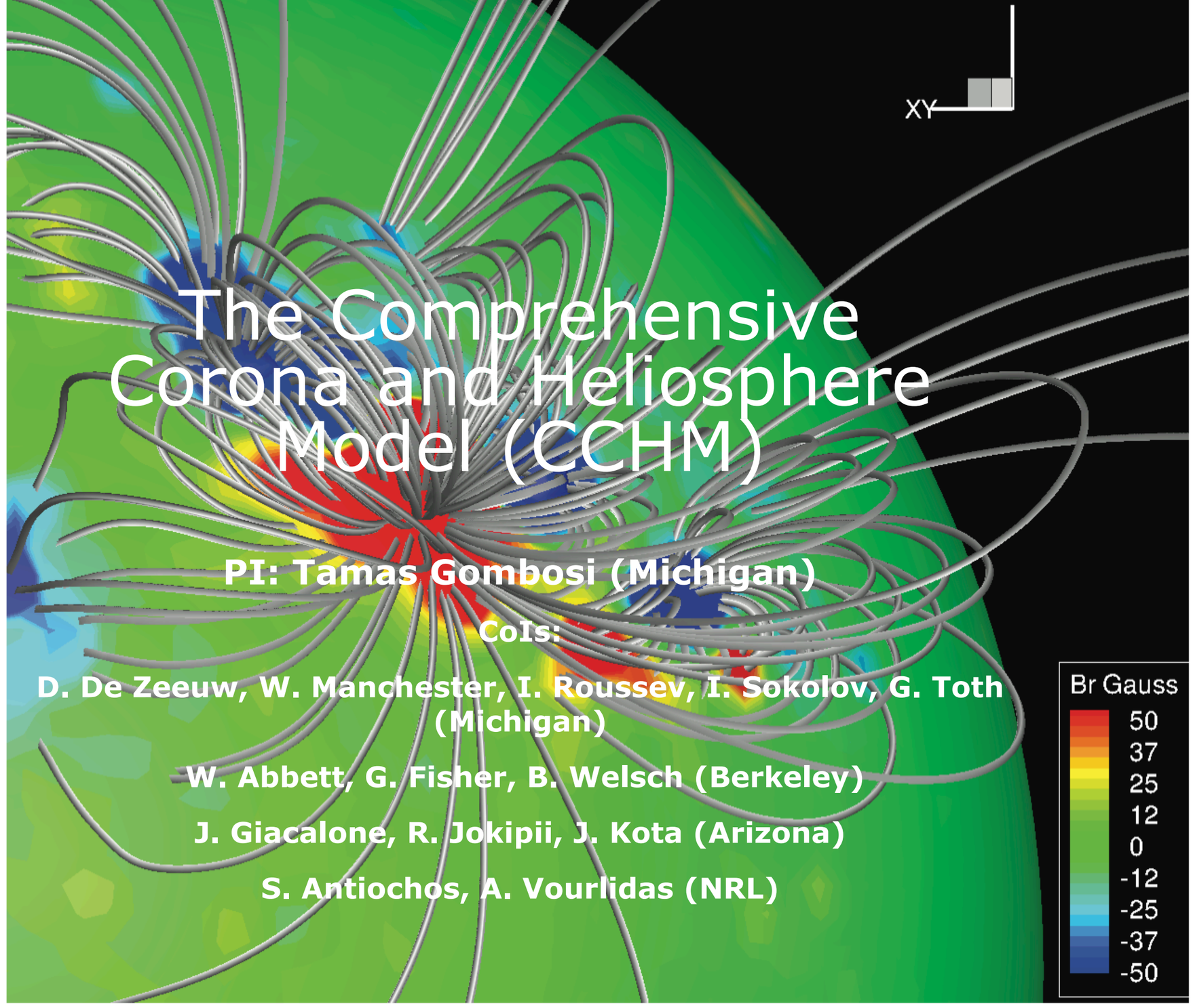

The Comprehensive Corona and Heliosphere Model (CCHM)

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CoIs:

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W. Abbett, G. Fisher, B. Welsch (Berkeley)

