

Magnetic Structure and Evolution of CMEs:

From Their Photospheric Source Regions to the Heliosphere

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Outline

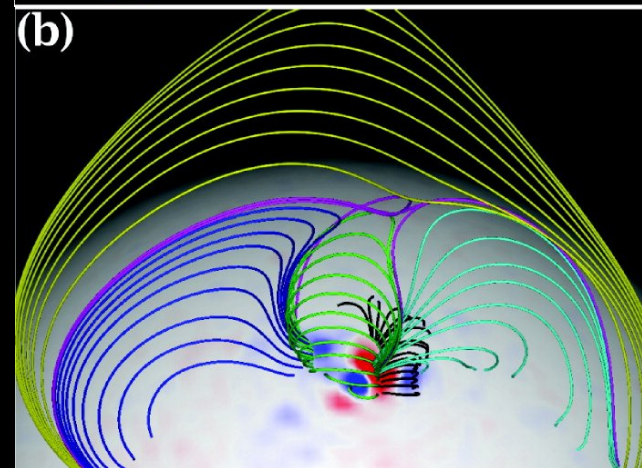
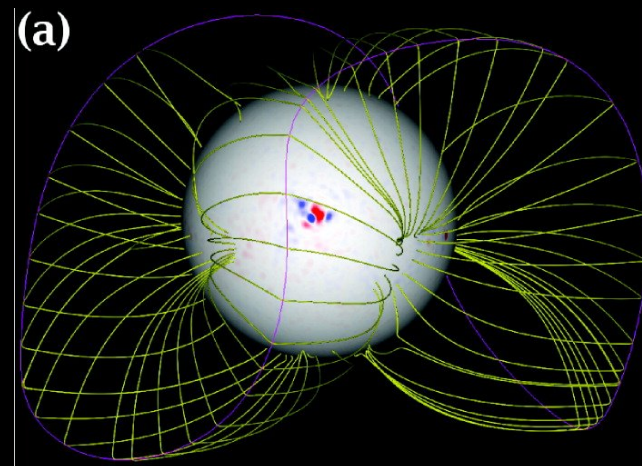
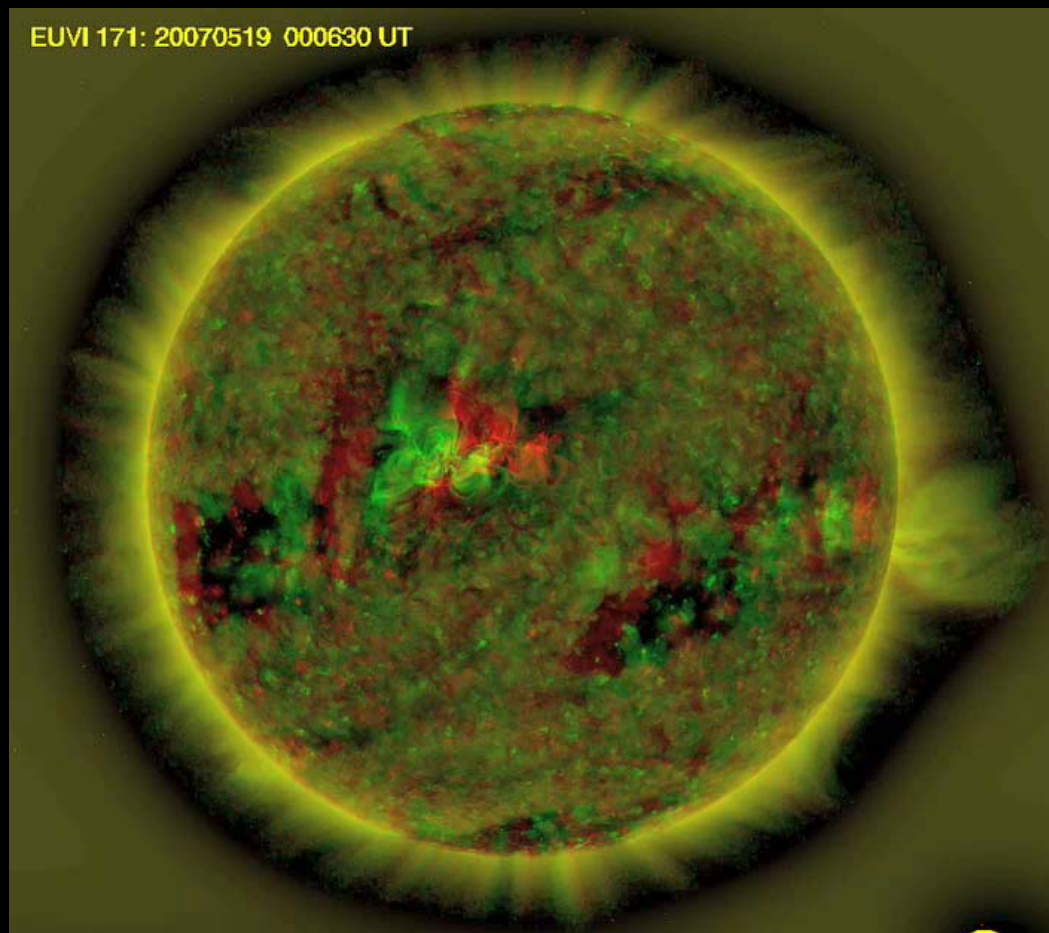
- 2007 May 19 CME
 - Summary of Source Region & In-Situ Analysis
 - Sun-to-1AU Rotation Effects ?!?!
- MHD Simulations of CME Rotation During Eruption
- Prospects for Future:
 - More realistic 3D MHD CME Simulations
 - Continued Event/Observational Data Analysis
 - Simulation-Observation Comparisons

2007 May 19 CME → May 22-23 ICME

Many aspects of event are well-studied, e.g.

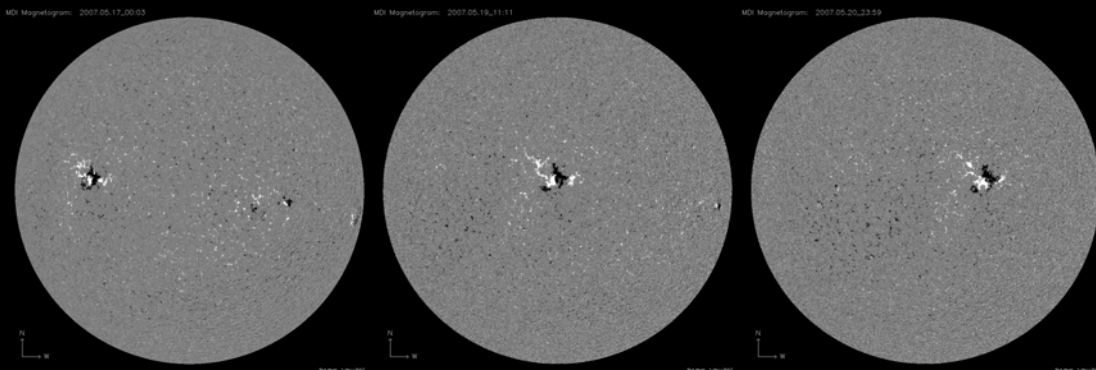
- Liu et al. 2008, ApJ 677, L133
- Long et al. 2008, ApJ 680, L81
- Li et al. 2008, ApJ 681, L37
- Veronig et al., 2008, ApJ 681, L113
- Gopalswamy et al. 2009, ApJ 691, L123
- Kilpua et al. 2009, SoPh in press
- Möstl et al. 2009, JGR in press
- Liewer et al. 2009, SoPh submitted
- and possibly more... ?

