UCSD-CCMC Collaborations

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- **IPS Tomography, General Remarks**
- **Corotating IPS Tomography**
  - **Current status**
  - **SAIC MAS Model**
- **Time-dependent IPS Tomography**
  - **Current status**
  - **U. Boulder ENLIL Model**
- **Time-dependent SMEI Tomography**
  - **Sample results**
  - **Future work**

IPS Tomography

- **Observational data are line-of-sight observations of IPS velocity and IPS scintillation level ("g-level") of radio point sources measured at meter wavelengths.**
- **STELab, Nagoya Univ., Nagoya, Japan (M. Kojima, M. Tokamaru). Few dozen IPS velocity and g-level data per day between April and November each year.**
- **The tomography takes heliospheric observations of solar wind density and velocity to construct a best-fit 3D solar wind density/velocity model, but no magnetic field.**
- **3D heliospheric magnetic field obtained from 2D magnetic field at inner boundary (15 solar radii) by passively convecting magnetic outward using reconstructed velocity field. Inner boundary magnetic field from photospheric maps run through X. Zhao's CSSS model; T. Dunn et al., Solar Phys. 227, 339-353, 2005).**

IPS Tomography (cont'd)

- **Fortran 77**
- **CVS, better docs, self-descriptive output files**
- **At CCMC most free parameters are frozen**
- **Most important parameters are selected to provide best-fit at 1 AU**

Corotating IPS Tomography

- **Finished, no more modifications anticipated (Does CCMC version allow magnetic field calculations?)**
- **Input data from final 'yearly' files or real-time 'daily' data**
- **'Yearly' files are available at CCMC**
- **Time-independent; data are processed in chunks of 28 days (one Carrington rotation)**
- **Useful for determining background solar wind (corotating structures, sector boundaries) and studying variations on time scales of > 1 Carrington rotation**
- **Results are sensitive to input data (CMEs!)**

Corotating IPS Tomography (cont'd):

magnetic field calculations

- **Stanford potential field source surface (from WSO website)**
- **WSO photospheric magnetic field maps processed through CSSS model**
- **Photospheric maps provided by NOAA (Nick Arge) from WSO & NSO/Kit Peak photospheric maps, and processed through CSSS model, in particular for real-time forecasts.**
- **Use results of SAIC MAS model at MAS outer boundary as input to tomography. Uses CCMC resources (to run MAS and tomography code).**

Time-dependent IPS Tomography

- **Stable, no major modifications for last two years (Does CCMC version allow magnetic field calculations?)**
- **Input data from final 'yearly' files or real-time 'daily' data**
- **With only a few dozen data points across the sky per day, results are VERY sensitive to input data (especially a worry for real-time forecasts)**
- **With time resolution of 1 day useful for analyzing and tracking CMEs from Sun to Earth**

- **Main future addition is introduction of MHD kernel to replace current kinematic solar wind kernel.**
- **Requires interface between MHD kernel and tomography engine (coordinate transformation from rectangular inertial coordinates to spherical heliographic coordinates is already in place)**

Time-dependent IPS Tomography (cont'd):

