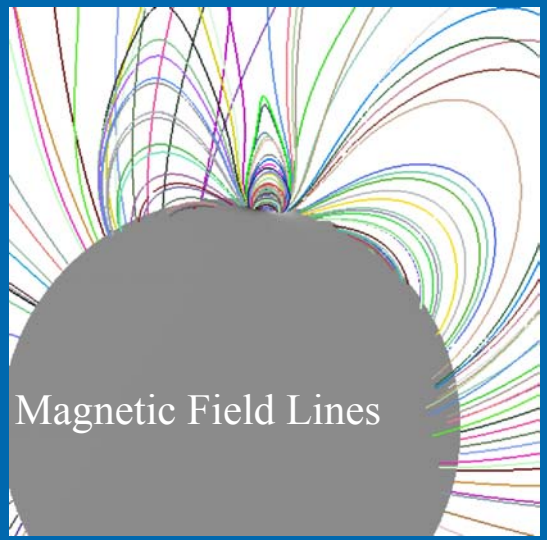
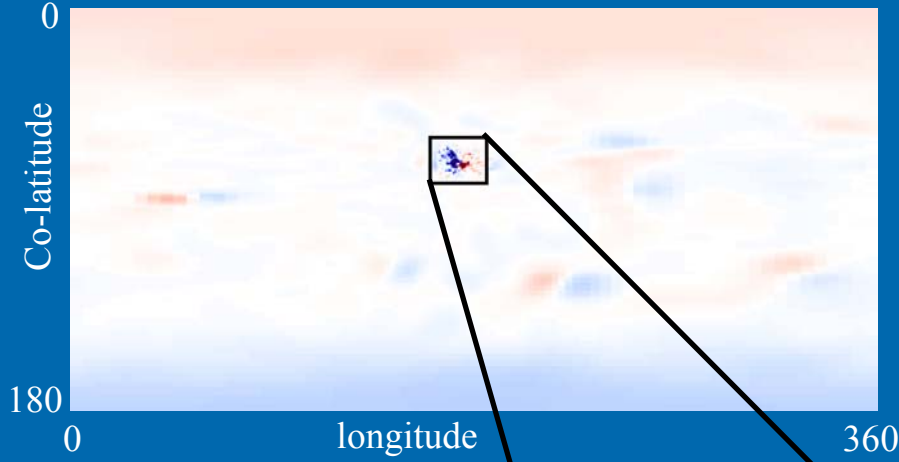
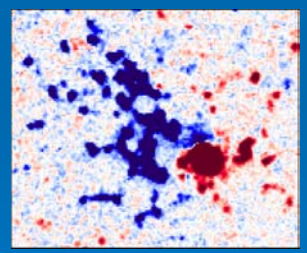
Working Towards A Realistic Model of Active Region CMEs



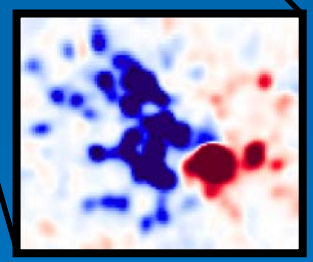
MHD Coronal simulation:
1000G bipolar active region
9G Background dipole

Boundary Condition for the Sun on May 11, 1997:
Nonuniform mesh, High resolution in active region





Raw SOHO
MDI data



Smoothed Version
Suitable for MHD

The Future: Simulation of the
Sun on May 11, 1997 and
subsequent eruption on May 12.

Modeling an Active Region CME

- High magnetic energy density in Active Regions powers fastest CMEs: This aspect of CME physics has not yet been captured in large-scale coronal simulations.
- Example: May 12, 1997 CME (A SHINE event)
- MHD calculation is very challenging: Need to capture strong magnetic fields ~ 1000 Gauss (e.g., Wilcox magnetograms unsuitable).
- For a tractable calculation, need to provide high resolution for the regions of interest while still modeling the global Sun.
- Simulation on the left is for a 1000 G idealized bipolar region embedded in a 9 G dipole field. The size of the region and strength of the field is similar to the May 12, 1997 active region.
- On the right, the magnetic flux distribution derived from high resolution SOHO MDI magnetograms (0.1 degree, courtesy of Y. Liu and P. Scherrer of Stanford).
- The solar magnetic field map has been filtered for low resolution for most of the Sun, with a high resolution (0.2 degrees) in the active region.
- The next step (presently in progress) is to develop a coronal simulation using this map as the boundary condition.
- This coronal solution will be used as the initial condition for simulations of the eruption of the active region and subsequent coronal mass ejection.