2007 May 19 CME → May 22-23 ICME

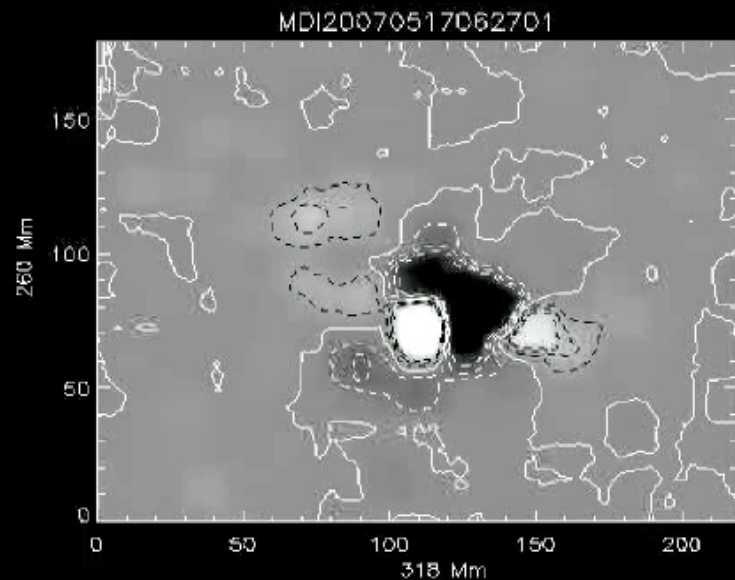
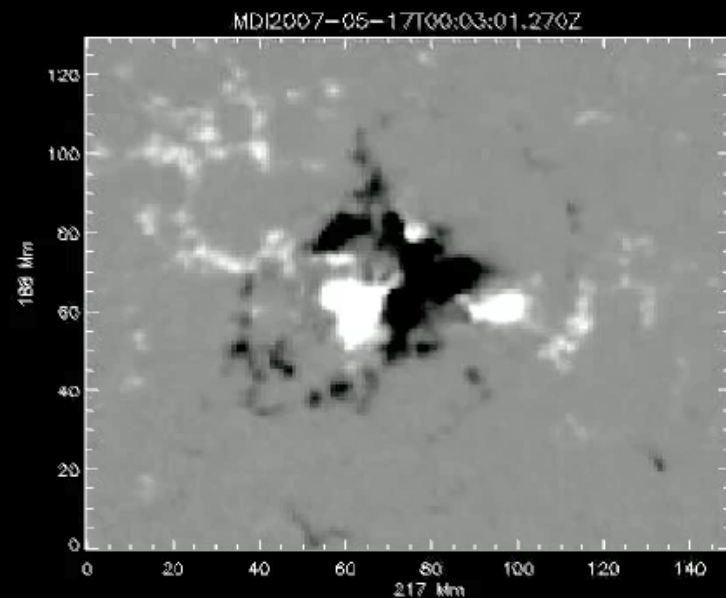
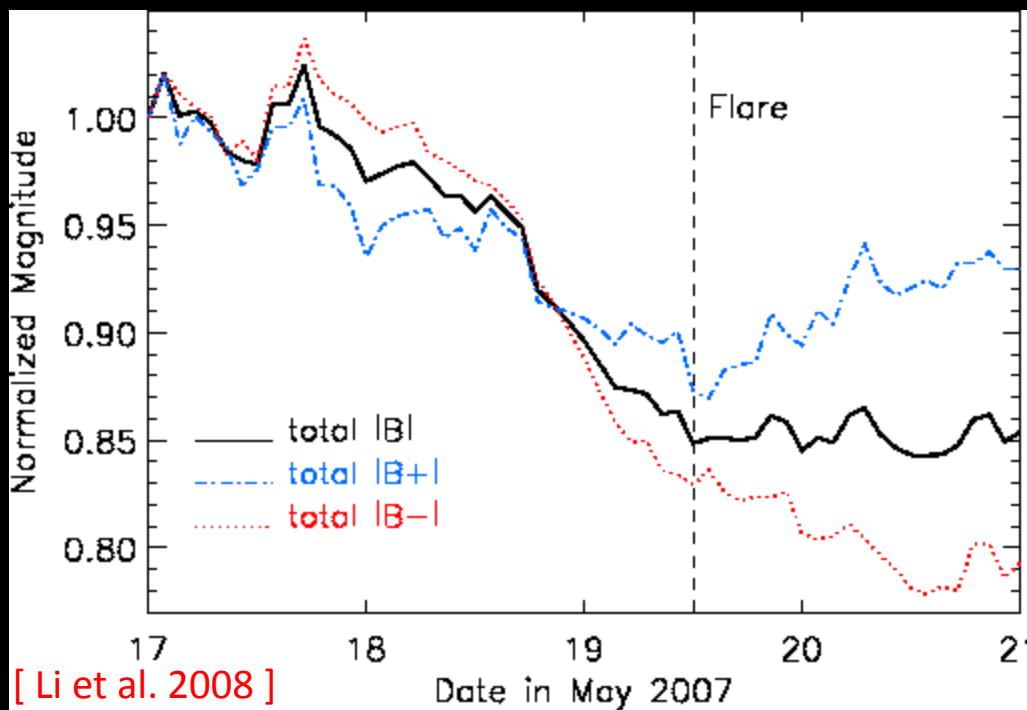


[Li et al. 2008]

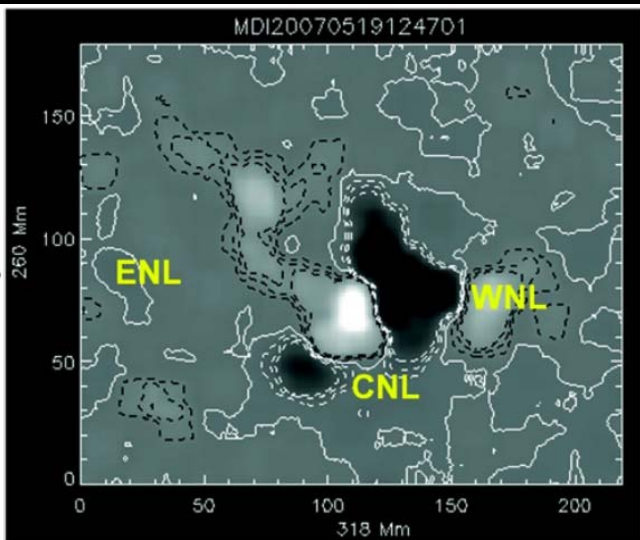
2007 May 19 CME → May 22-23 ICME



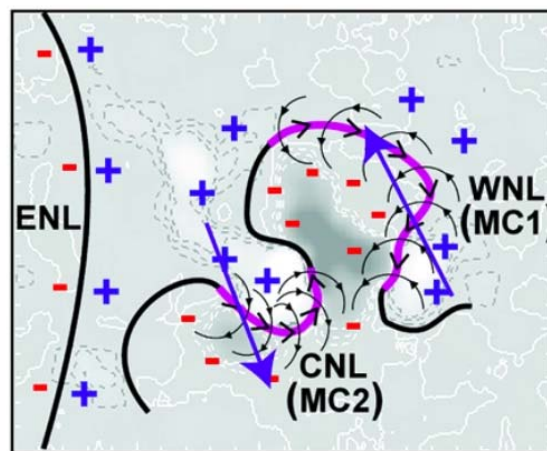
Total magnetic flux in the region decreased by $\sim 17\%$ in ~ 48 hrs before the B9.5 flare.



