Simulated CME Full-Sky Faraday Rotation

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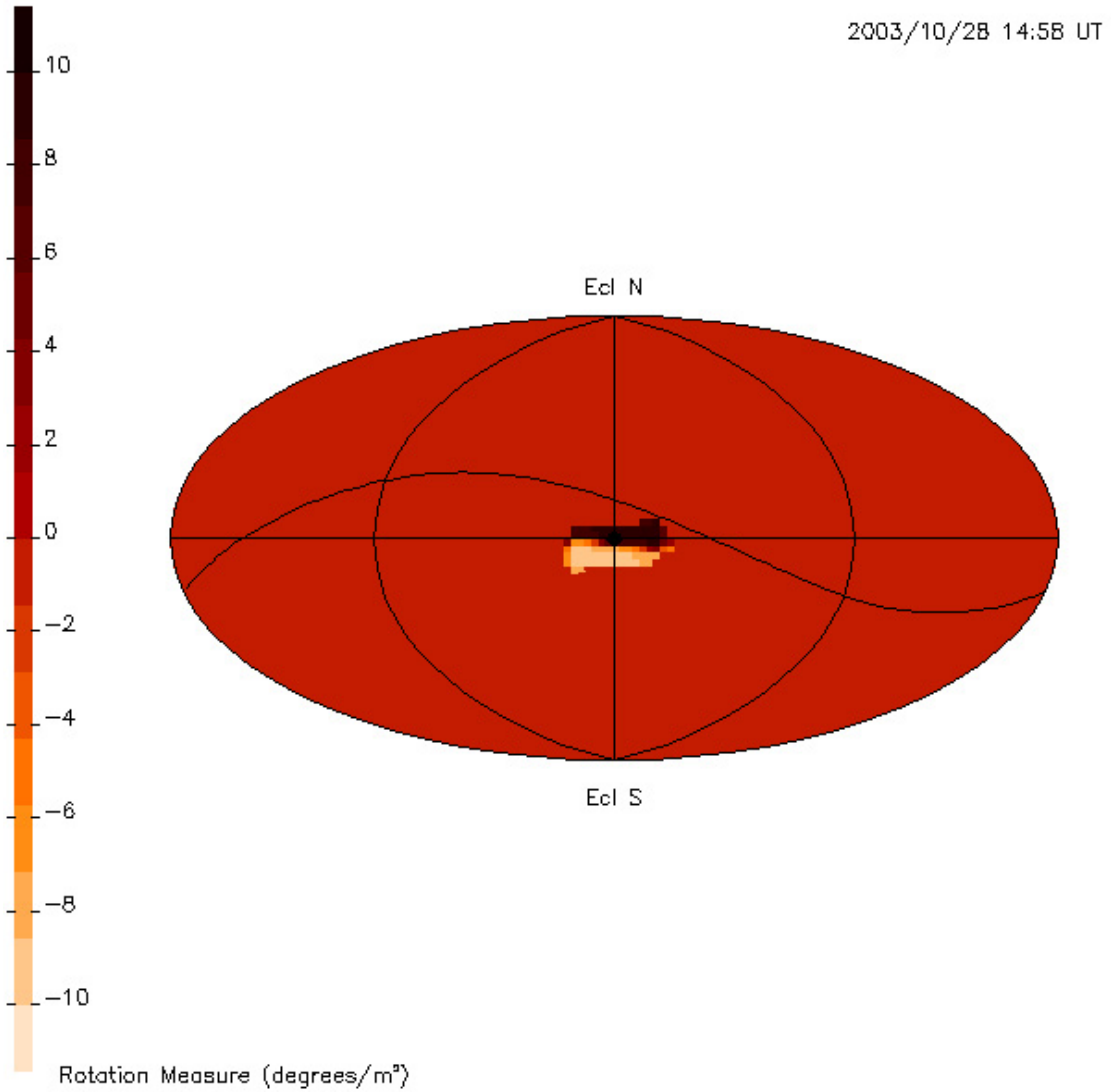
2:UC-San Diego

Model Parameters

- Flux rope orientation, handedness, magnetic field magnitude, impact parameter, velocity, radius, expansion rate, electron density
- Source density (images show 10,000 sources in the sky)
