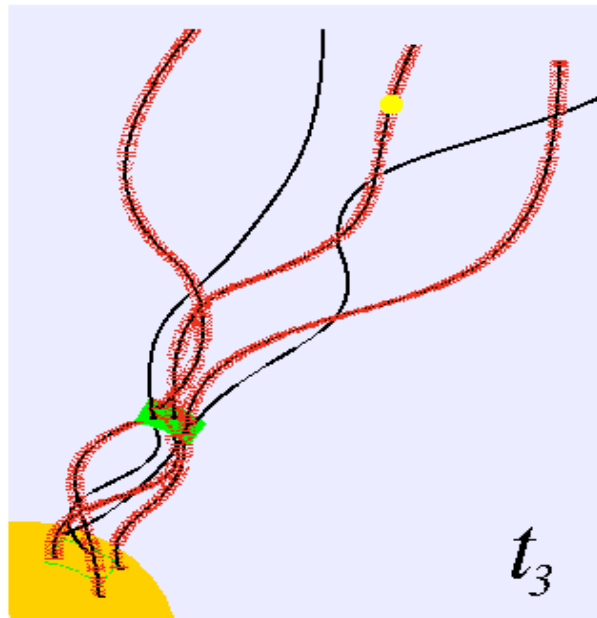
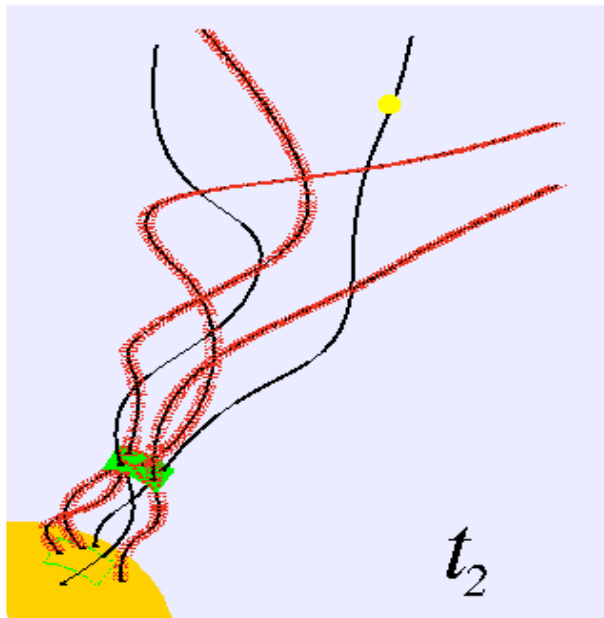
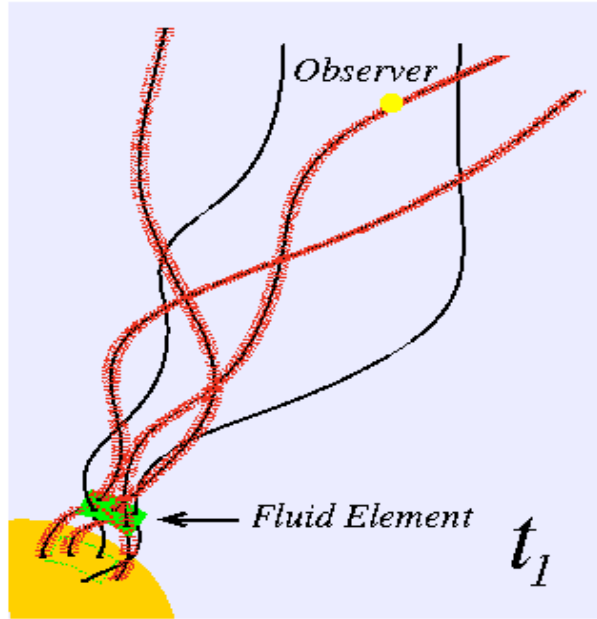
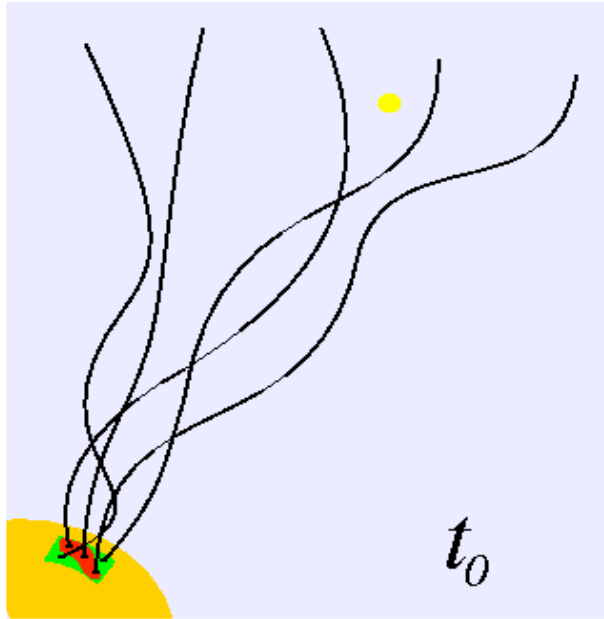


Figure credit: Hurford et al. 2003

Question to be answered:

Do interplanetary particles show the same source-region offset that the X-ray data has?