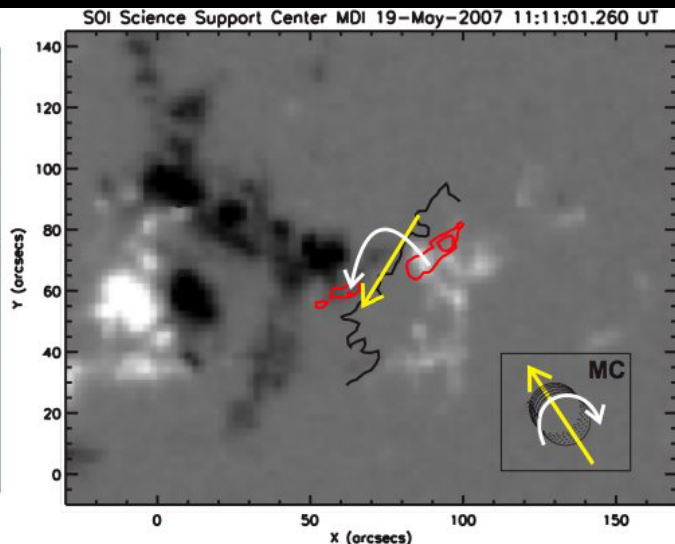
2007 May 19 CME → May 22-23 ICME



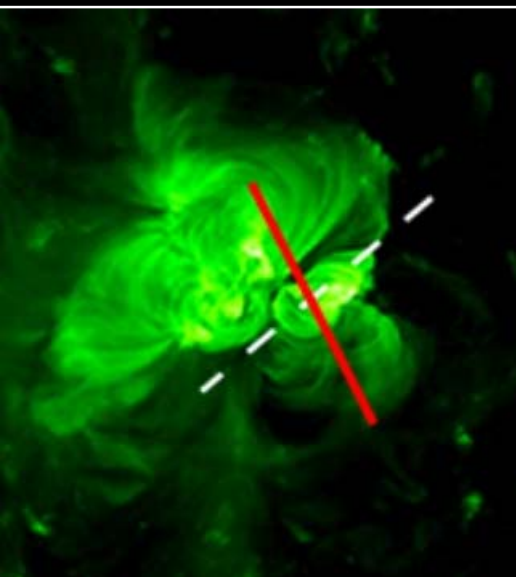
[Li et al. 2008]



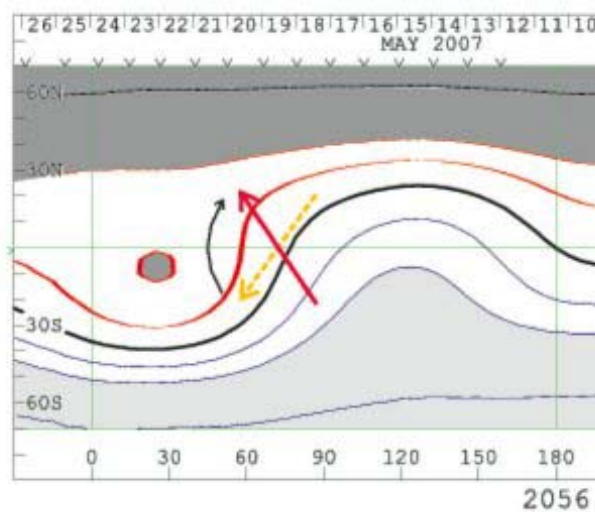
[Kilpua et al. 2009]



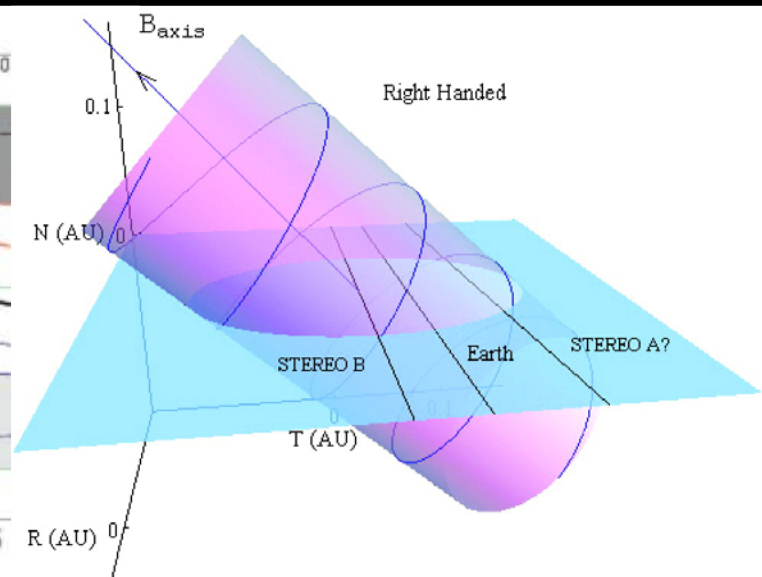
[Möstl et al. 2009]



[Kilpua et al. 2009]

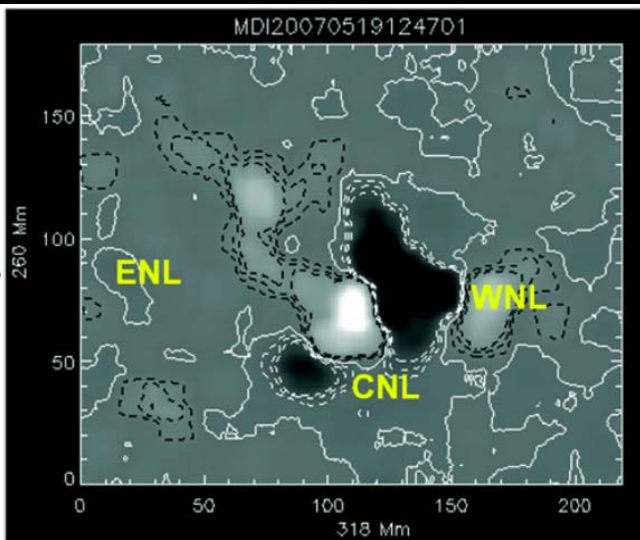


[Möstl et al. 2009]

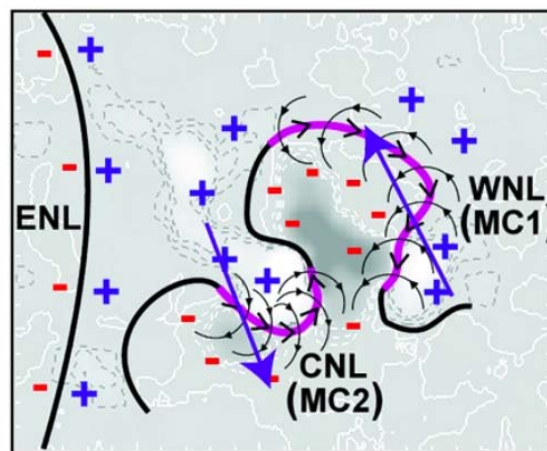


[Liu et al. 2008]

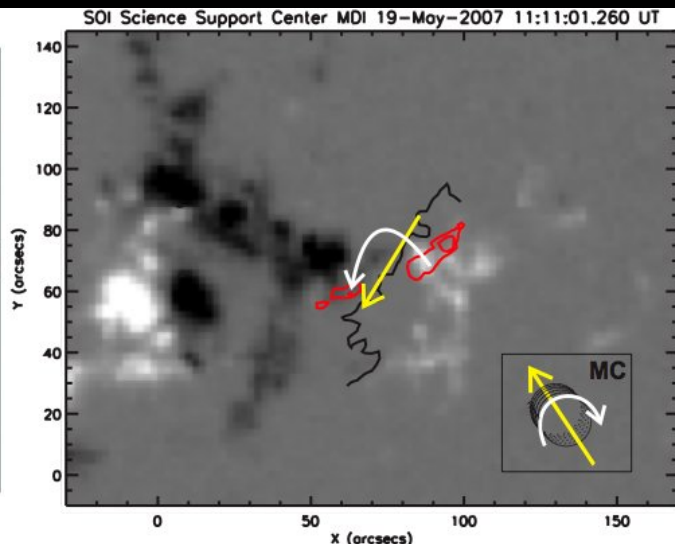
2007 May 19 CME → May 22-23 ICME



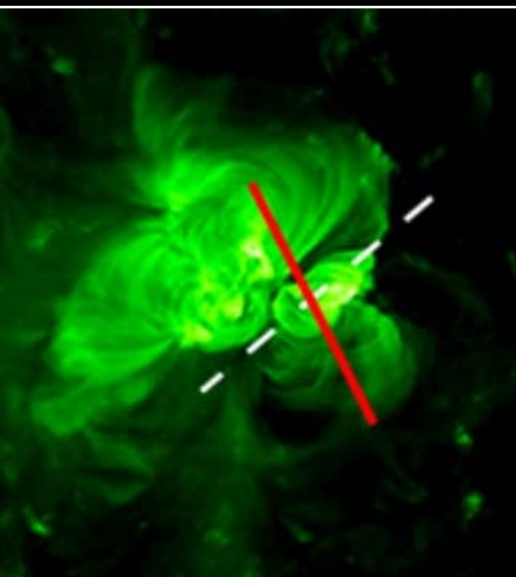
[Li et al. 2008]