- The following images show a left-handed rope oriented along the GSE-Y axis


2003/10/28 14:58 UT
Ecl N
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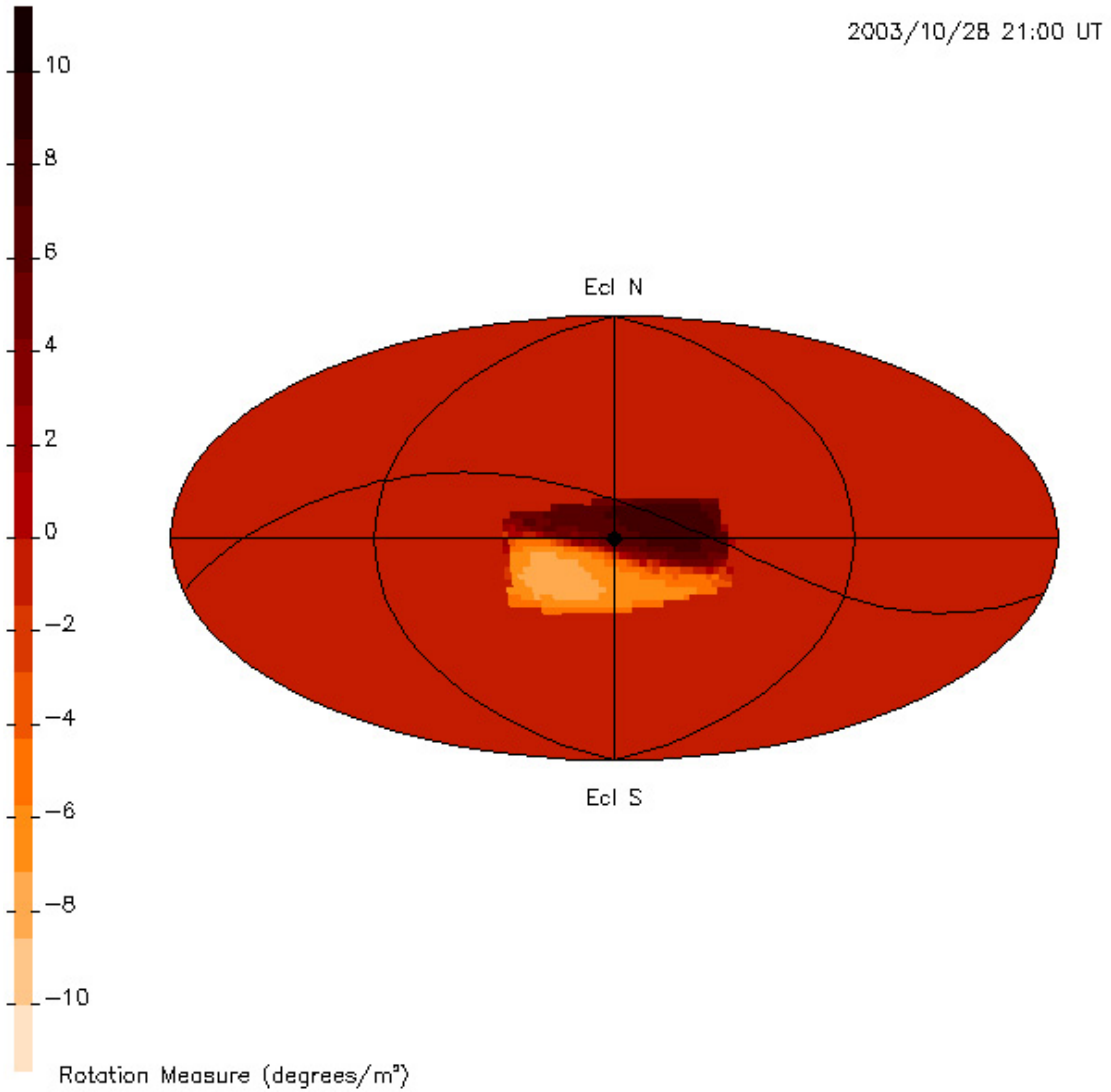
Rotation Measure (degrees/m²)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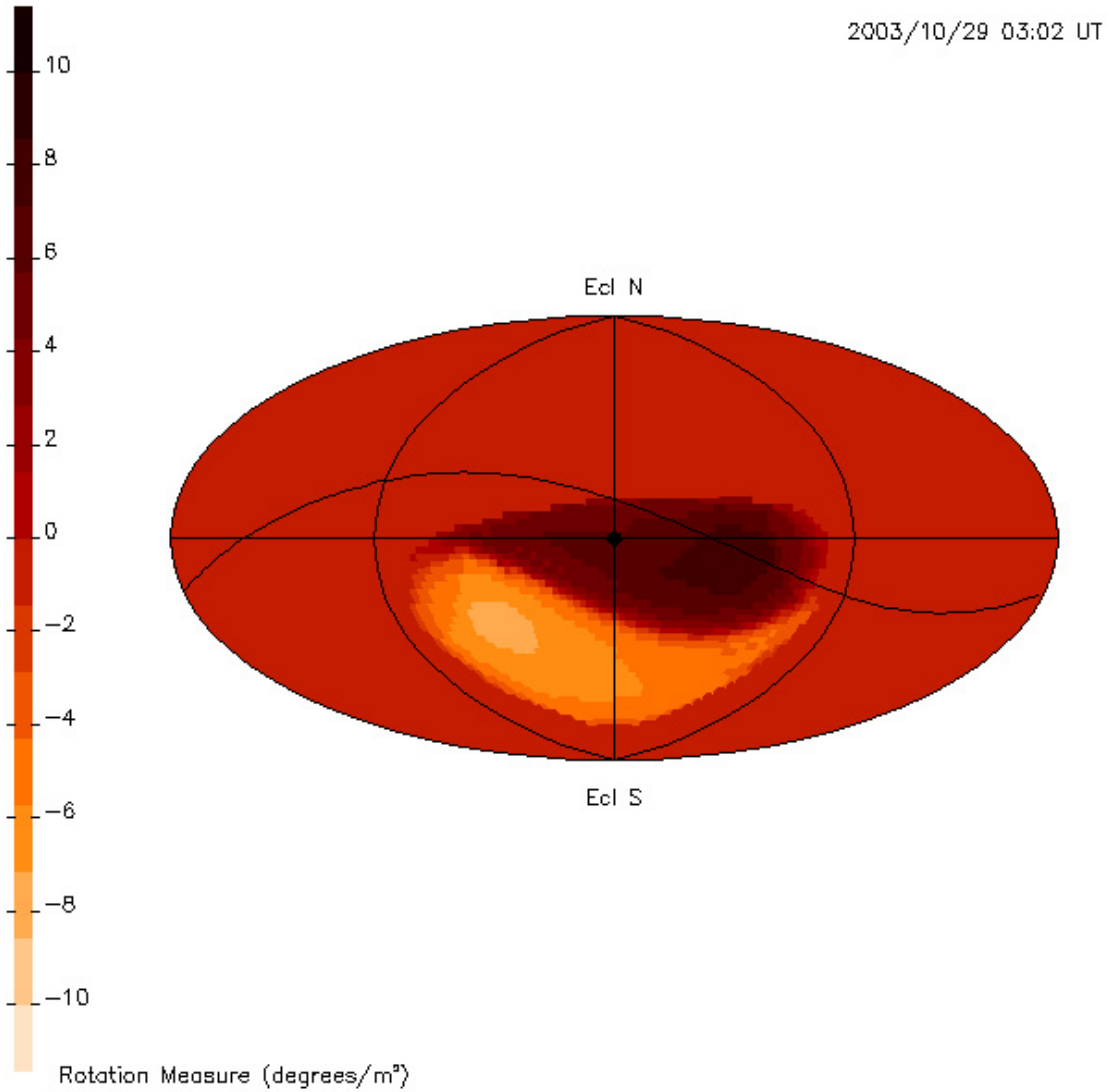
