3D CME Kinematics & Topology

Chairs:
David Barnes
Christian Møstl
Barbara Thompson

Our main “end users”: heliospheric ICME propagation modelers, Bz/arrival/input to geospace, SEP researchers, cataloguers (and what do they want?)

3D CME measurements are used as inputs to heliospheric models to determine arrival time and impact at heliospheric locations. If your model’s prediction is incorrect, how do we know whether it was due to the model itself, or because the input was wrong?
A better constraint on 3D CME measurement errors will help modelers understand where their solar wind/propagation models need improvement.

What do/can we measure?

- Speed/acceleration as a function of height: v(r,t)
  - Speed may be nonradial too
  - ENLIL uses input at 21.5 RSun, other models are different
  - Heliospheric imagers overlap with models, can be used to validate model performance mid-way
- Latitude/longitude of CME “leading edge:”
  - CME may be asymmetric about lat/lon, most models assume some symmetry
- CME shape
  - “width” if cone/lemniscate model, more complex with other topologies
- Other possibilities: Magnetic field topology/structure (for Bz input to Earth, for example), CME-associated (non-CME) brightenings/shock “envelope”

What's the best that we can do?

We cannot guarantee a "perfect" 3D CME measurement with any of the planned observations of the upcoming decade (or ever, really). What we can do is provide hard constraints on the range of values, e.g. "the maximum speed at 21.5 RSun, according to all of the possible 3D CME fits, was 1200 km/sec."

Work on using supplemental data sources / alternative sources of information to help determine the causes of "incorrect" forecasts, pinpoint when forecasts fail and why.

Do a better job at defining "what is a CME," the different components and manifestations of CMEs in coronal data & solar wind data.

What’s beyond our control?

What happens to the CME topology in the solar wind - right now it’s not so clear and very difficult to predict

How well your solar wind propagation model reproduces background solar wind, shocks, and other factors mitigating CME propagation and the manifestations of CME impact at Earth