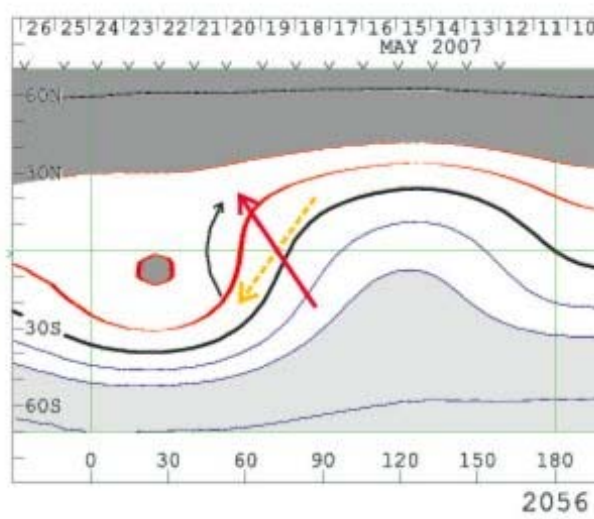
[Kilpua et al. 2009]



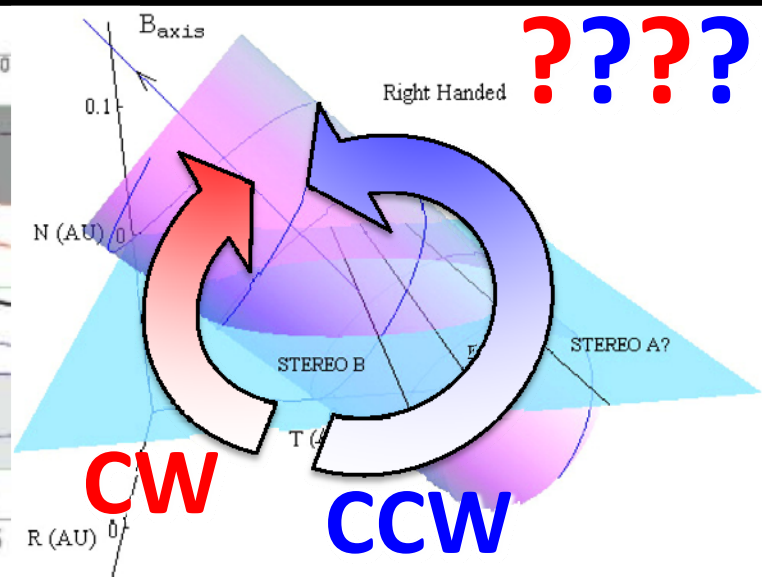
[Möstl et al. 2009]



[Kilpua et al. 2009]

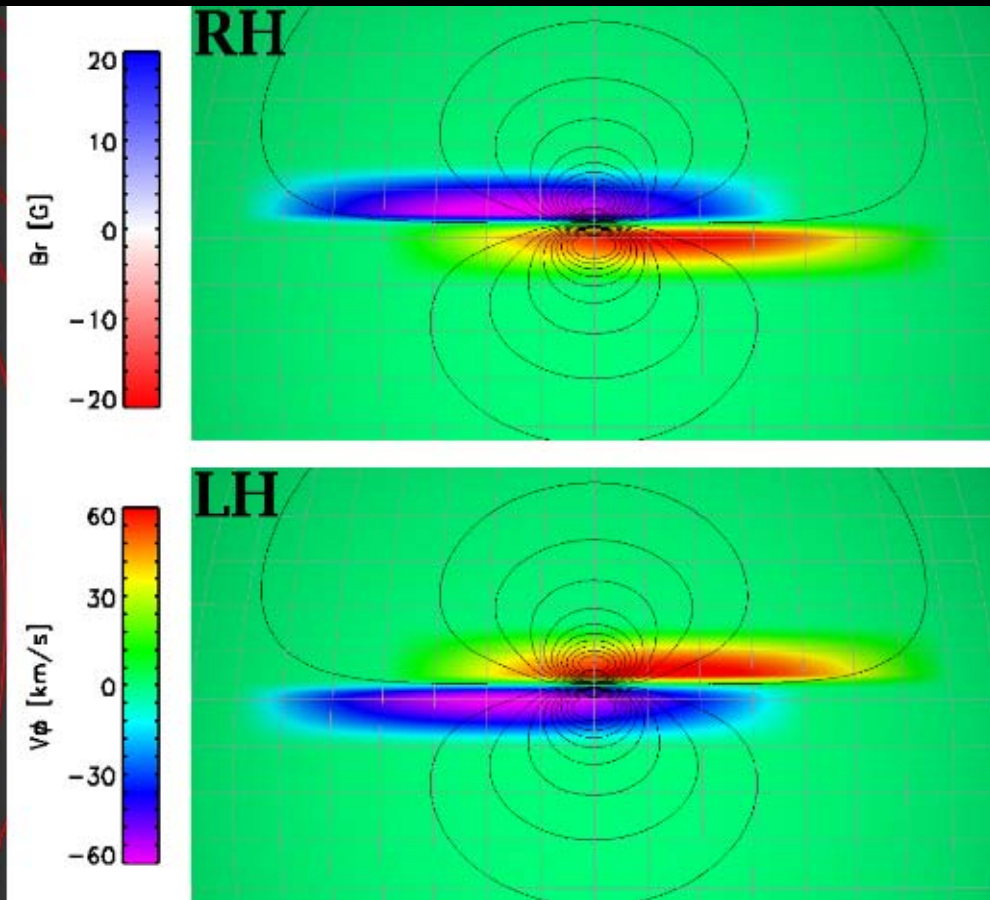
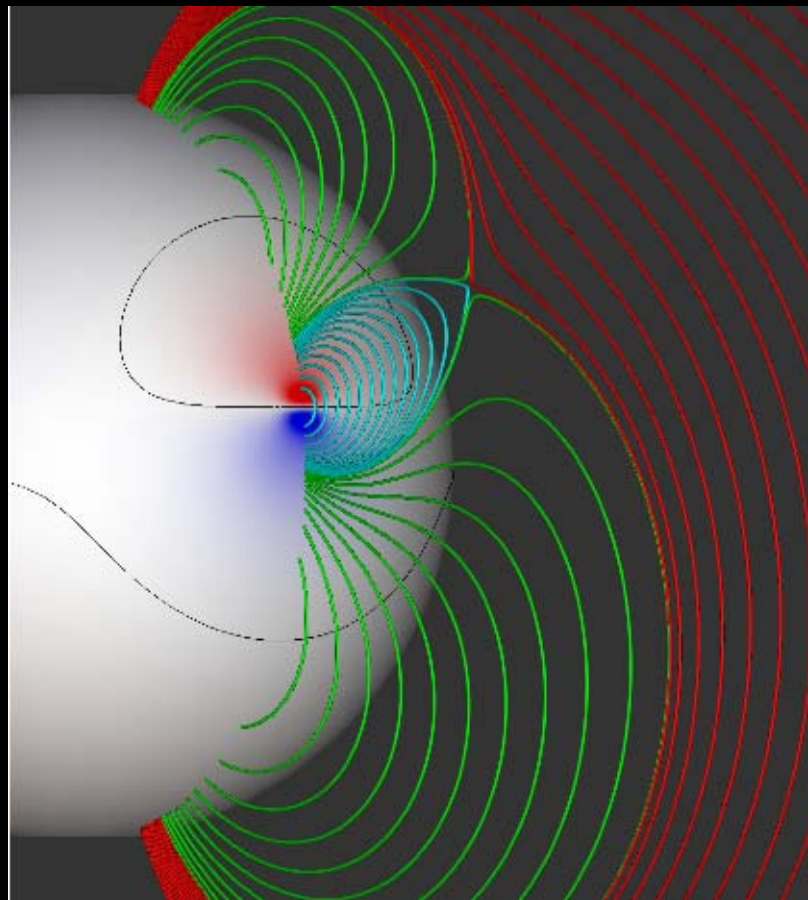