Rotation Measure (degrees/m²)


2003/10/29 03:02 UT
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Rotation Measure (degrees/m²)
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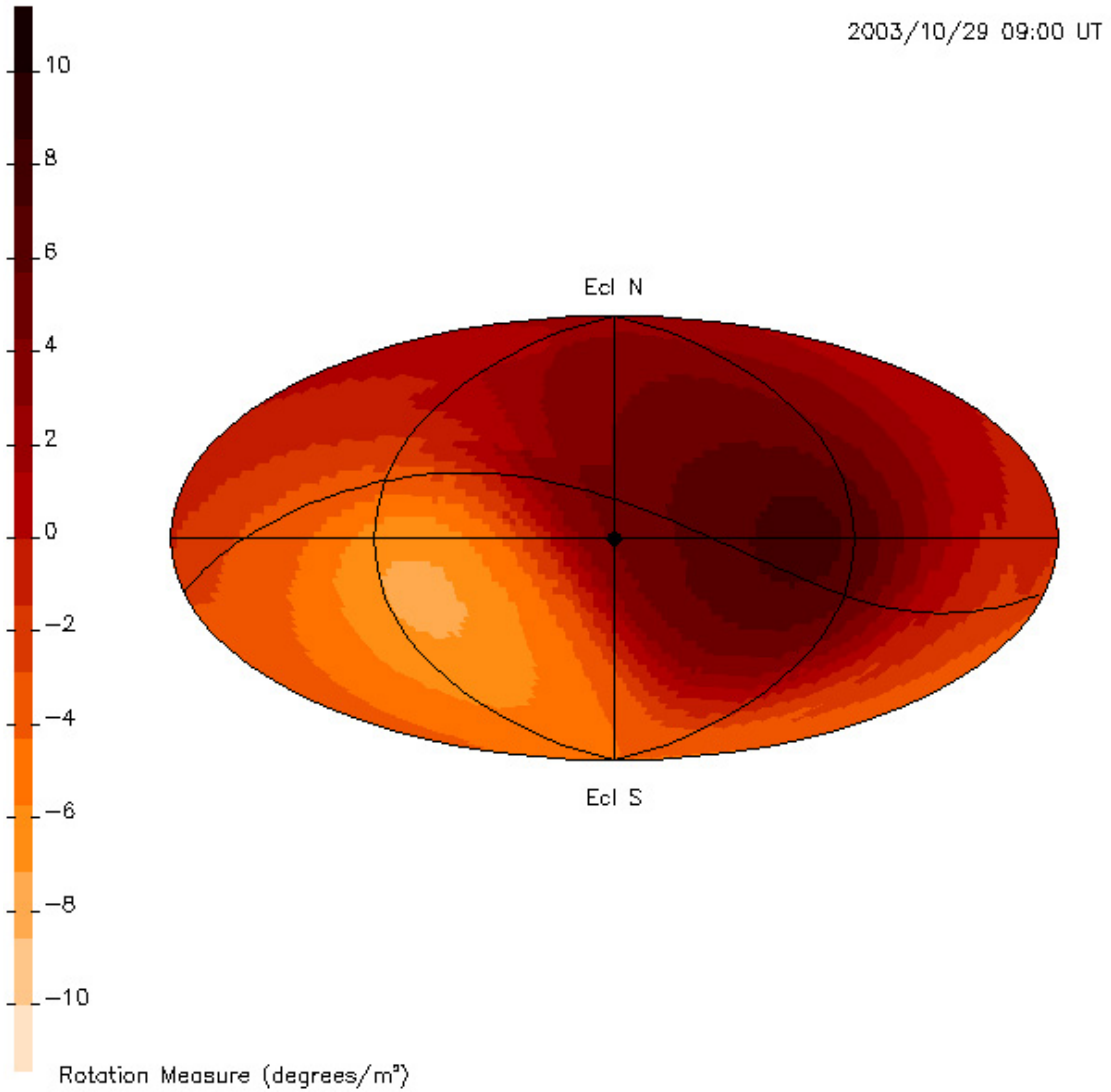
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Rotation Measure (degrees/m²)
