AN MHD MODELING WEB SITE FOR SECCHI AND IMPACT SUPPORT

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SCIENCE APPLICATIONS INTL. CORP.
SAN DIEGO

SUPPORTED BY SECCHI AND IMPACT

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WEB SITE FEATURES

- **http://iMHD.net/stereo**
- Our intent is to facilitate the interpretation of STEREO data
- MHD solutions: coronal \((1R_S - 20R_S)\) and heliospheric \((20R_S - 1AU)\)
- Currently: polytropic model
- Currently: medium spatial resolution
  - (corona: 61 × 71 × 65; heliosphere: 71 × 81 × 129)
- Coming soon: improved energy equation model, higher resolution
- All Carrington rotations in the STEREO era (CR2048–)
- Comparisons with images and *in situ* STEREO A and B data, plus Earth data
- Magnetic field lines, heliospheric current sheet (HCS)
- Solar wind sources mapped back to the Sun
- *In situ* solar wind comparisons
- Coronal hole maps
MHD EQUATIONS
(POLYTROPIC MODEL)

\[ \nabla \times B = \frac{4\pi}{c} J \]
\[ \nabla \times E = -\frac{1}{c} \frac{\partial B}{\partial t} \]
\[ E + \frac{1}{c} v \times B = \eta J \]
\[ \frac{\partial \rho}{\partial t} + \nabla \cdot (\rho v) = 0 \]
\[ \rho \left( \frac{\partial v}{\partial t} + v \cdot \nabla v \right) = \frac{1}{c} J \times B - \nabla p + \rho g + \nabla \cdot (\nu \rho \nabla v) \]
\[ \frac{\partial p}{\partial t} + \nabla \cdot (pv) = -(\gamma - 1)p \nabla \cdot v \]
\[ \gamma = 1.05 \text{ in the corona} \]
MHD EQUATIONS
(Im prove d Energy Equation Model)

\[ \nabla \times \mathbf{B} = \frac{4\pi}{c} \mathbf{J} \]
\[ \nabla \times \mathbf{E} = -\frac{1}{c} \frac{\partial \mathbf{B}}{\partial t} \]
\[ \mathbf{E} + \frac{1}{c} \mathbf{v} \times \mathbf{B} = \eta \mathbf{J} \]
\[ \frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{v}) = 0 \]
\[ \rho \left( \frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v} \right) = \frac{1}{c} \mathbf{J} \times \mathbf{B} - \nabla p - \nabla p_w + \rho \mathbf{g} + \nabla \cdot (\nu \rho \nabla \mathbf{v}) \]
\[ \frac{\partial p}{\partial t} + \nabla \cdot (p \mathbf{v}) = (\gamma - 1) \left( -p \nabla \cdot \mathbf{v} - \nabla \cdot \mathbf{q} - n_e n_p Q(T) + H \right) \]
\[ \gamma = 5/3 \]
\[ \mathbf{q} = -\kappa \mathbf{\hat{b}} \mathbf{\hat{b}} \cdot \nabla T \] (Close to the Sun, \( r \lesssim 10 R_s \))
\[ \mathbf{q} = 2\alpha n_e T \mathbf{\hat{b}} \mathbf{\hat{b}} \cdot \mathbf{v} / (\gamma - 1) \] (Far from the Sun, \( r \gtrsim 10 R_s \))

+ WKB equations for Alfvén wave pressure \( p_w \) evolution
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize, analyze, and even download global MHD simulation results of the solar corona and inner heliosphere for the period coinciding with the STEREO mission. You can also compare our model results with measurements taken by the SECCHI and IMPACT instruments on board STEREO.
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize and even download global MHD simulation results of the solar corona and interplanetary medium for the period coinciding with the STEREO mission. You can also compare our results with measurements taken by the SECCHI and IMPACT instruments on board STEREO.
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize and even download global MHD simulation results of the solar corona and interplanetary field for the period coinciding with the STEREO mission. You can also compare our model with measurements taken by the SECCHI and IMPACT instruments on board.
**IMPACT :: Time Series Comparisons**