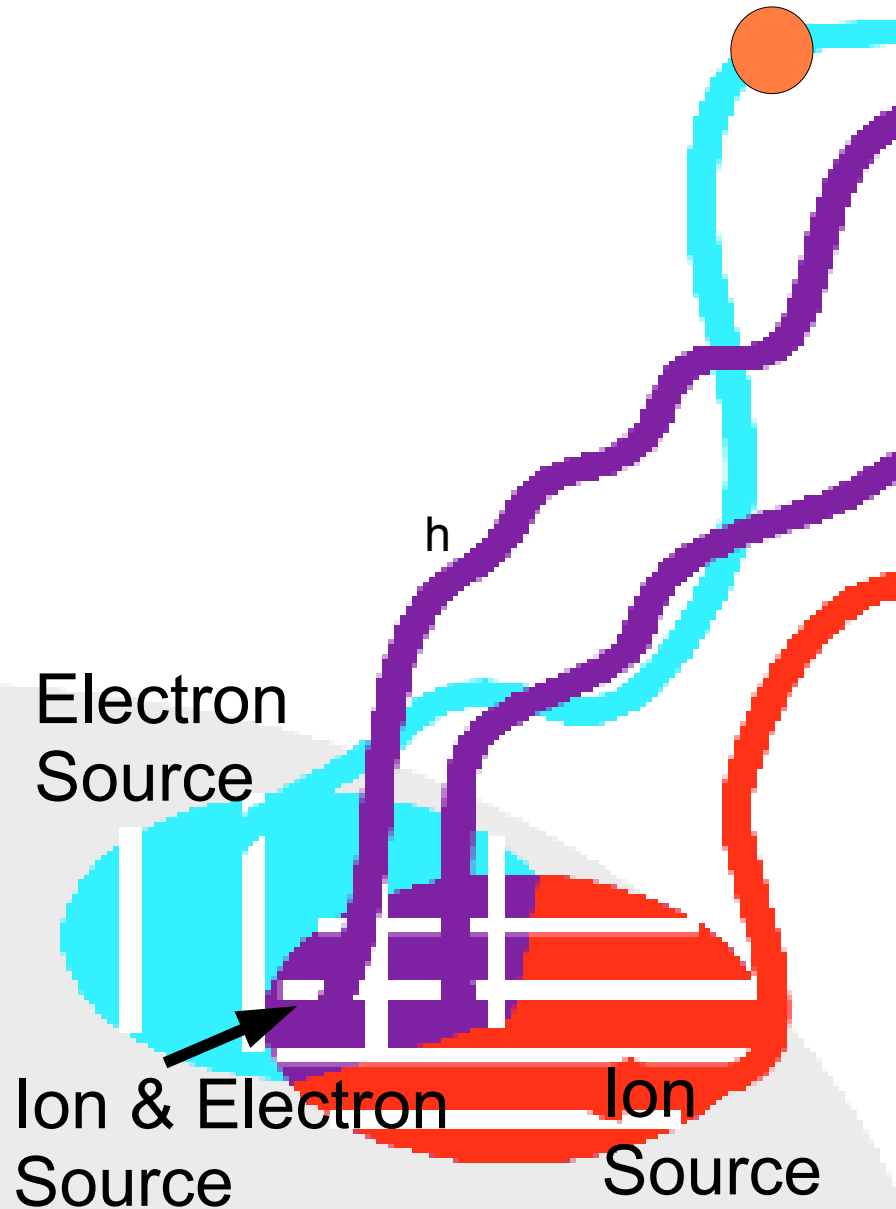


Dropouts:

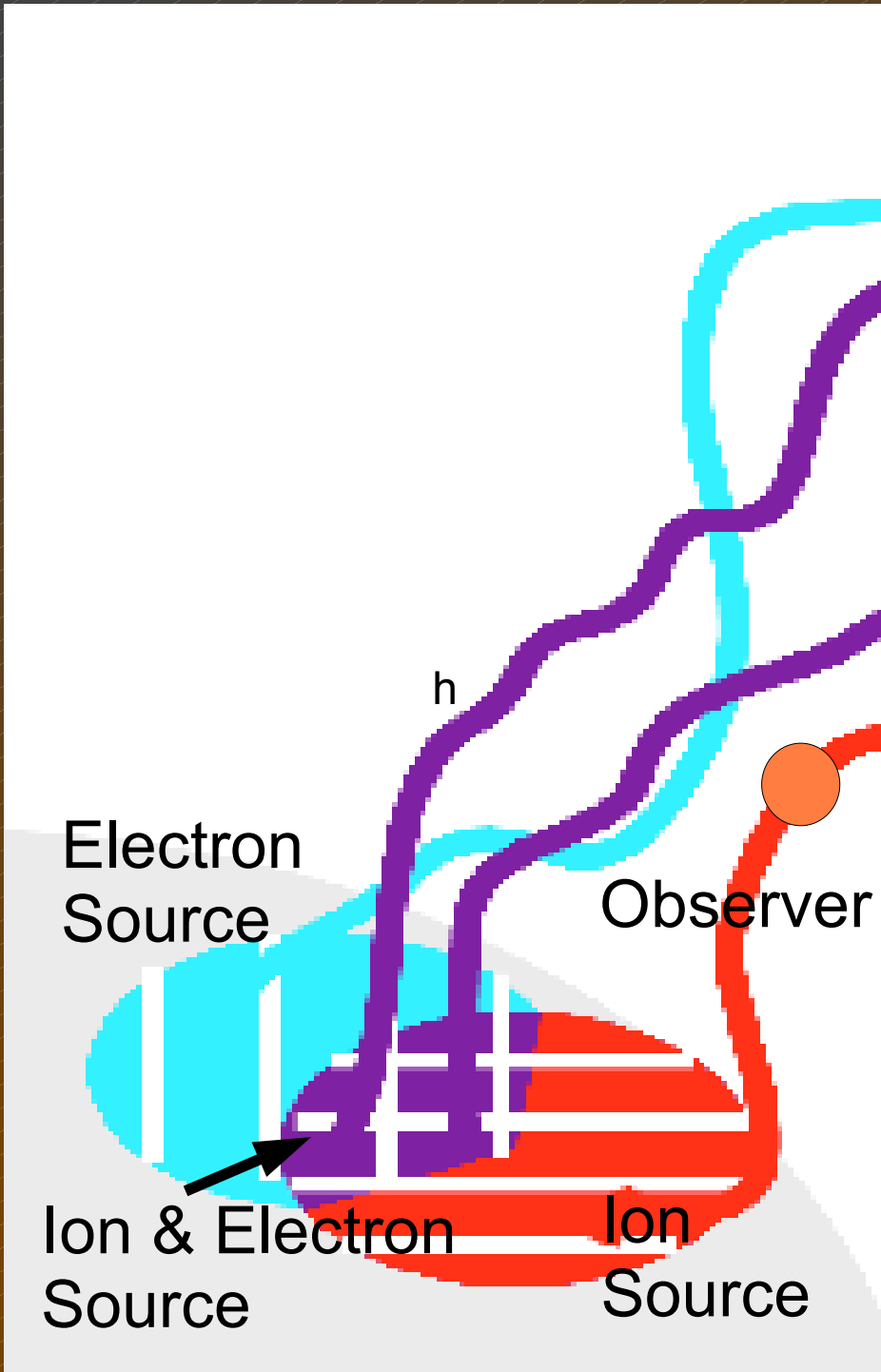
**Field lines
connected or
not connected
to the source
become mixed
together.**