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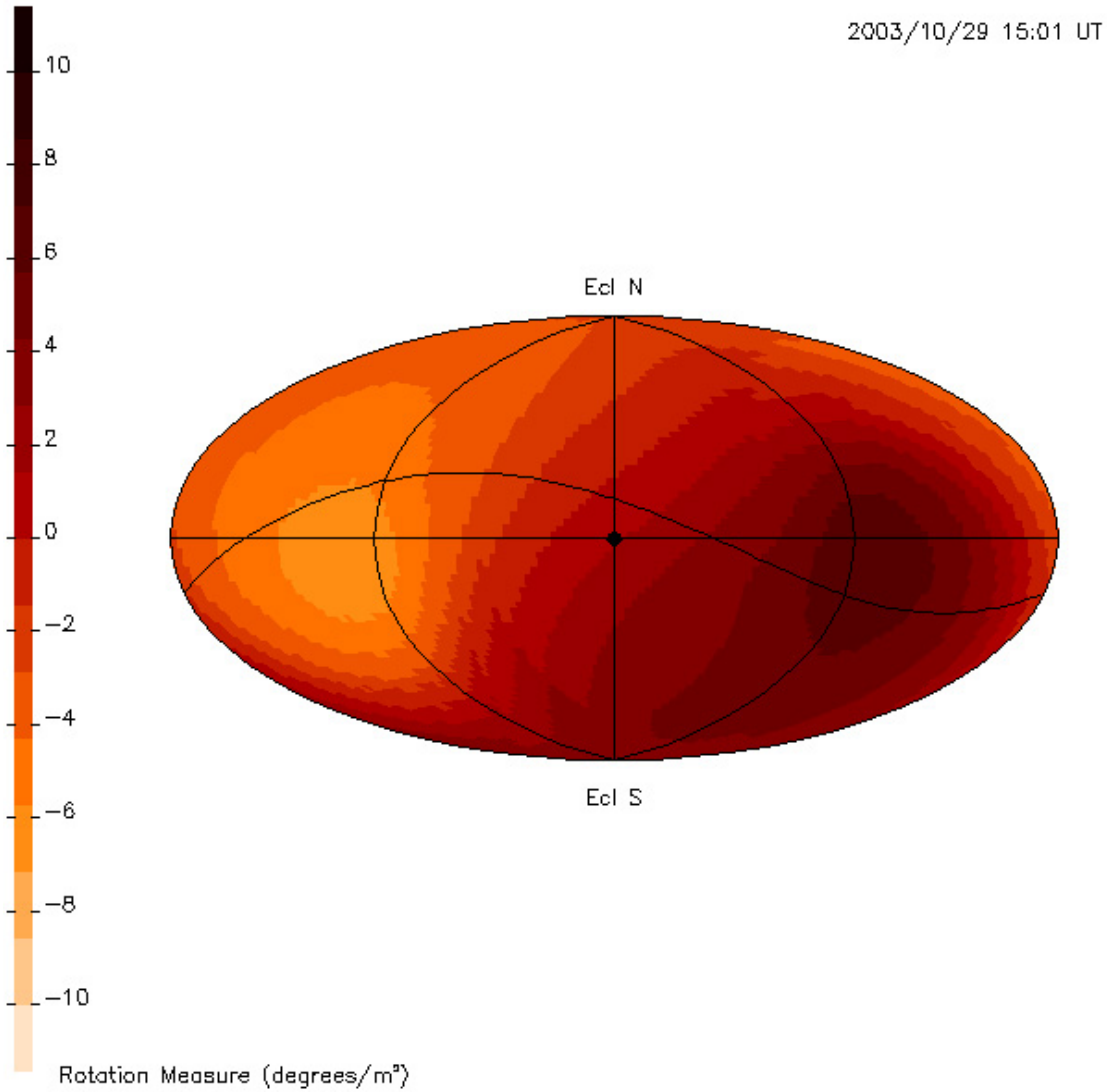
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Rotation Measure (degrees/m²)
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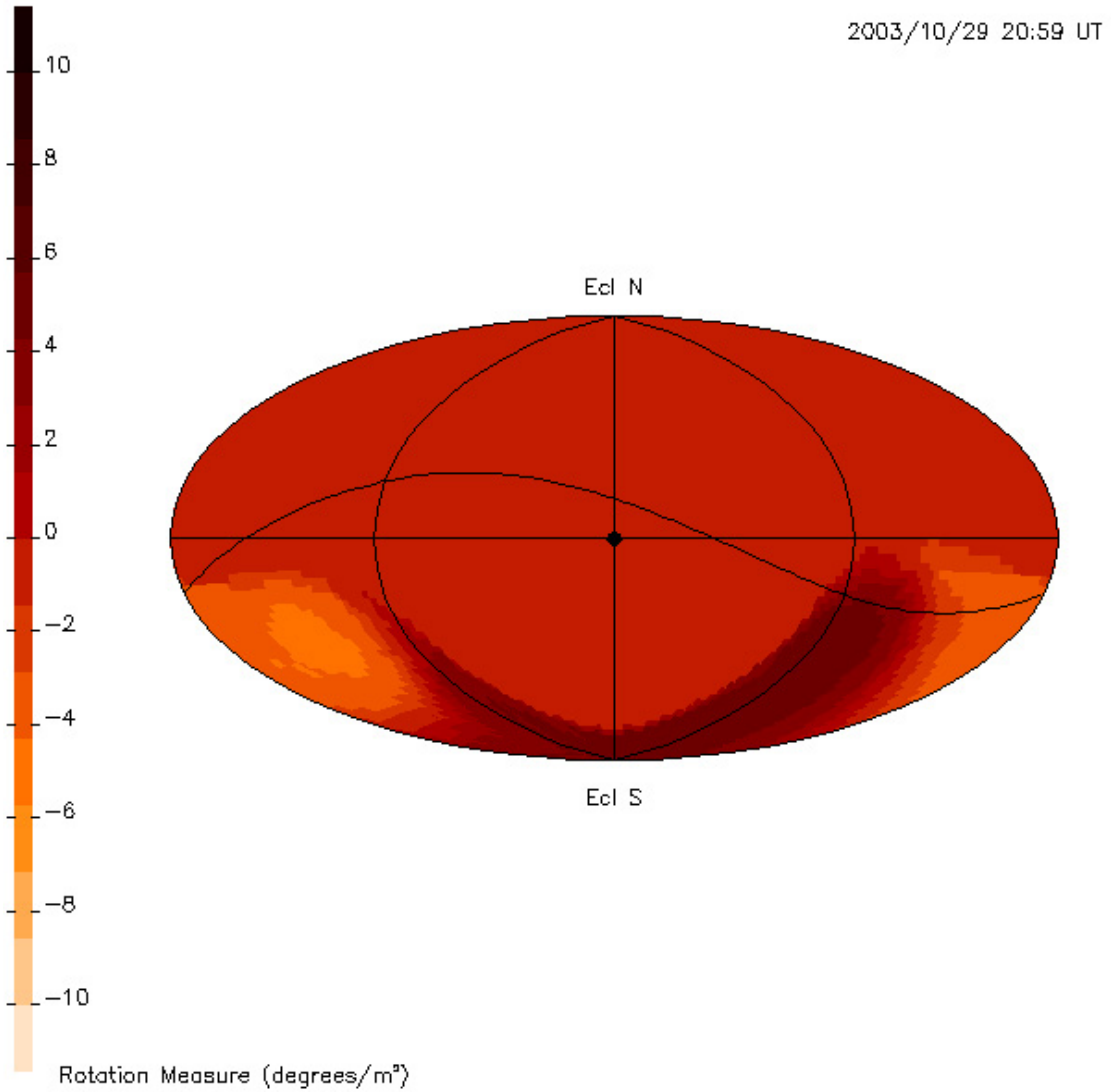
2003/10/29 20:59 UT
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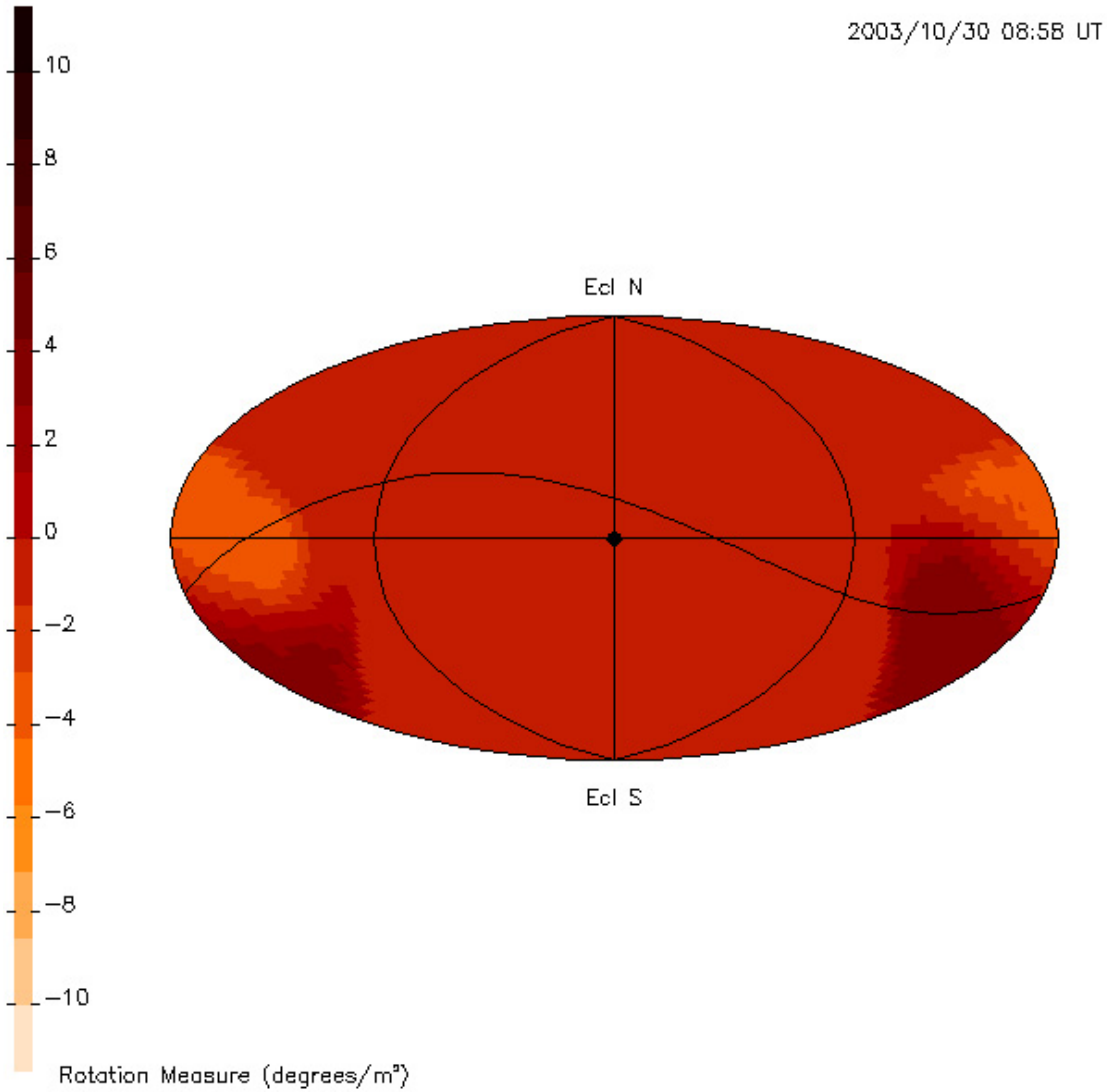