[Möstl et al. 2009]



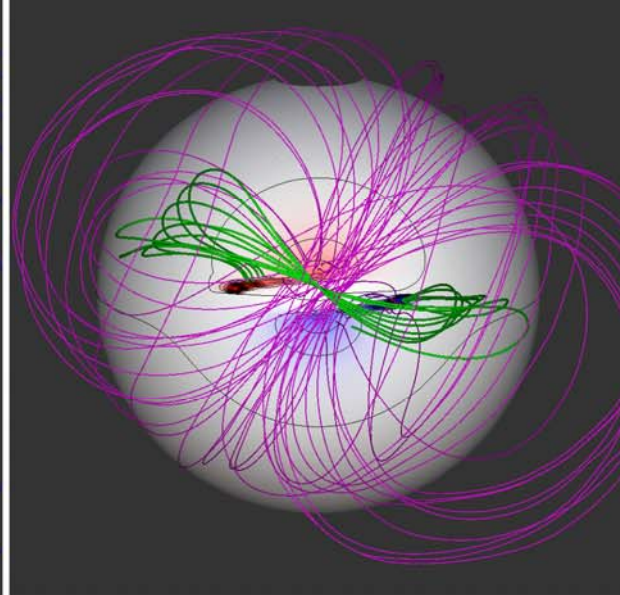
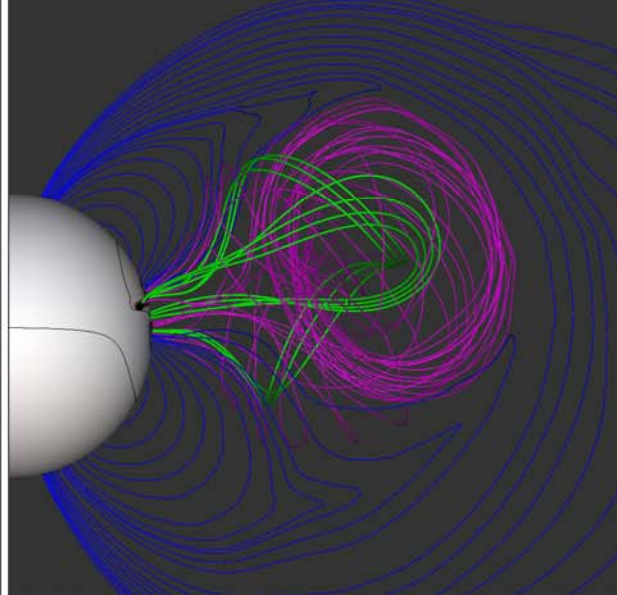
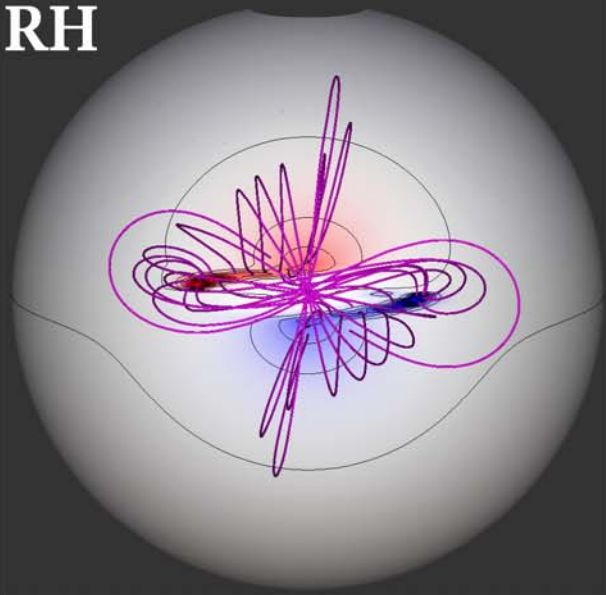
[Liu et al. 2008]

CME Rotation During Eruption

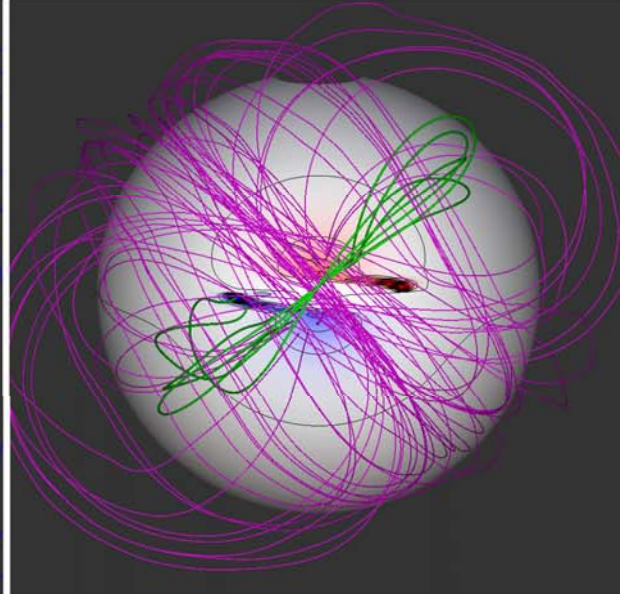
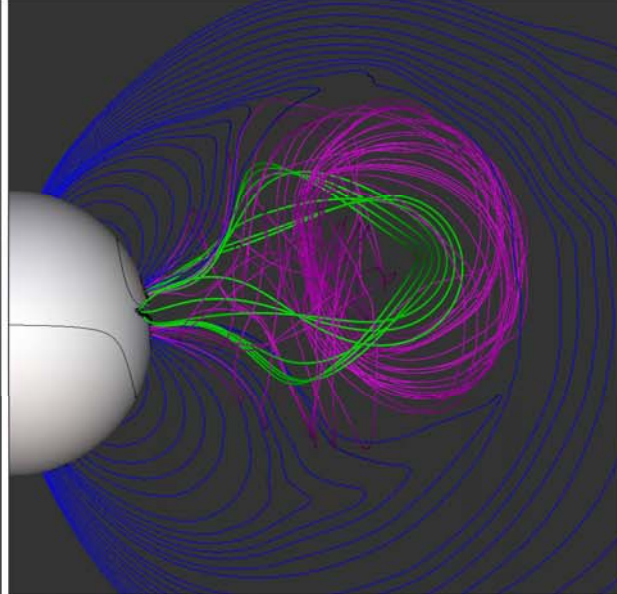
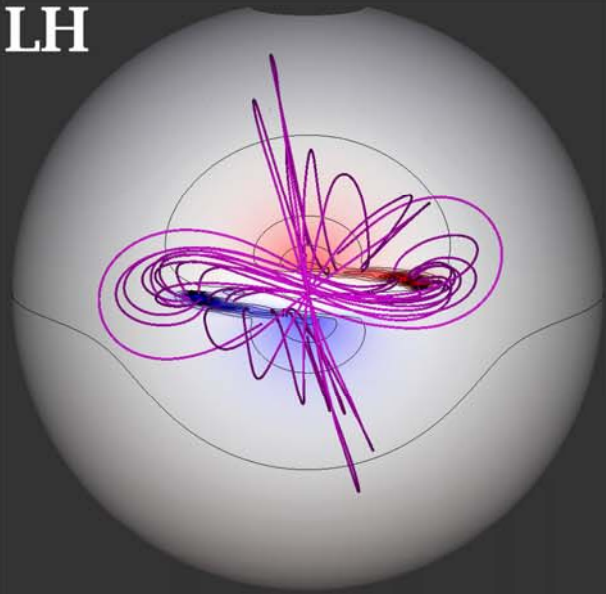