Figure credit: Joe Giacalone

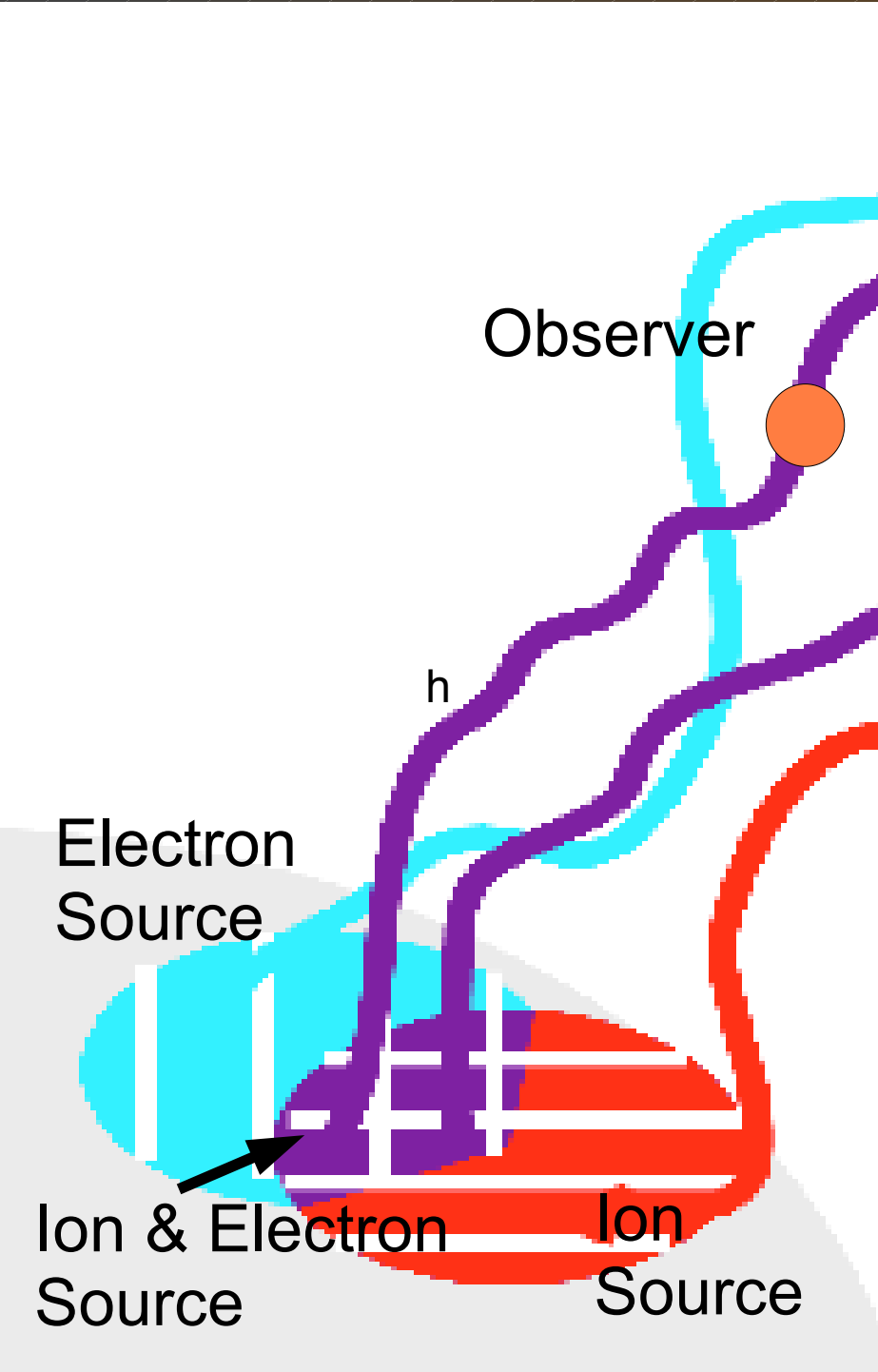
Observer



**Observer sees
electron intensity,
ions dropped out.**

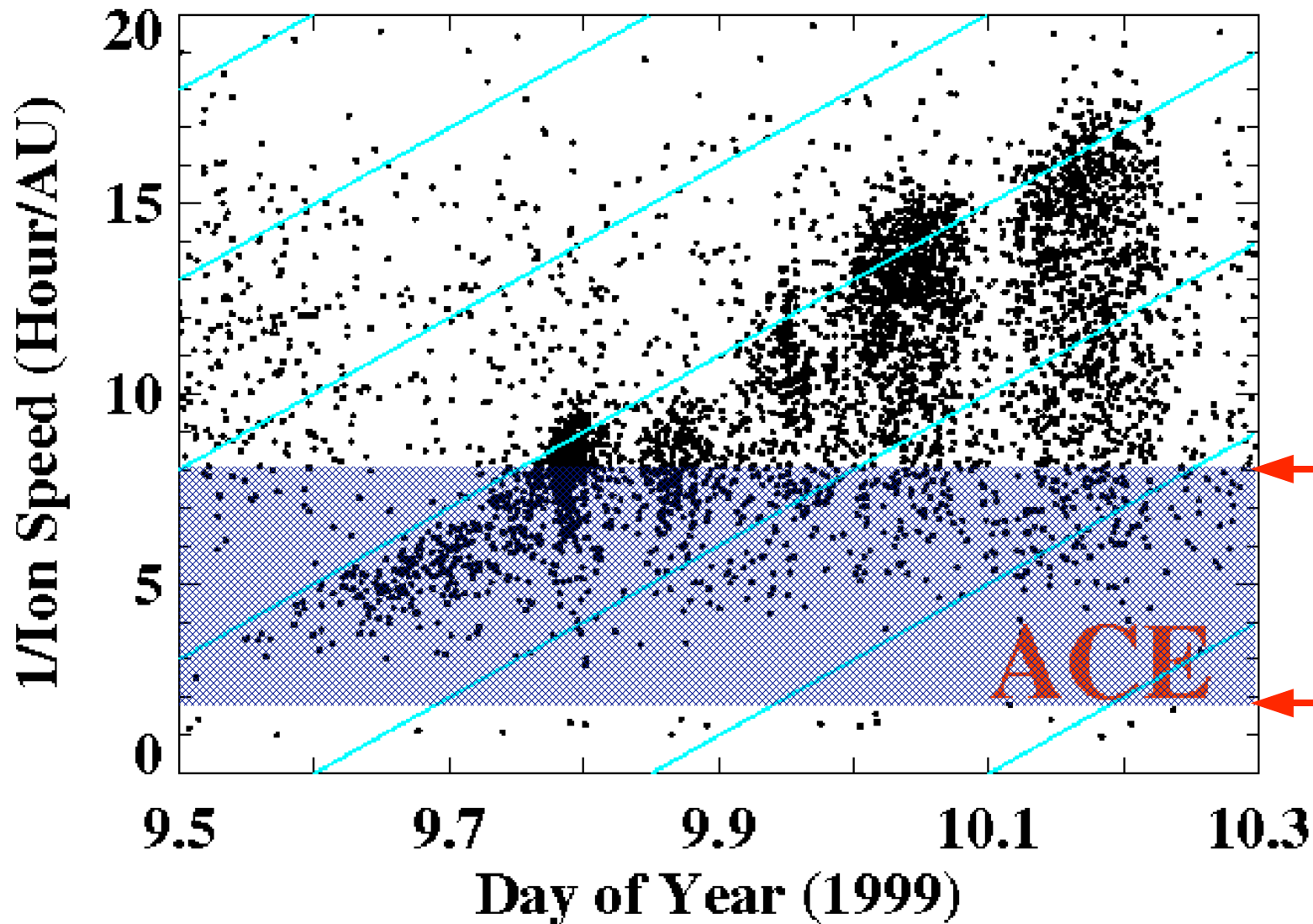