Rotation Measure (degrees/m²)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Rotation Measure (degrees/m²)
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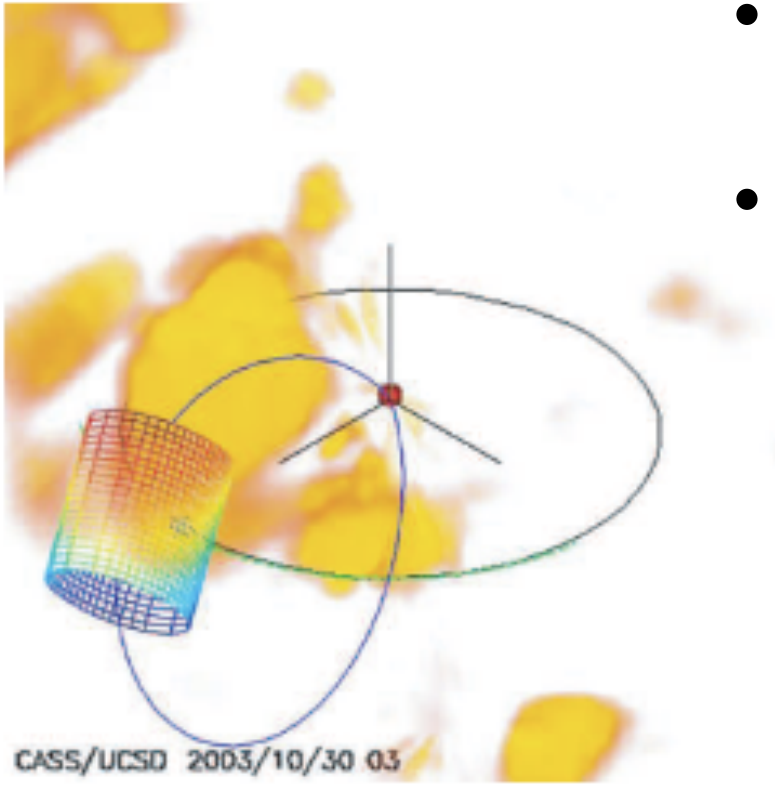
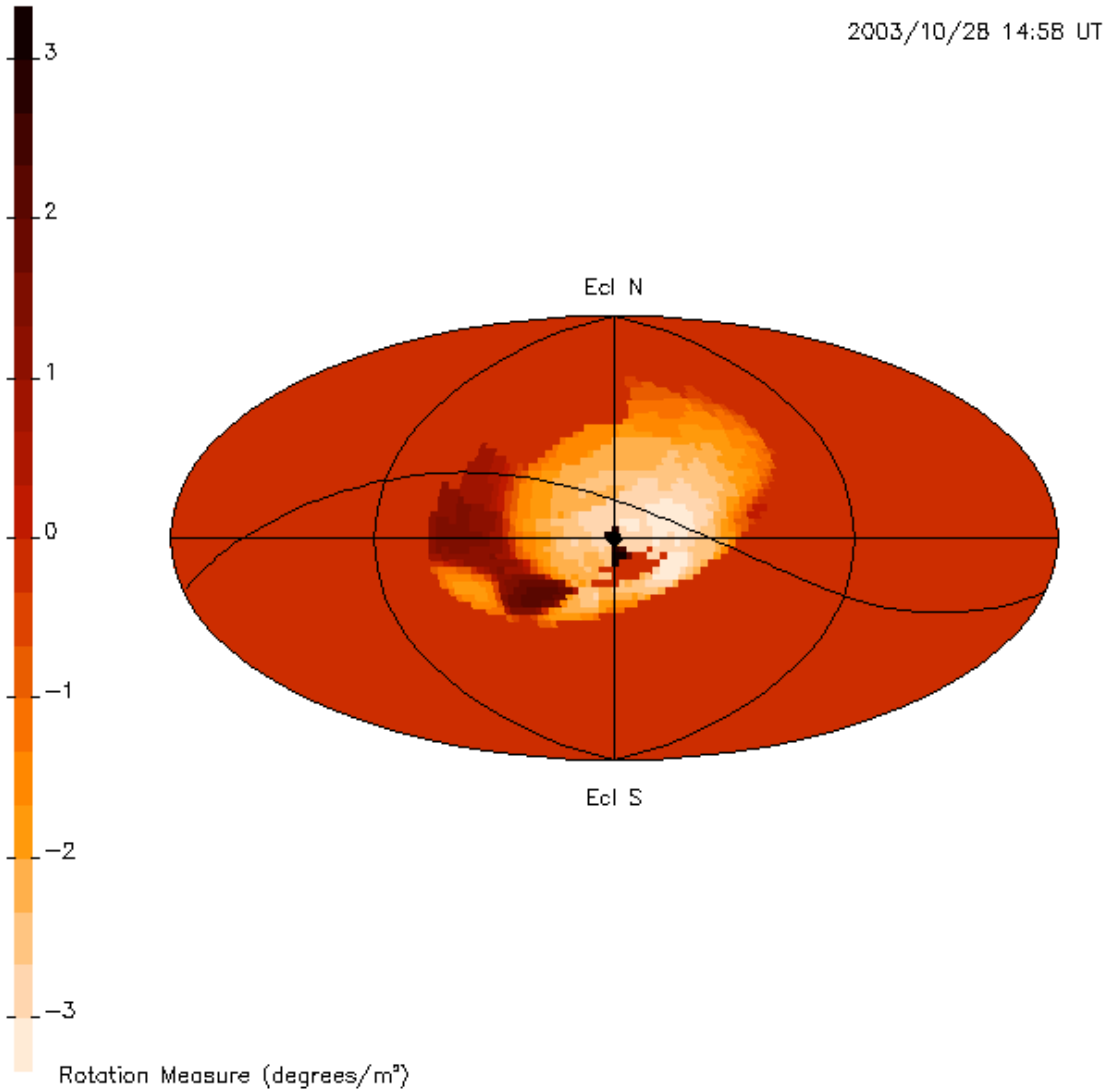
2003 Halloween Event



- T. Mulligan non-force-free magnetic field fits to ACE data