CME Rotation During Eruption

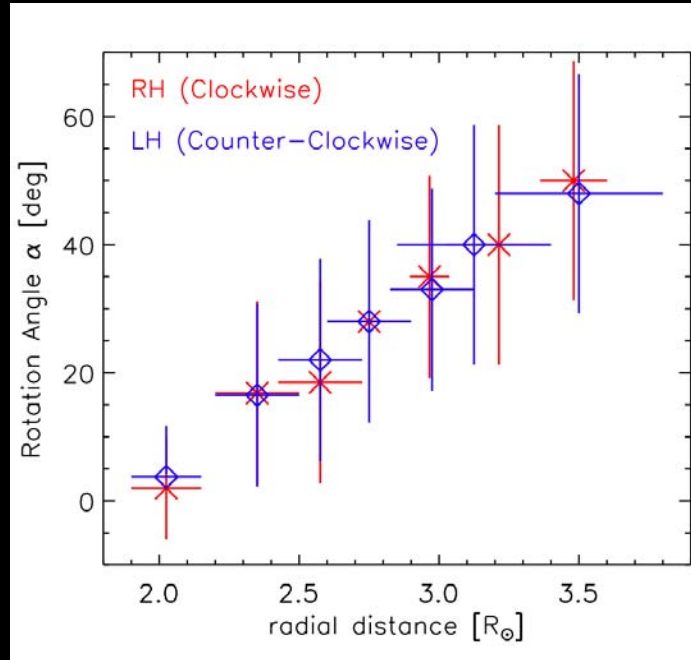
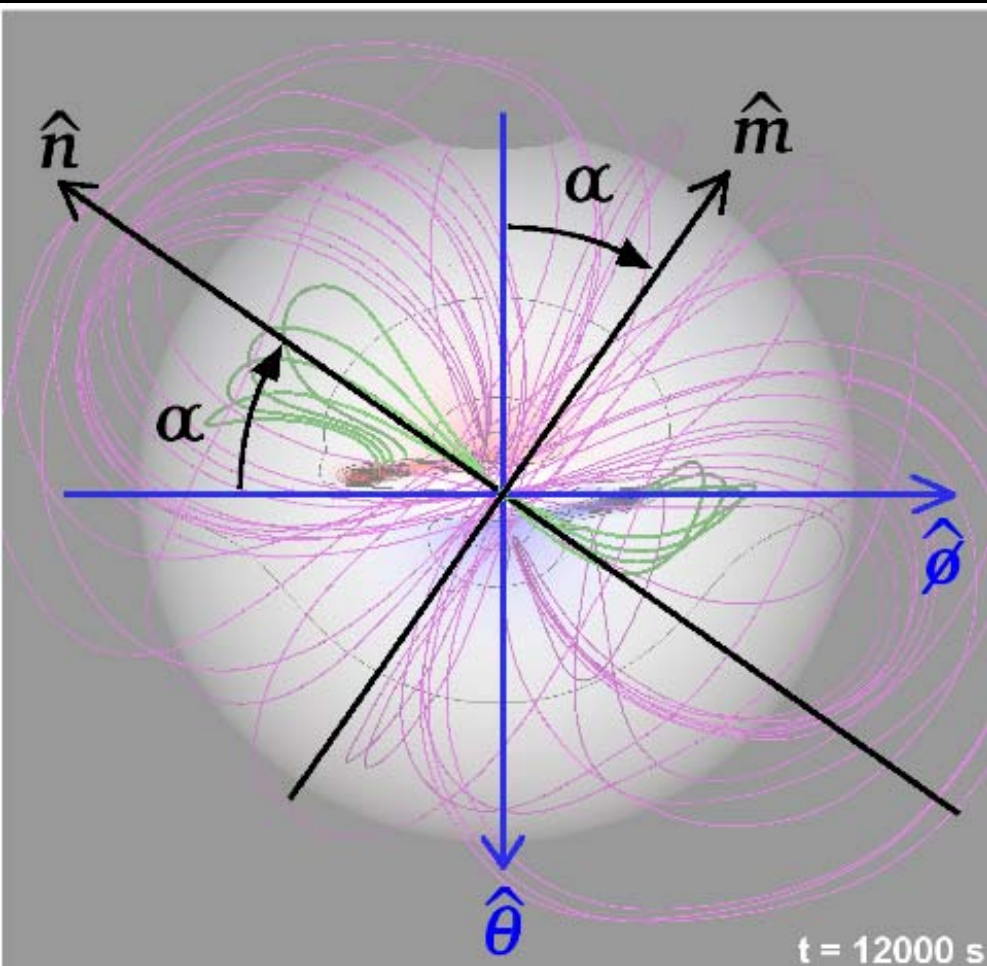
RH



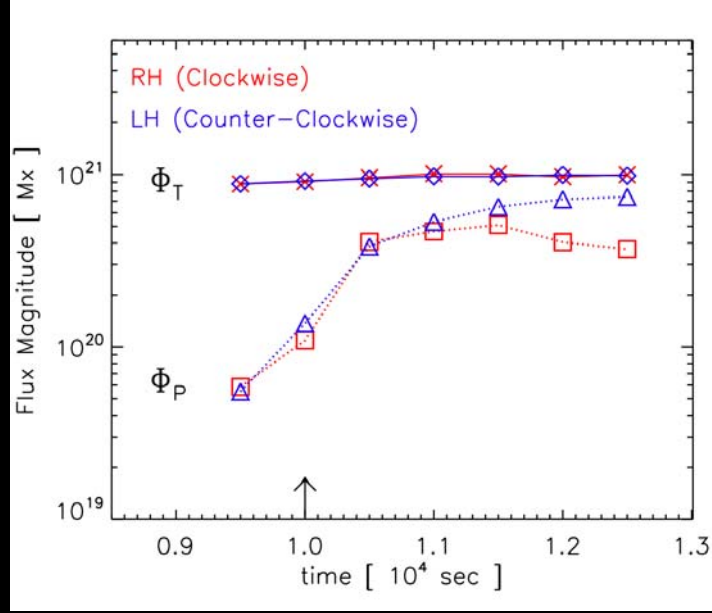
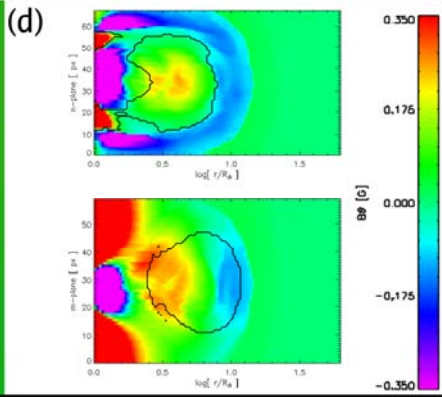
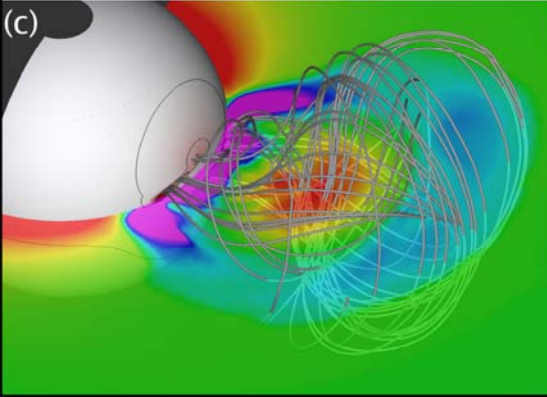
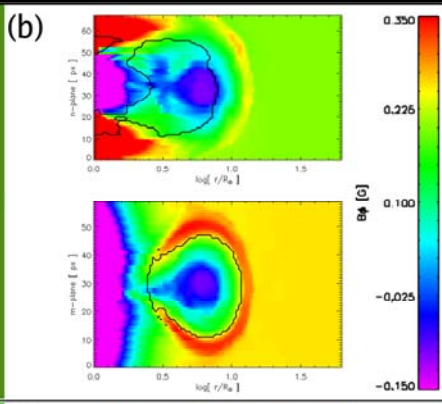
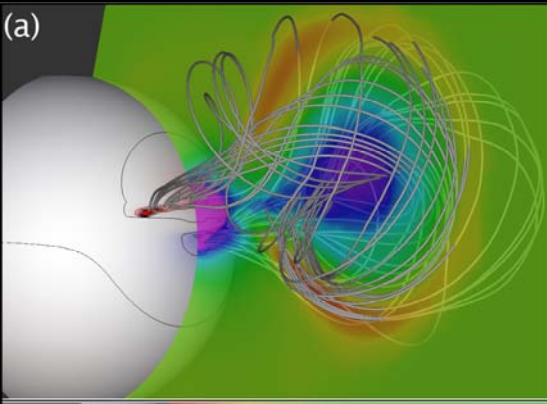
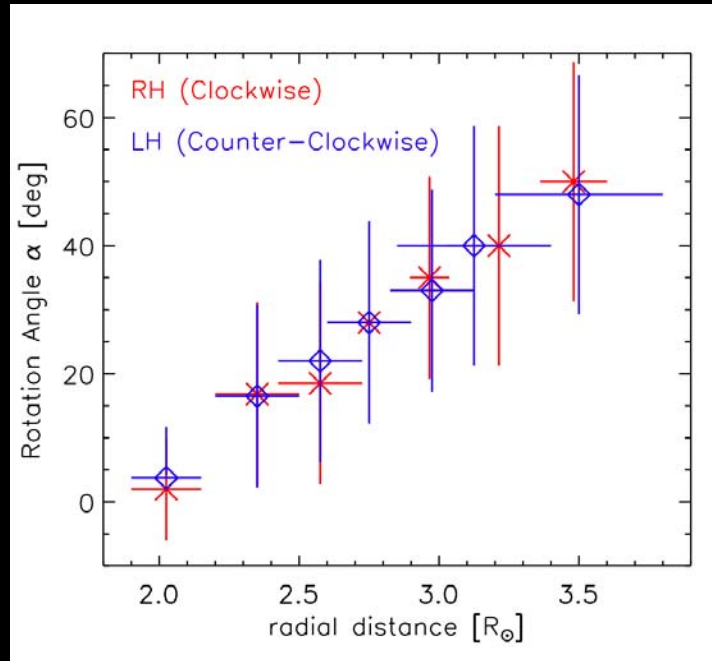
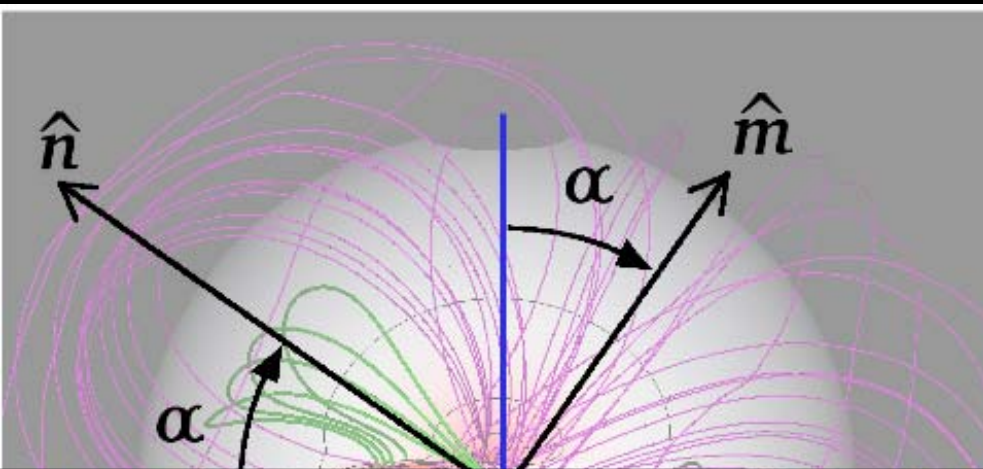
LH