Heliospheric MHD connection

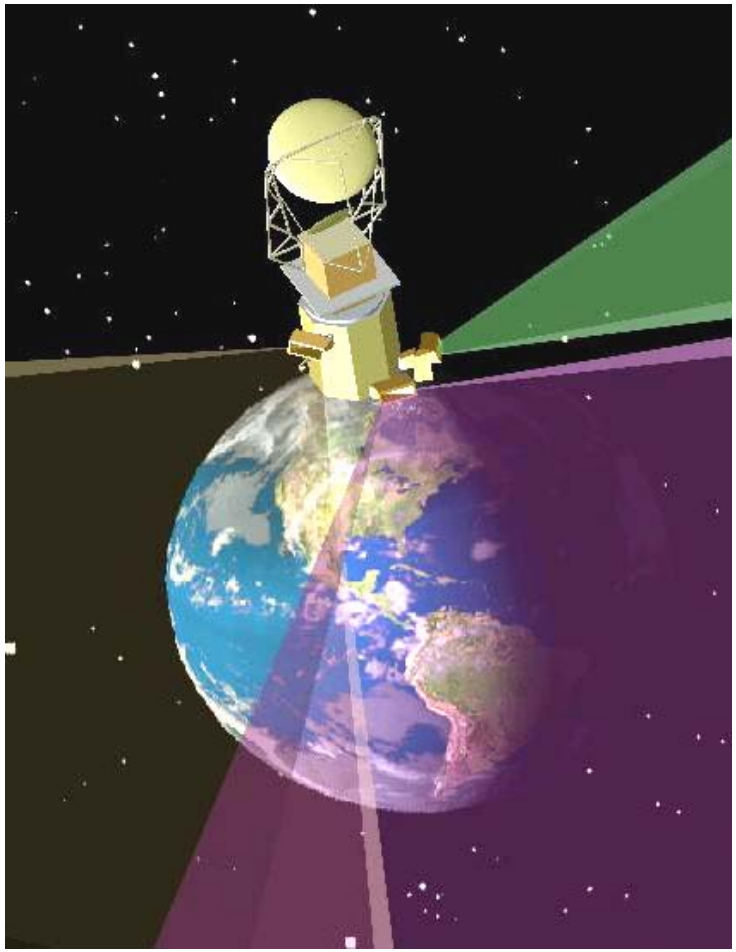
- **Tomography provides a description of density and velocity at the inner boundary based on observational heliospheric data. These can serve as more realistic boundary for heliospheric MHD models (e.g. ENLIL).**

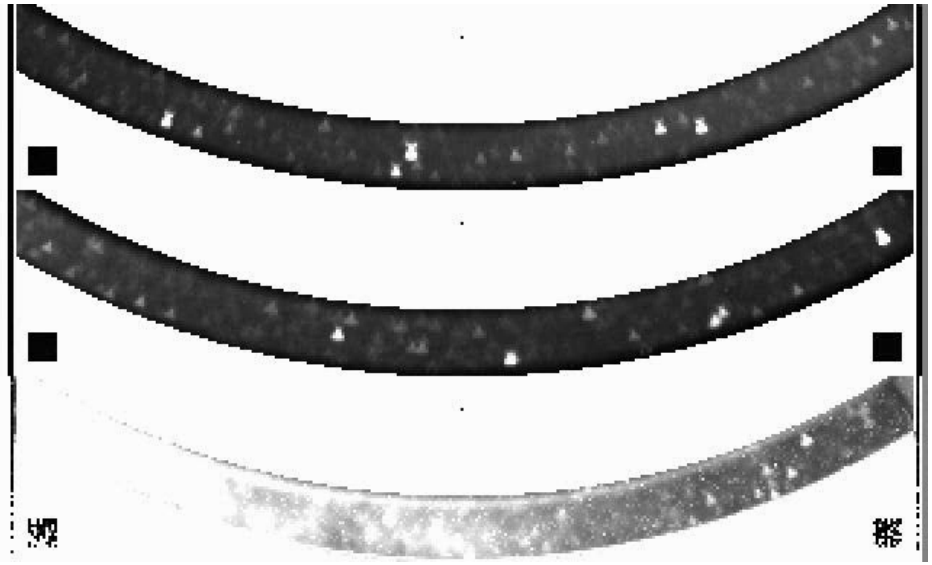
- **Conversely, as observational data become better and more plentiful (SMEI !) the tomography would benefit from a better solar wind kernel.**

- **Main future addition to tomography is introduction of MHD kernel to replace current kinematic solar wind kernel.**

- **Requires interface between MHD kernel and tomography engine (coordinate transformation from rectangular inertial coordinates to spherical heliographic coordinates is already in place)**