Observer sees ion intensity, electrons dropped out.



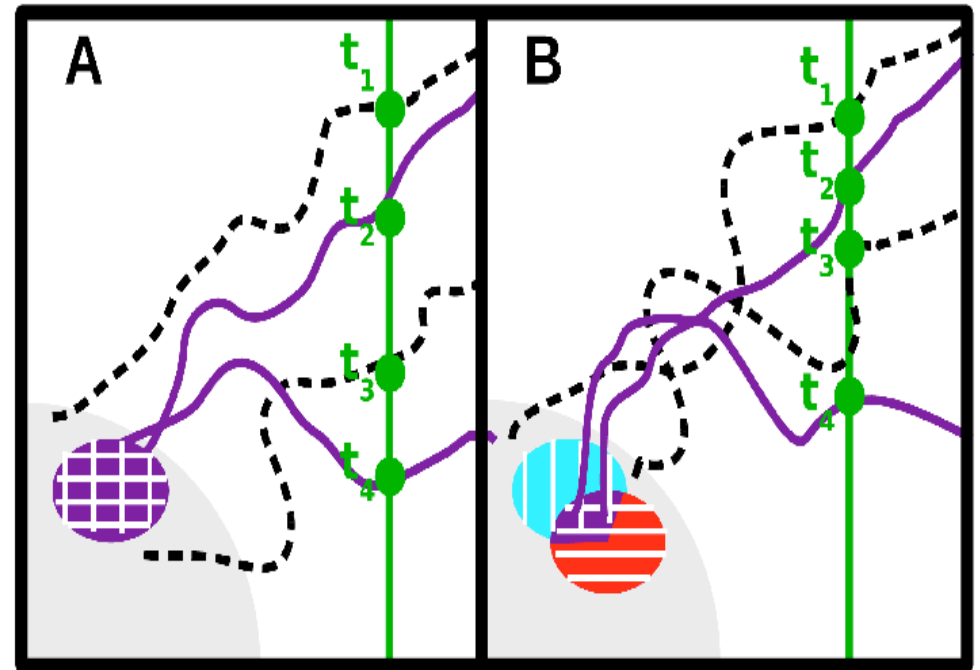
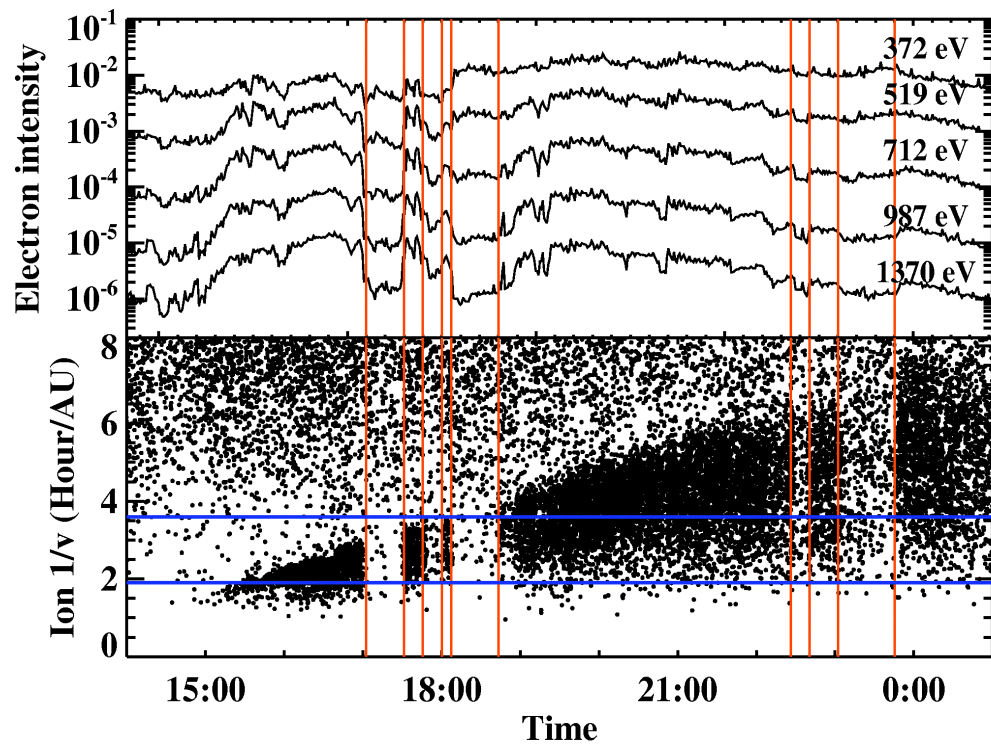
Observer sees both ion and electron intensity simultaneously.