J. Giacalone, R. Jokipii, J. Kota (Arizona)

S. Antiochos, A. Vourlidas (NRL)

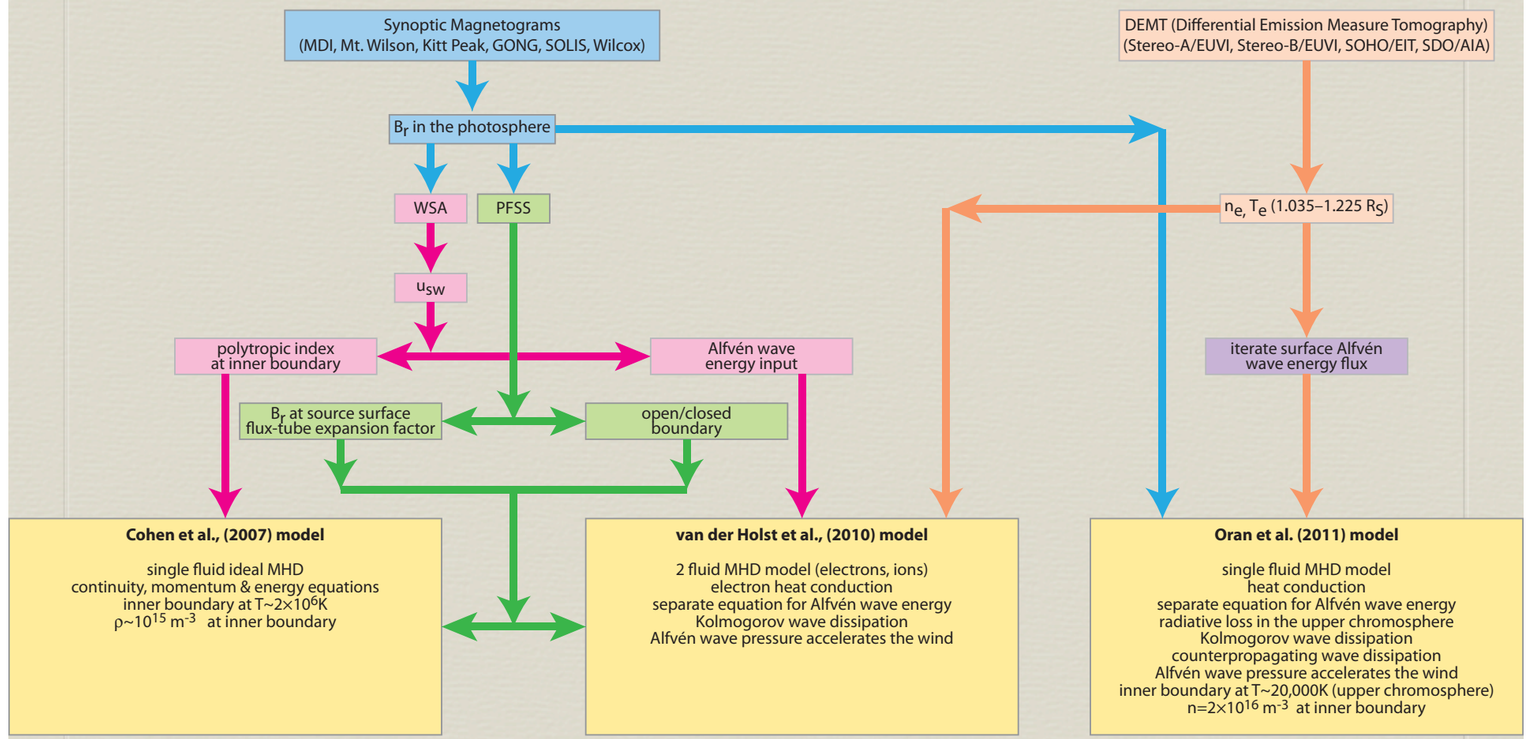
CCHM Goals

- Develop and maintain a first-principles based comprehensive numerical model of the 3D time-dependent structure and dynamics of the slowly varying corona and the ambient solar wind based on the SWMF.
- Main features:
  - Provide 3D description of the corona and the heliosphere
  - Incorporate magnetograms as input
  - Be able to initiate solar eruptions
  - Predict the solar wind parameters at any point in space
  - Provide modularity to incorporate new or more sophisticated physics
  - Have a user-friendly web portal
  - Enable faster than real-time simulation capability
  - Be able to run continuously in a "pipeline mode"
  - Deliver a working version to the CCMC
  - Apply rigorous evaluation and validation
- Goals are accomplished, code is available at CCMC

ATMOSPHERIC, OCEANIC AND SPACE SCIENCES

UNIVERSITY of MICHIGAN ■ COLLEGE of ENGINEERING

CCHM Corona Models



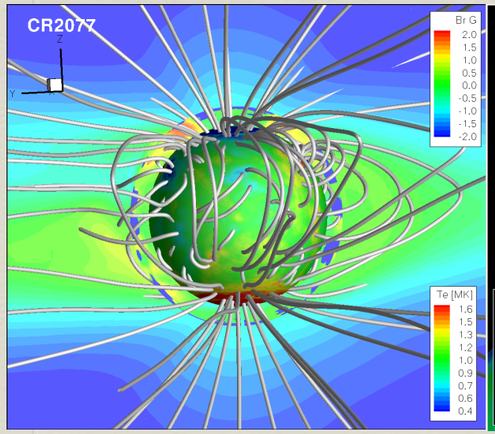
Frazin et al.: SH41B-03
Sokolov et al.: SH43A-1936
Manchester & van der Holst: SH23A-1931
Fang et al.: SH54A-06