Solar Mass Ejection Imager

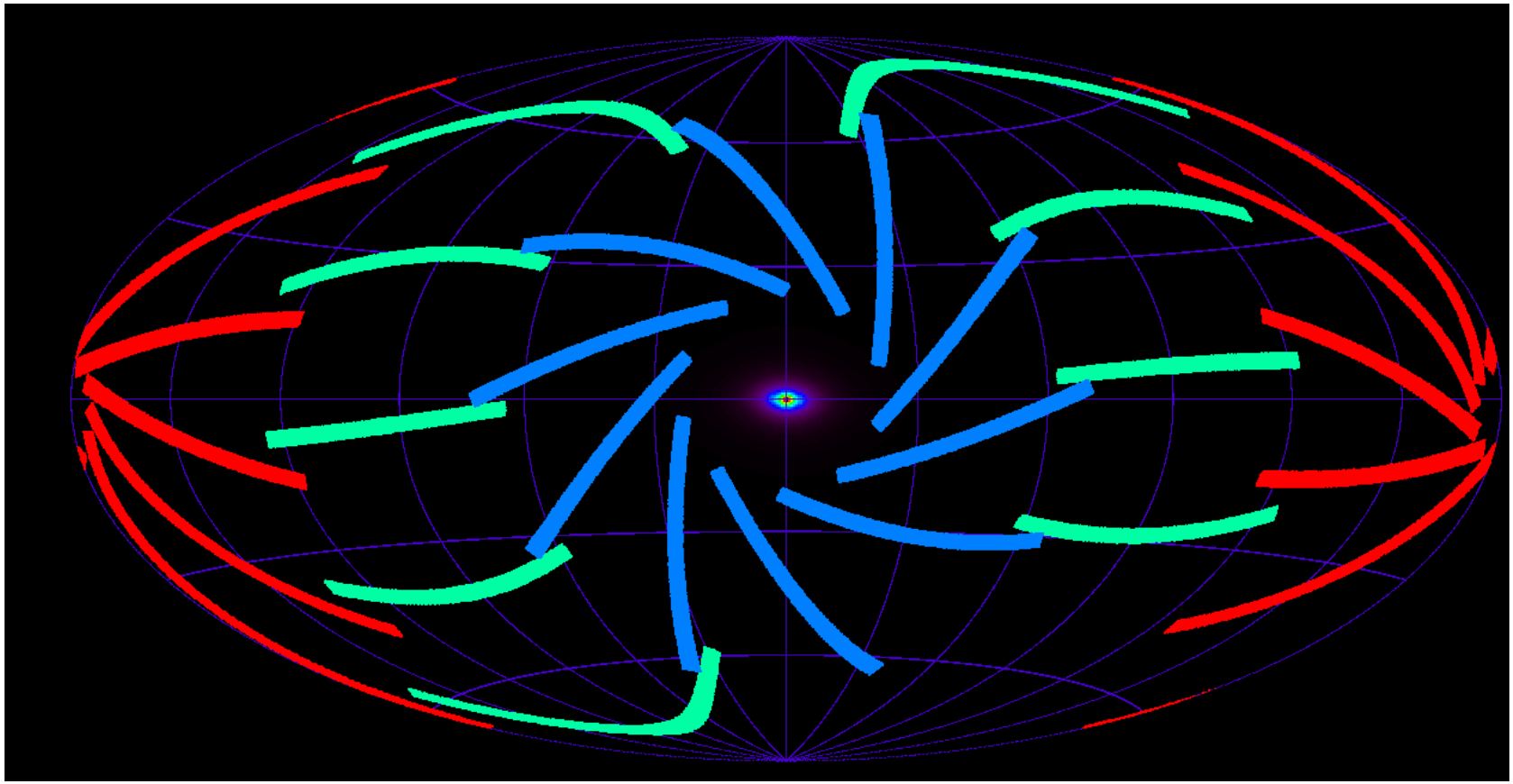




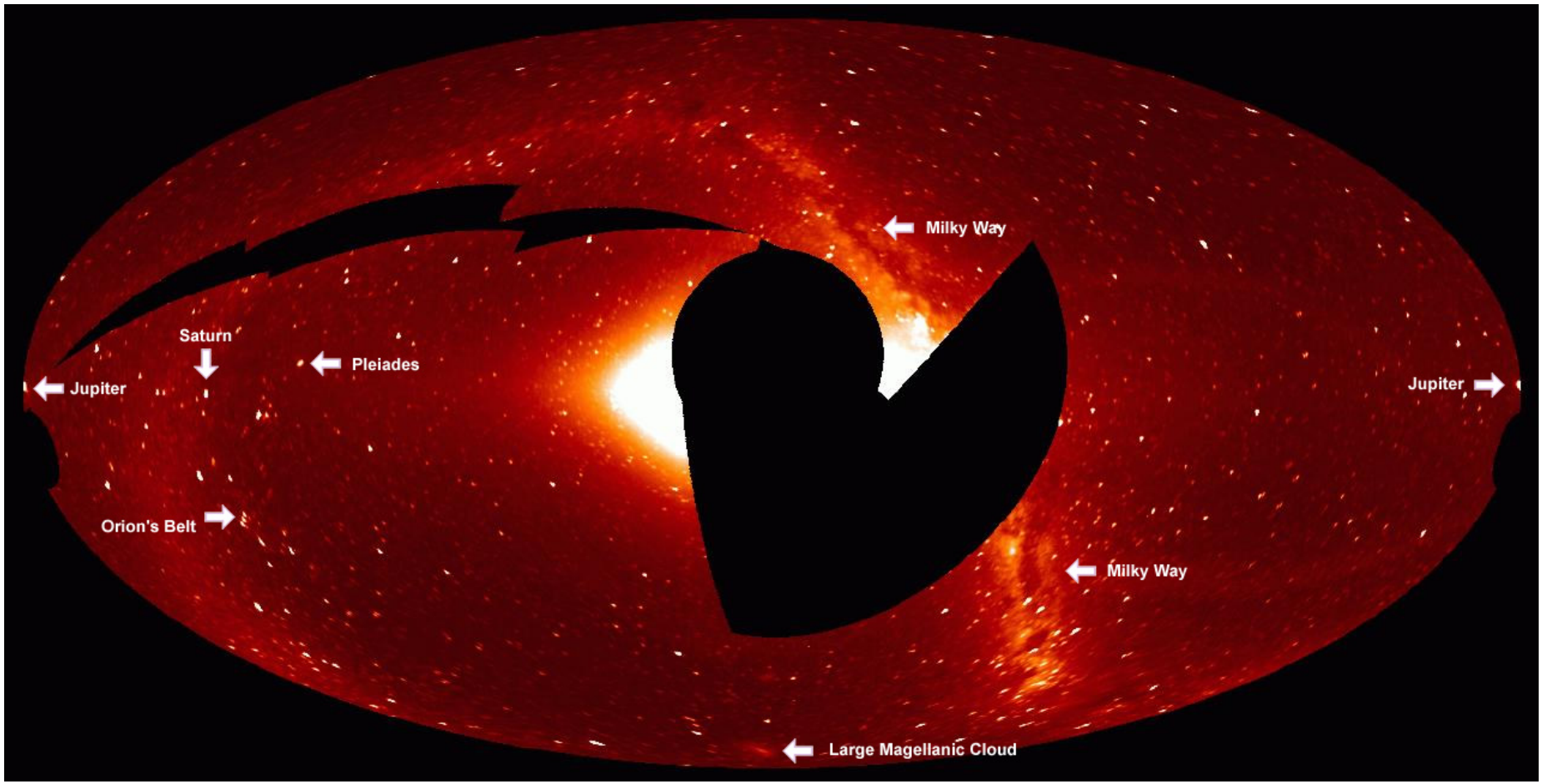
Individual CCD frames from each camera every 4 seconds.

Composite for Aitoff Map

Blue = Cam3; Green = Cam2; Red = Cam1



Composite all-sky map Feb 2, 2003 from the three SMEI cameras.