SWEPAM vs. ULEIS Velocity Ranges

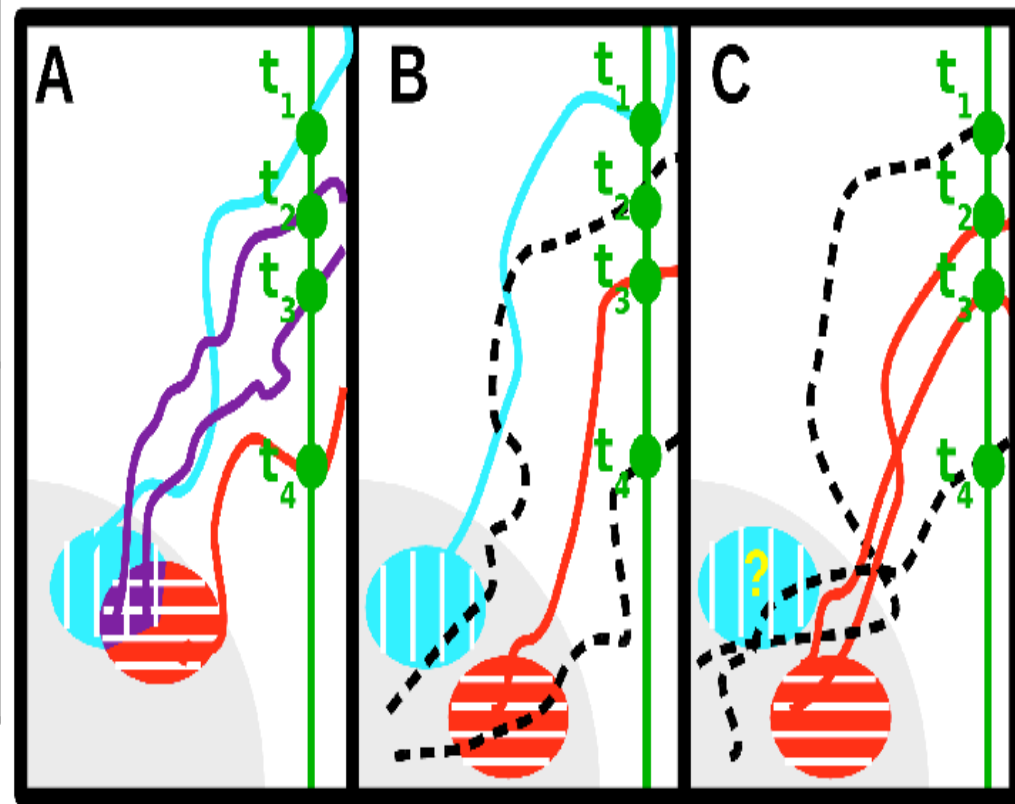
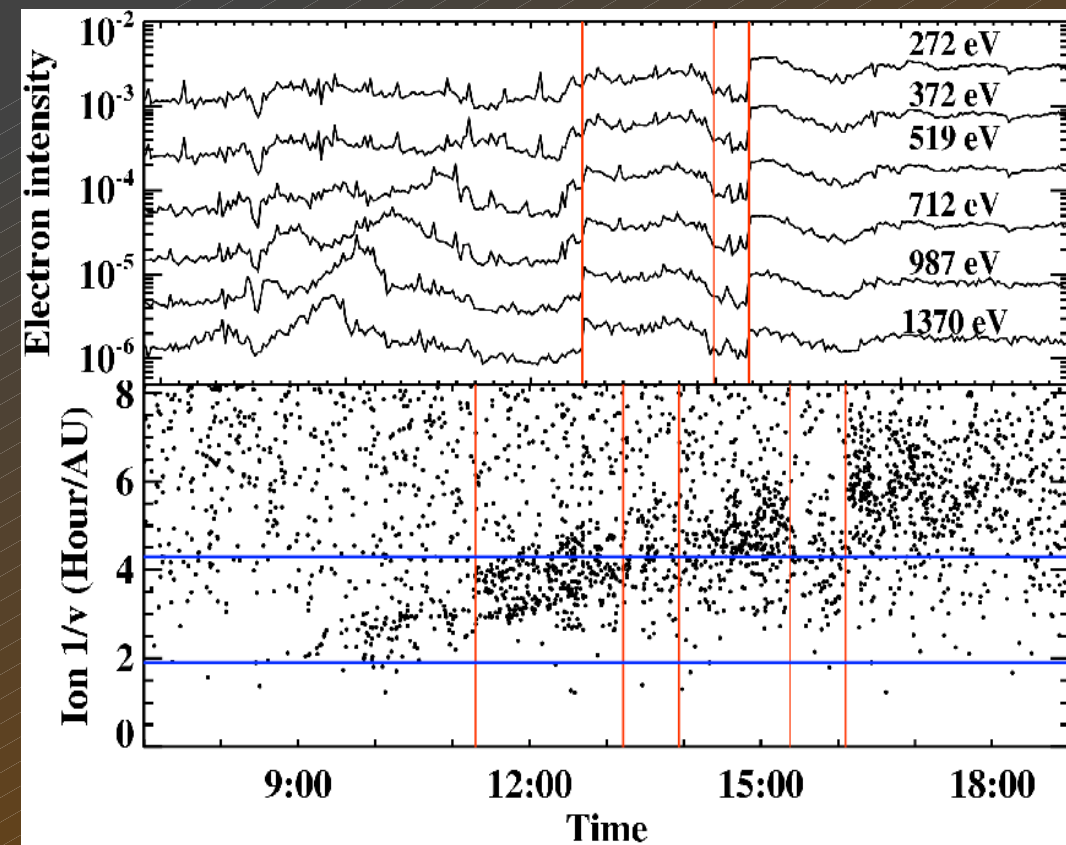