Oran et al.: SH43A-1938
Jin et al.: SH53C-08
Downs et al.: SH43A-1939
Van der Holst et al.: SH43B-1944

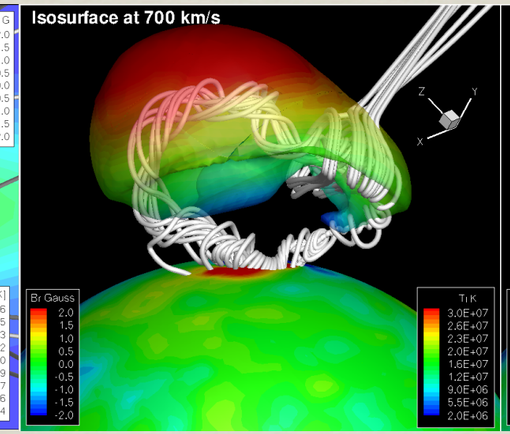
CCHM CME Initiation Models

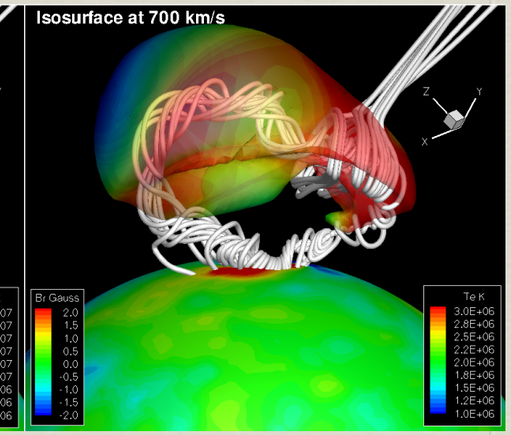
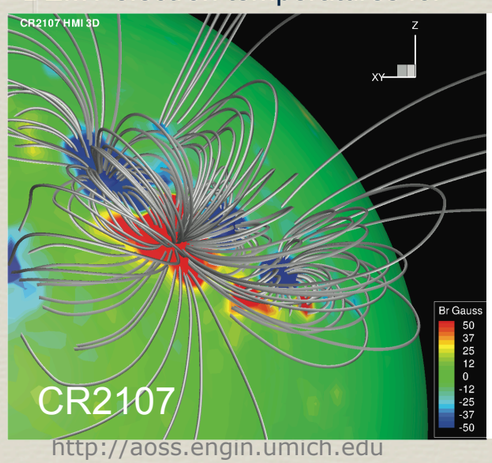
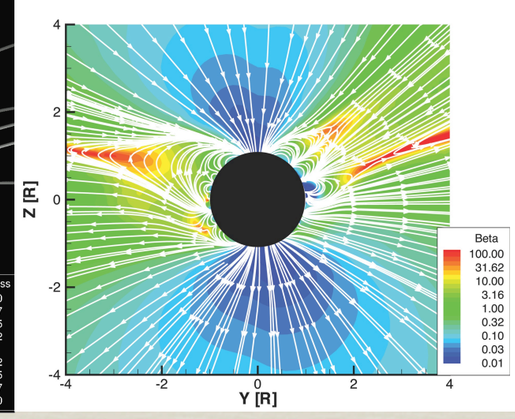
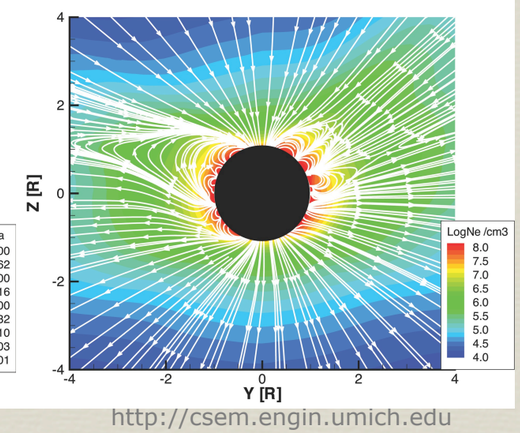
- Empirical: Erupting flux rope
  - Location, orientation and strength are free parameters
  - Fast, present workhorse model
- Photospheric physics-based: Shear flow model
  - Driven by boundary conditions
  - Breakout
  - Can be used in real-time simulations
- Subphotospheric physics-based: Magnetic flux emergence
  - Most complete physics
  - Very resource intensive, cannot be used in real-time simualtions

Some Examples



Comparison of simulated and DEMT electron temperatures for





At the CME shock front limited ion coupling, and heat conduction keep electrons much cooler than the cospatial ions.