CME Rotation During Eruption

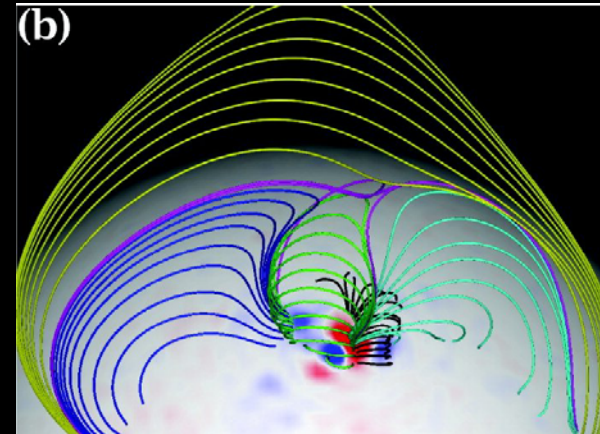
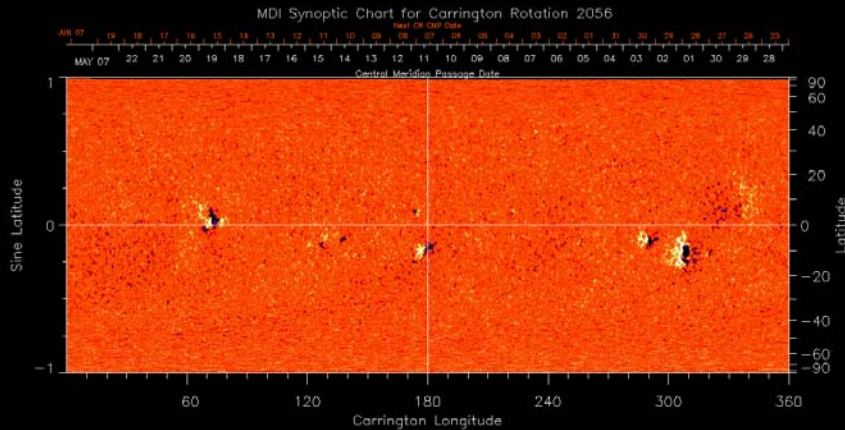


CME Rotation During Eruption

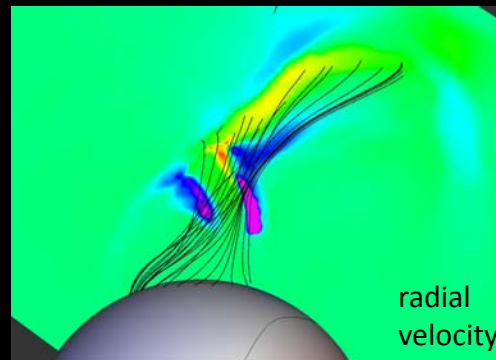
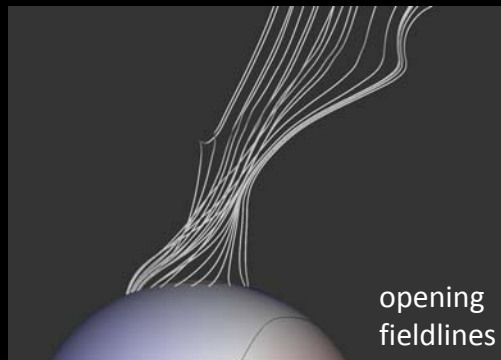