Time-dependent Tomography

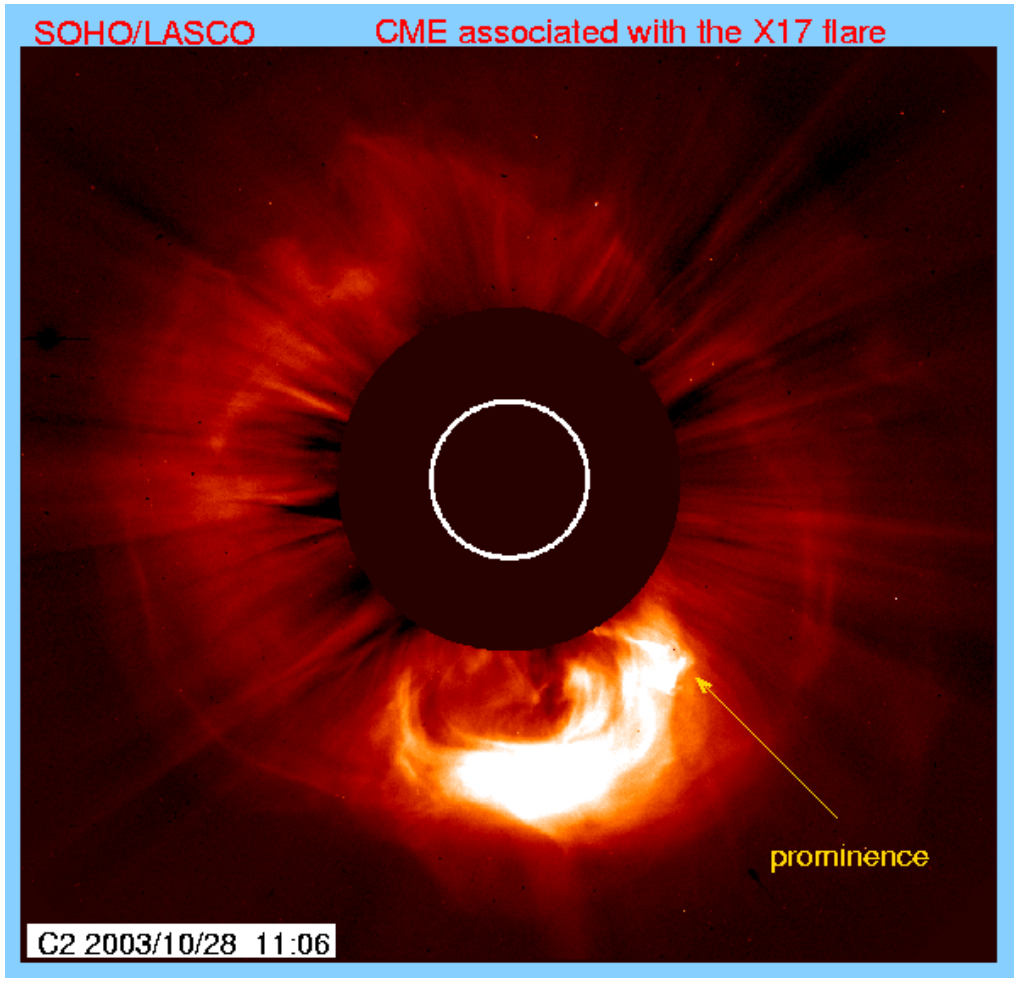
With the Solar Mass Ejection Imager

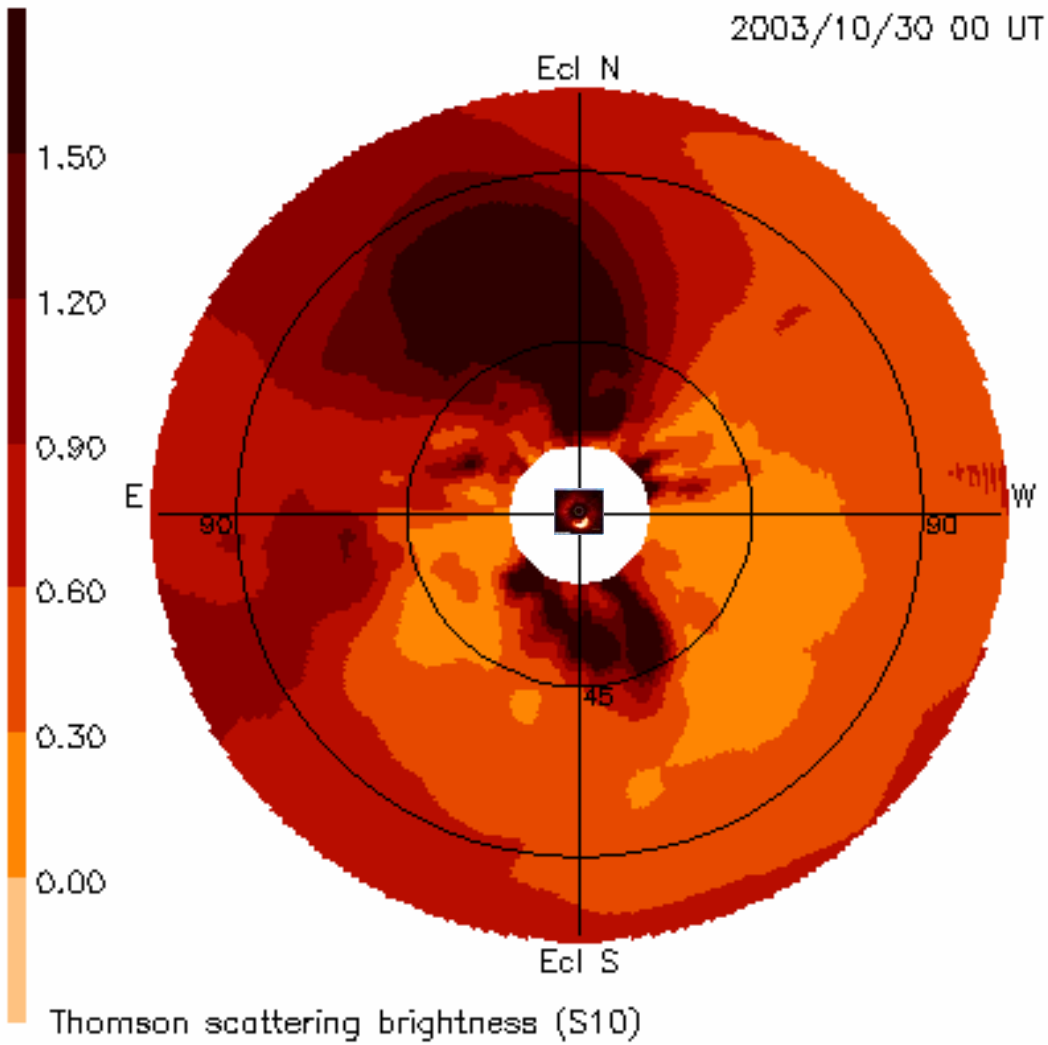
- **a LOT more data than IPS (from few dozen IPS sources per day to few times 10^4 square degree bins of Thomson scattering brightness per 100-minute orbit)**
- **WE NEED A BIGGER BOAT !!**
- **Resolution of reconstruction is better by about a factor 10 in all dimension (space & time).**
- **Applied only to a few CME events so far.**

- **A more realistic solar wind model than the simple kinematic model is necessary: MHD kernel**