73.3 eV
electron

1370 eV
electron

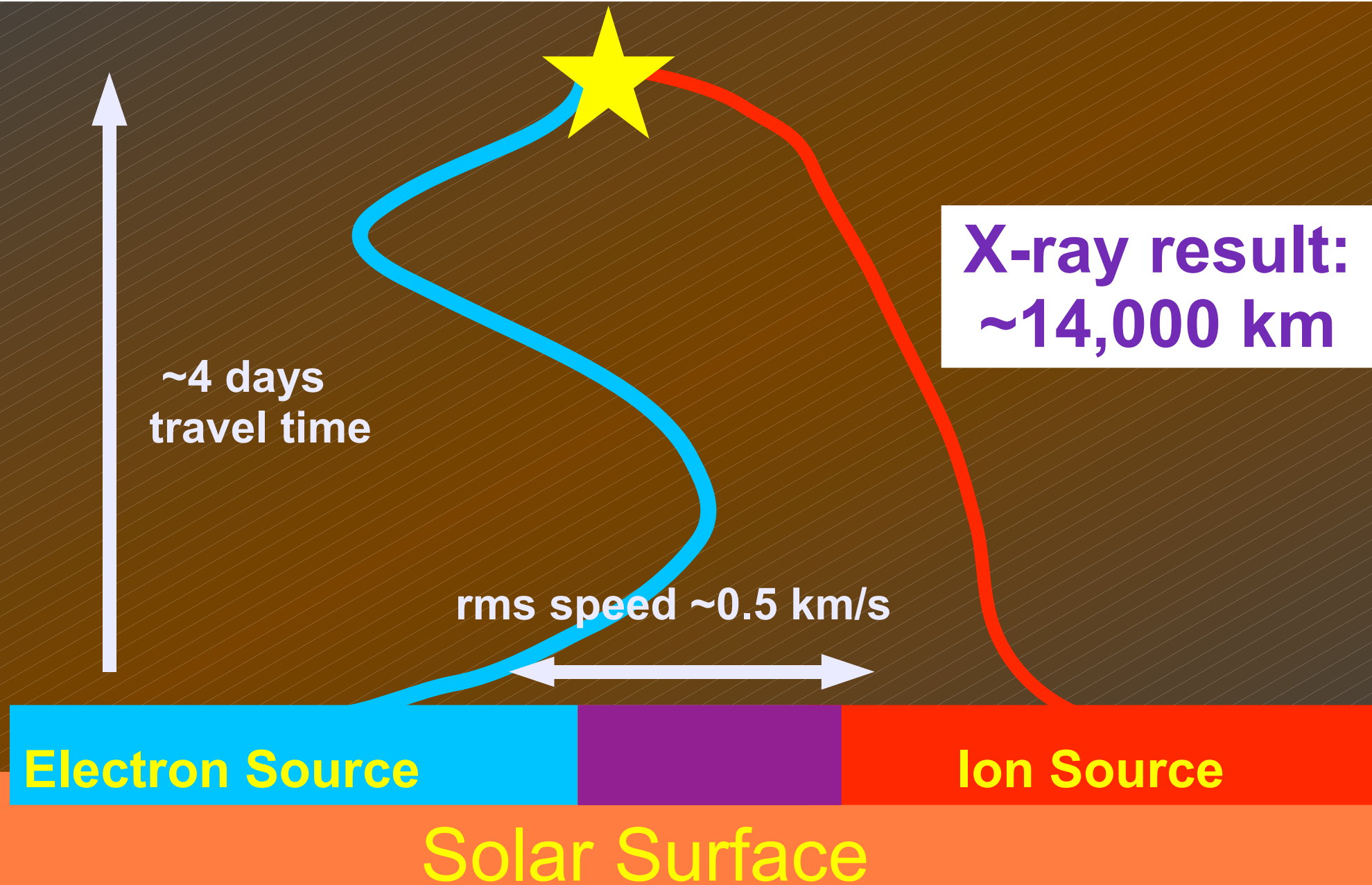


In about half of the events in undisturbed solar wind, ions and electrons always have simultaneous dropouts.