Future Work - Simulations

- Data “Inspired” ... 3D side-arcade (lateral) breakout

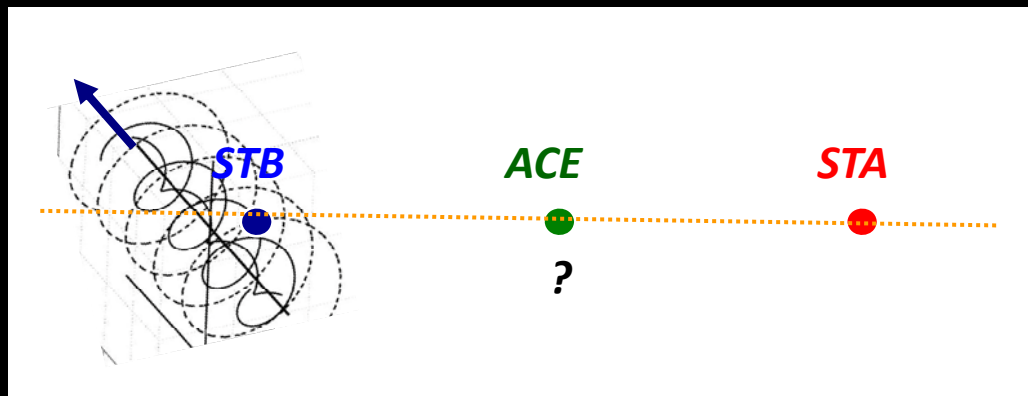
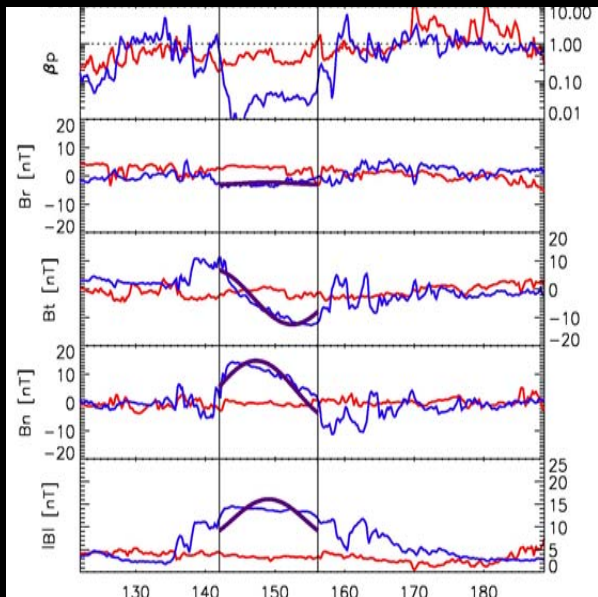
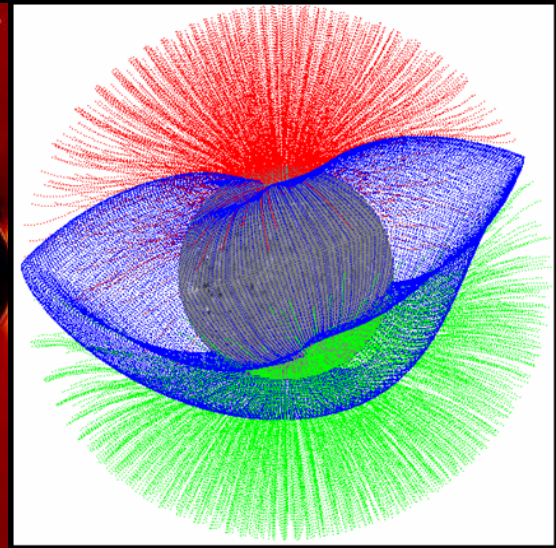
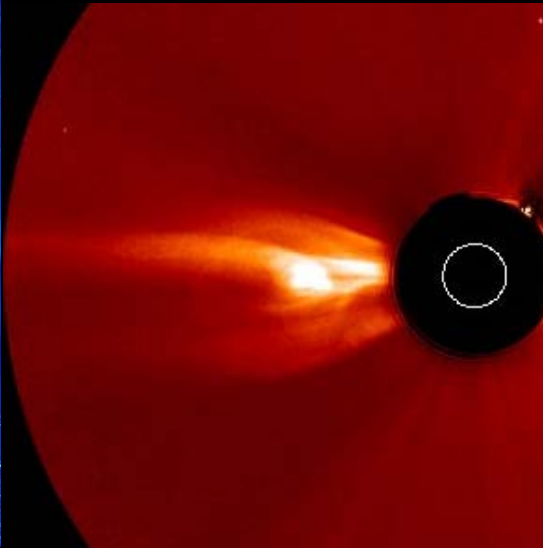
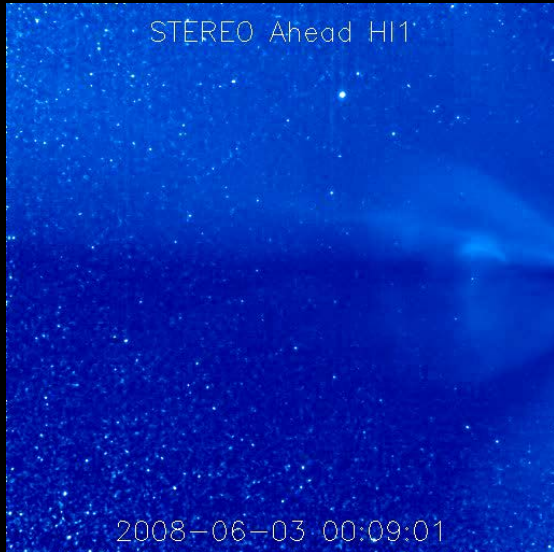


- Currently have PFSS/Magnetogram synoptic map initial conditions with outer boundary at R_{SS} –



-- need solar wind outflow keep fields open for $r > R_{SS}$ (being currently tested in 2.5D coming soon to 3D)

Future Work – Data Analysis

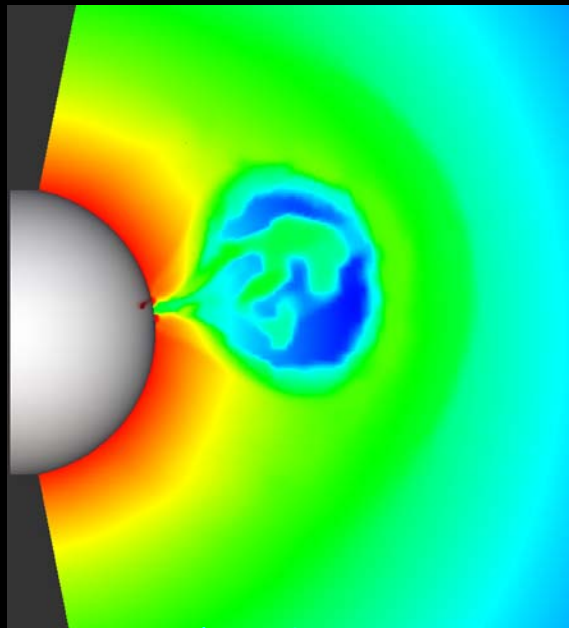


e.g., 02 Jun 2008 CME → 06 Jun 2008 ICME
See Li et al. presentation tomorrow...

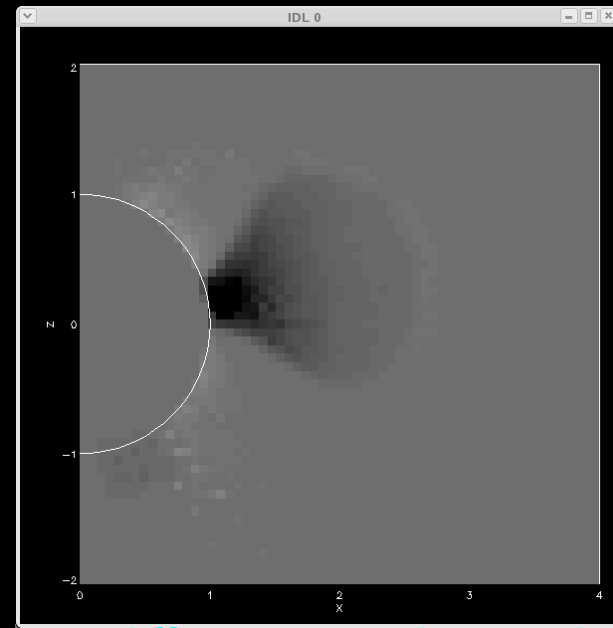
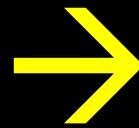
...and others!!

Future Work - Data/Model Comparison

Block-adaptive spherical ARMS data (mass density) interpolated to uniform Cartesian grid for IDL manipulation



ARMS $\phi=0$ density slice
(09250 s)



Base difference $y=0$ density slice
(09250 - 00000 s)

- Pre-eruption cavity, 3-part CME structure, shock formation & propagation in white-light/synthetic coronagraph images
- 3D Height-time profiles of running difference features

Thanks!

Looking forward to working with
previous, current, and future collaborators!