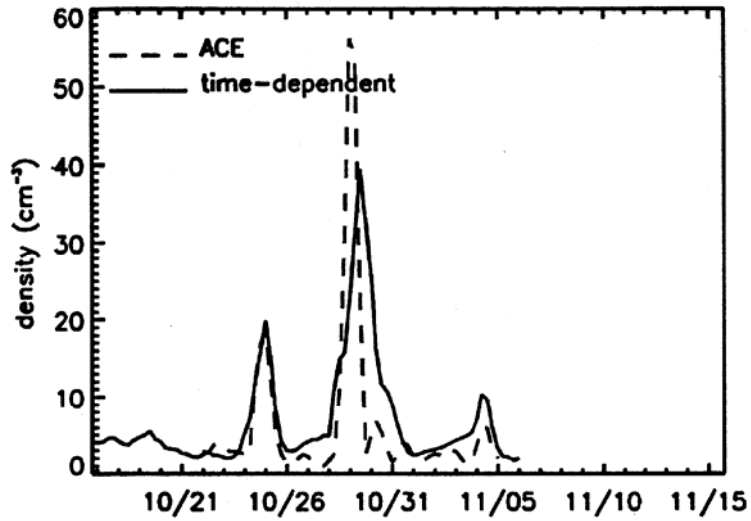
Halo CME 28 October 2003

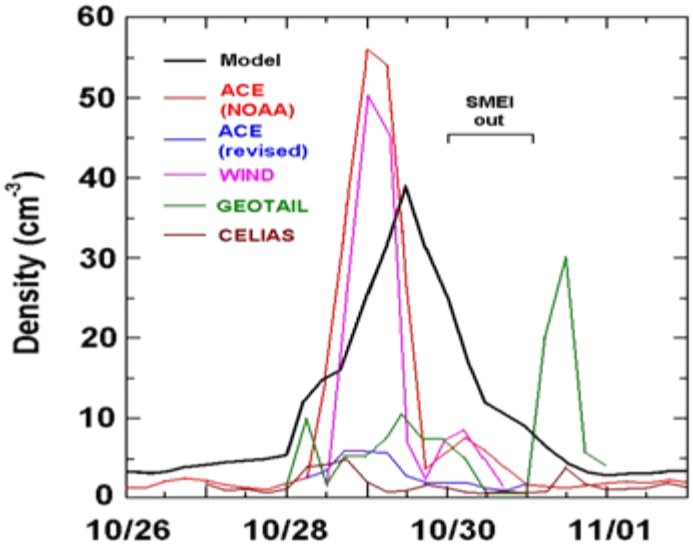
(LASCO C2; 6 solar radii)

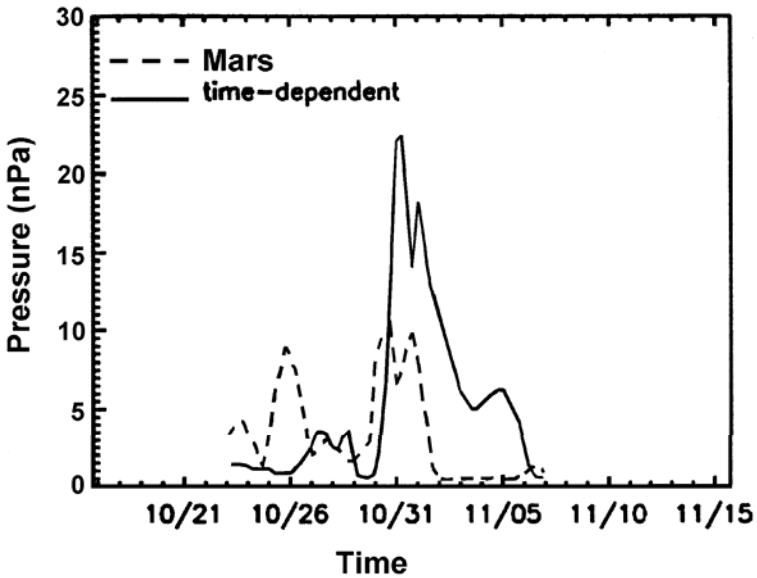



2003/10/30 00 UT
Ecl N
Ecl S
E
W
90
90
45
1.50
1.20
0.90
0.60
0.30
0.00
Thomson scattering brightness (S10)


SMEI
CASS/UCSD 2003/10/28 00







- **Only ground truth: in situ data**
- **@ Earth, but also @ Mars: ram pressure (modeled from Mars Orbiter magnetic field data; Crider, private communication)**
- **Is ground truth really truth?**
- **Optimizing for local fit affects global solution**