In about half of the events in undisturbed solar wind, ions and electrons have some non-simultaneous dropouts.

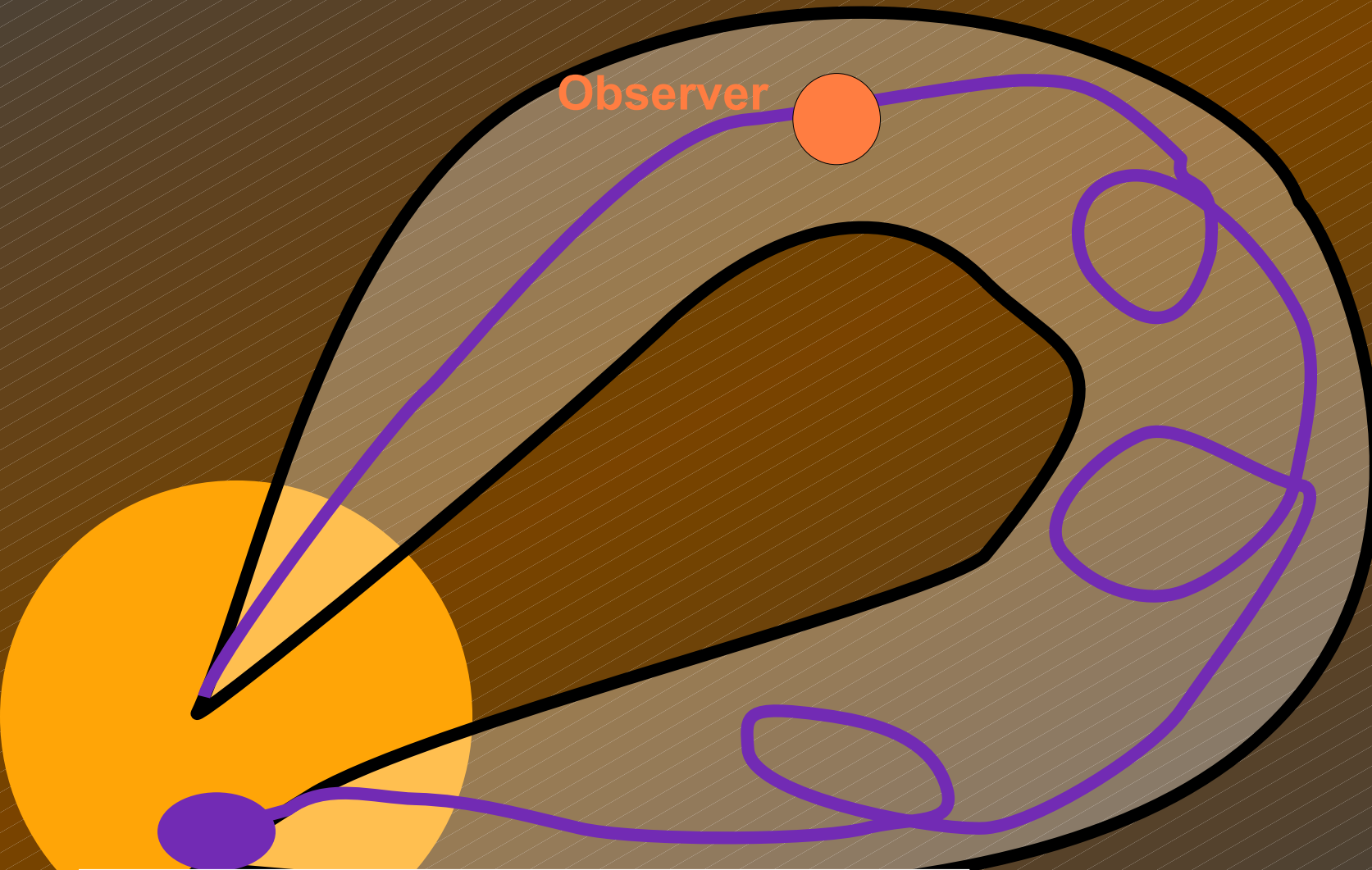
Single-source regions must be $\leq 100,000$ km apart to see both in the same event



Secondary Question:

Are the source regions for particle events occurring inside ICMEs the same as or different from those with no ICME present?

In all events where the spacecraft was inside an ICME, all dropouts were simultaneous.



Ion & Electron Source

What to Take Away

- Interplanetary particle dropouts can be compared with remote sensing data to learn about particle source regions.
- Half of events that occur in solar wind with no ICME present have simultaneous dropouts and half have non-simultaneous dropouts. The centroids of the ion-accelerating and electron-accelerating regions are probably displaced by tens of thousands of geometry.
- Events that occur within ICMEs only have simultaneous dropouts. Suggestive of some differences in acceleration processes?