**Observed and Simulated Radial IMF Polarity for CR 2060**

- **Observatory:** STEREO A (12-hr avg.)
- **Simulation:** SWE MHD Code
- **CR Start:** 2007-08-15 15:23:33 UTC
- **CR End:** 2007-09-12 02:51:09 UTC

- **Postscript File:** /stereo/data/mag_plastic/sta_mag_br-pol_cr2060.ps

**Observed and Simulated Solar Wind Speed for CR 2060**

- **Observatory:** STEREO A (12-hr avg.)
- **Simulation:** SWE MHD Code
- **CR Start:** 2007-08-15 15:23:33 UTC
- **CR End:** 2007-09-12 02:51:09 UTC

- **Postscript File:** /stereo/data/mag_plastic/sta_plastic_wp_cr2060.ps
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize and even download global MHD simulation results of the solar corona and interplanetary field for the period coinciding with the STEREO mission. You can also compare our results with measurements taken by the SECCHI and IMPACT instruments on board.
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<th>Date/Time</th>
<th>Image Description</th>
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<tr>
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<td>03/13/2007 00:13:18*</td>
<td>MAS Simulated STEREO B for</td>
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<tr>
<td>03/13/2007 00:13:18*</td>
<td>MAS Simulated STEREO A for</td>
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*The times above the COR1 images are extracted from the filenames and may differ slightly from the timestamp printed on image itself.
**MHDWEB: Solar Terrestrial Relations Observatory**  
**Modeling Support for SECCHI and IMPACT**

**SECCHI :: PB Comparisons**

STEREO B on 03/13/2007 00:13:18*  
STEREO A on 03/13/2007 00:13:18*

*The times above the COR1 images are extracted from the filenames and may differ slightly from the timestamp printed on the image itself.*
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize and even download global MHD simulation results of the solar corona and interplanetary field for the period coinciding with the STEREO mission. You can also compare our results with measurements taken by the SECCHI and IMPACT instruments on board the spacecraft.
Welcome to SAIC's STEREO modeling website. On these pages, you can visualize and even download global MHD simulation results of the solar corona and interplanetary medium for the period coinciding with the STEREO mission. You can also compare our simulations with measurements taken by the SECCHI and IMPACT instruments on board STEREO.
Carrington Rotation: 2067
Solution: Corona (1-30 R_\text{sun})
(R/R_{\text{sun}}, Theta, Phi) = (1, 50^\circ, 270^\circ)
Field Line Thickness: 2.50
Field Line Quality: MEDIUM
MHDWEB: SOLAR TERRESTRIAL RELATIONS Observatory
MODELING SUPPORT FOR SECCHI AND IMPACT

MHDWEB Tools :: Visual 3D Plotter

Carrington Rotation: 2067
Solution: Heliosphere (20-1075 R$_{sun}$)
(R/R$_{max}$, Theta, Phi) = (1, 50°, 270°)
Field Line Thickness: 1.50
Field Line Quality: MEDIUM

![Visual 3D Plotter](image_url)

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<th>Parameters</th>
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<td>Phi Angle</td>
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[Run Visual] [Reset Form]
WEB SITE FEATURES (CONT.)

- Summary plots of fields (meridional, synoptic)
- Interactive plotting (1D, 2D, and 3D)
- Magnetic field line and HCS topology (rotate 3D views)
- pB comparisons with COR1 images
- STEREO spacecraft trajectories
- Ability to download MHD solutions
Warning

This is a beta version of the site, and may contain inconsistencies and errors. Please contact us before using this data for applications where accuracy is important.

• Please take this seriously!
PLANNED IMPROVEMENTS

- Improved energy equation model, higher resolution
- Alfvén speed plots and diagnostics
- Comparisons with HI
- Simulations of individual CME events (long term)
- Improved interactive features
- Comparison with source-surface + CS (WSA) model
- Verification and validation