- Sheath region downstream of CME was constructed:
  - Thickness varied from R in the flow direction to 2R in the perpendicular
  - Density and magnetic field values within region were increased by a factor of 2 next to the CME and fell with an inverse square to no enhancement on the edge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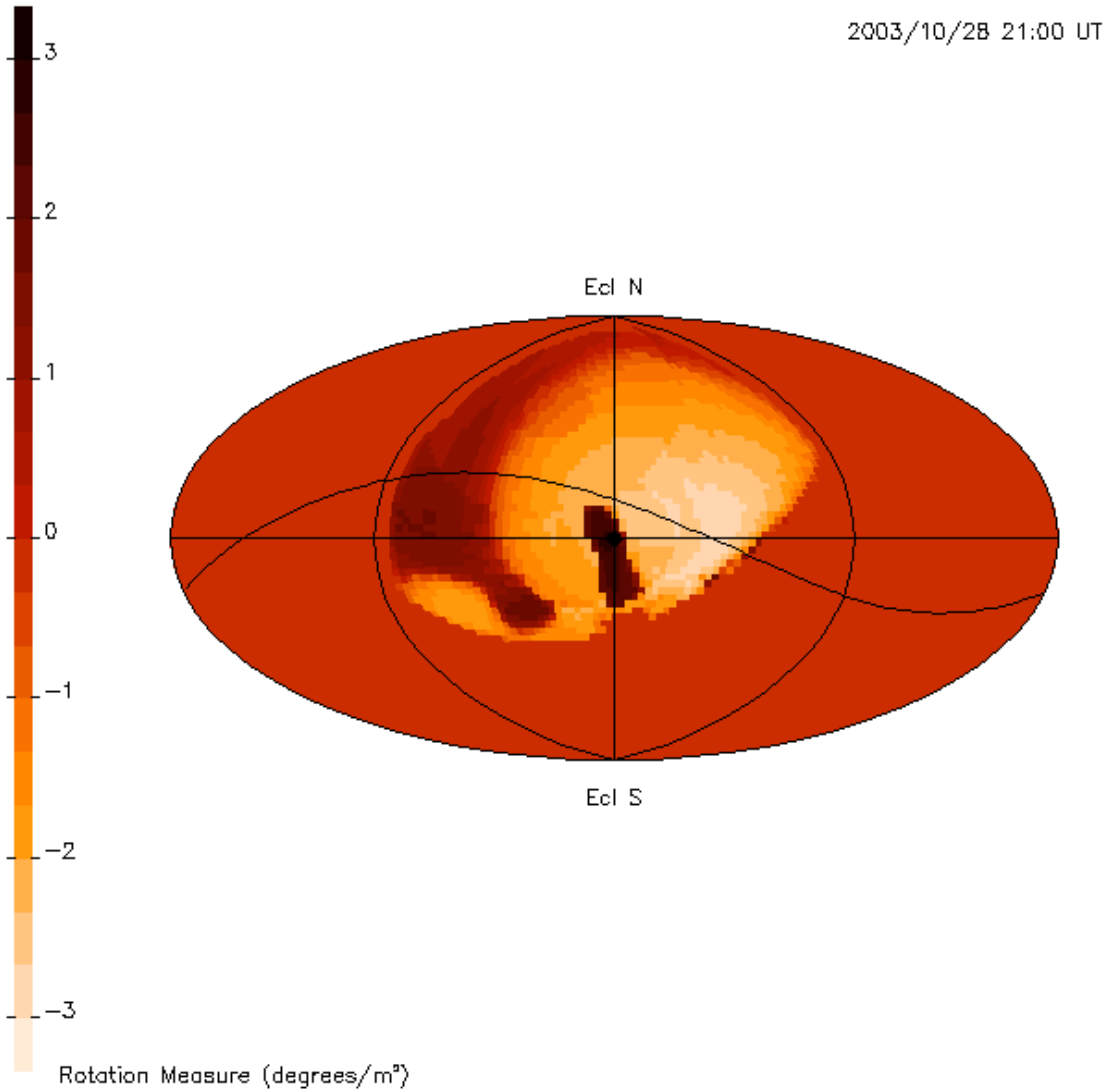
Rotation Measure (degrees/m²)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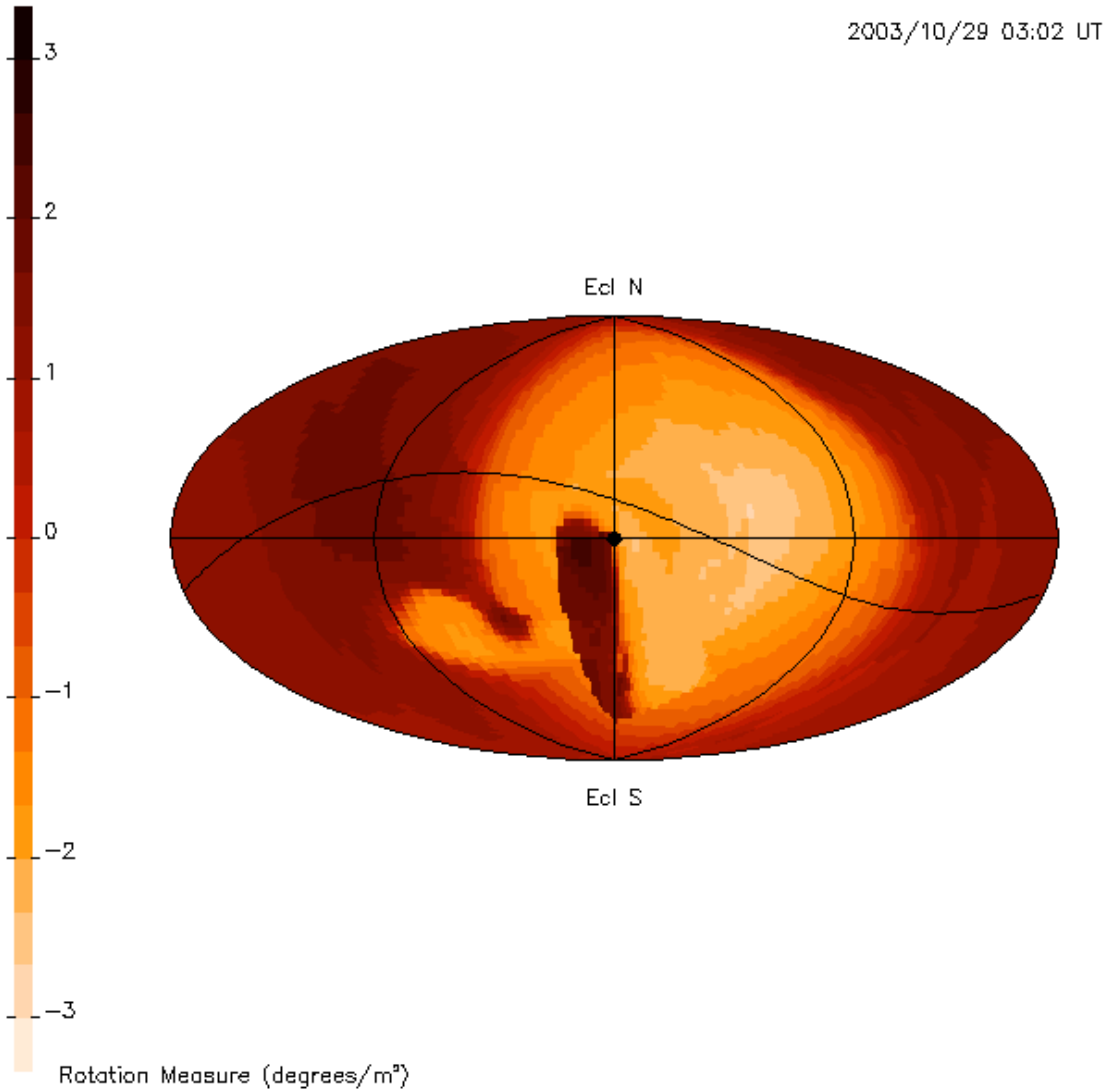
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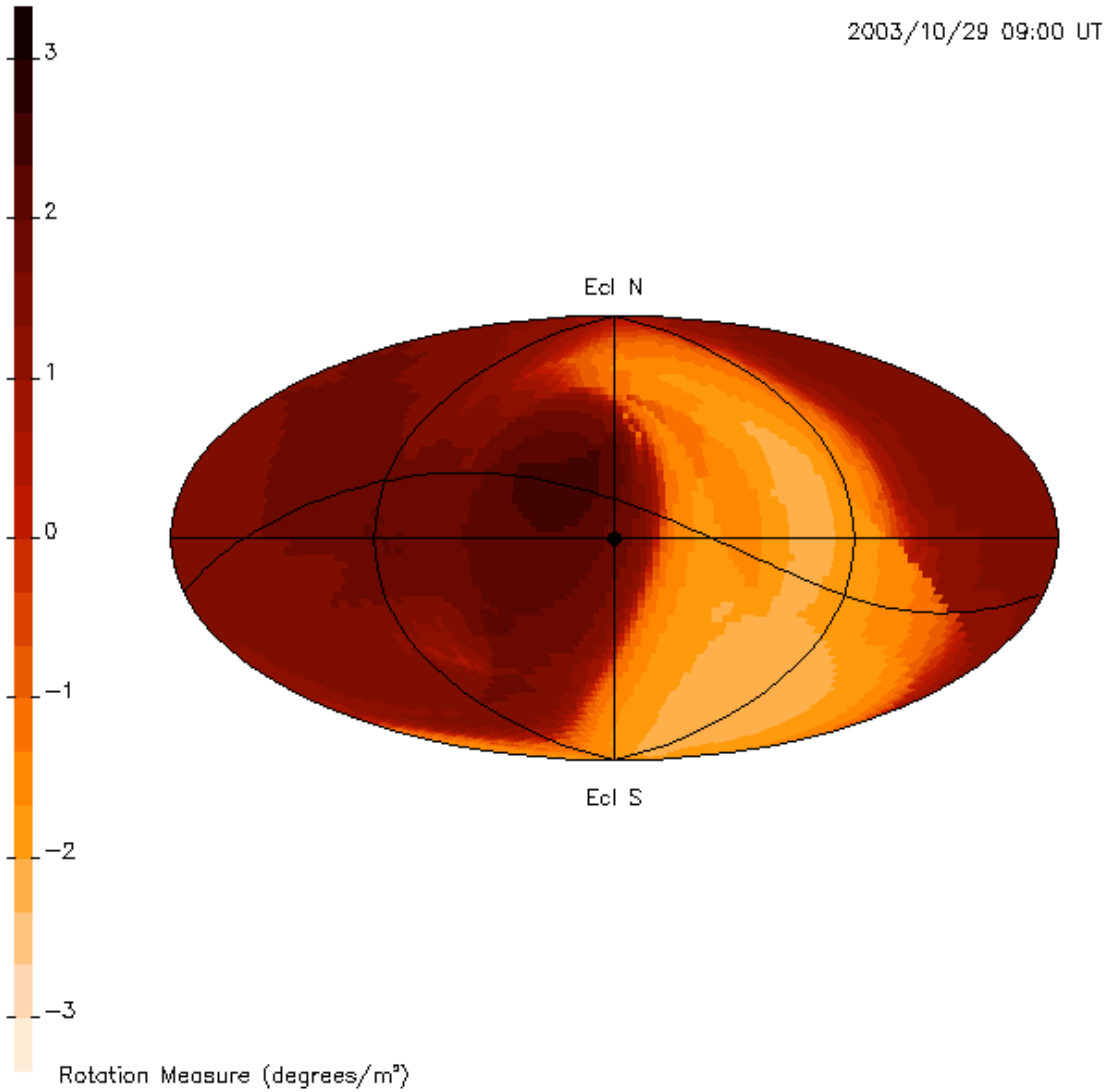
Rotation Measure (degrees/m²)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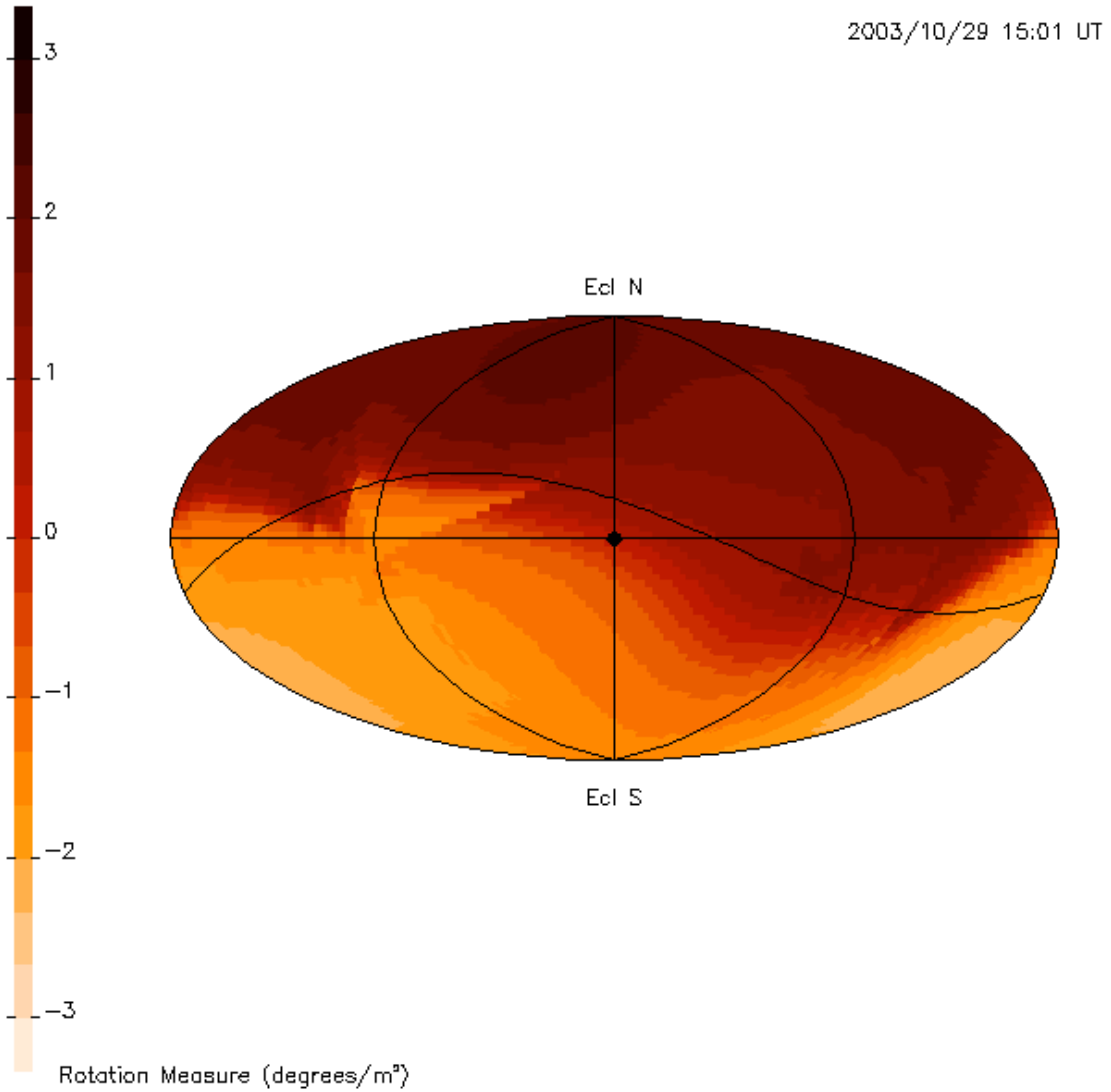
Rotation Measure (degrees/m²)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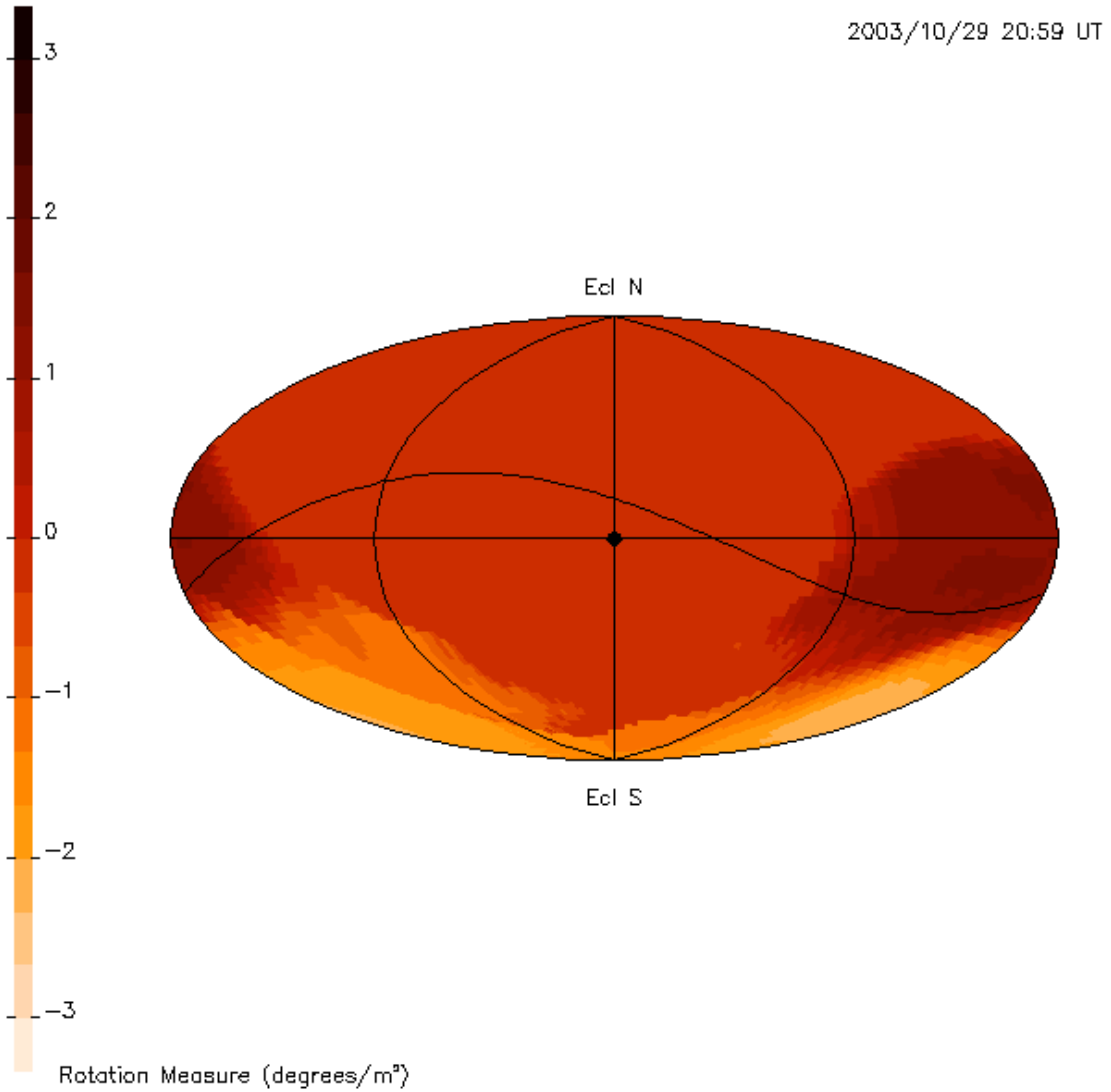
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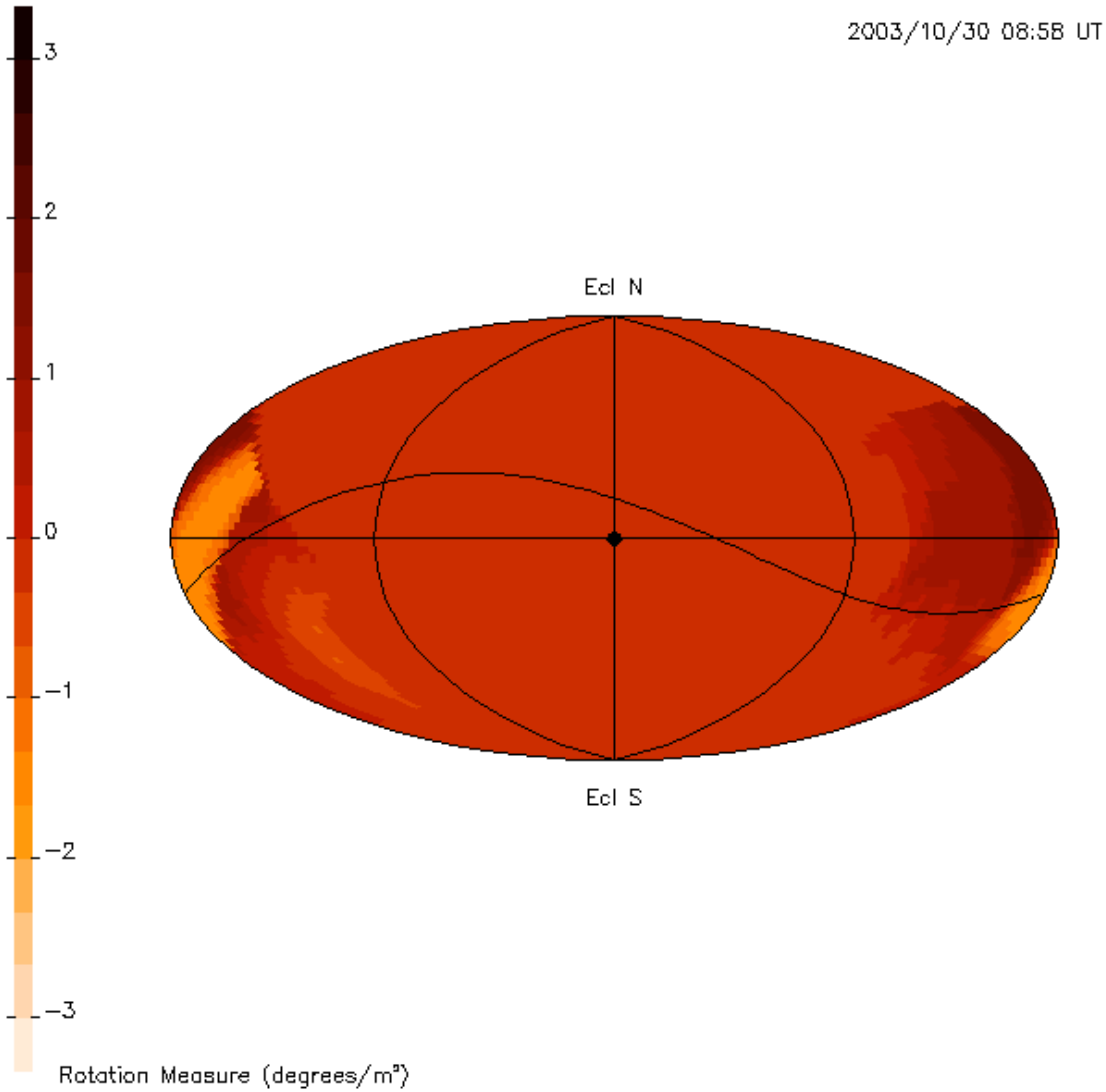
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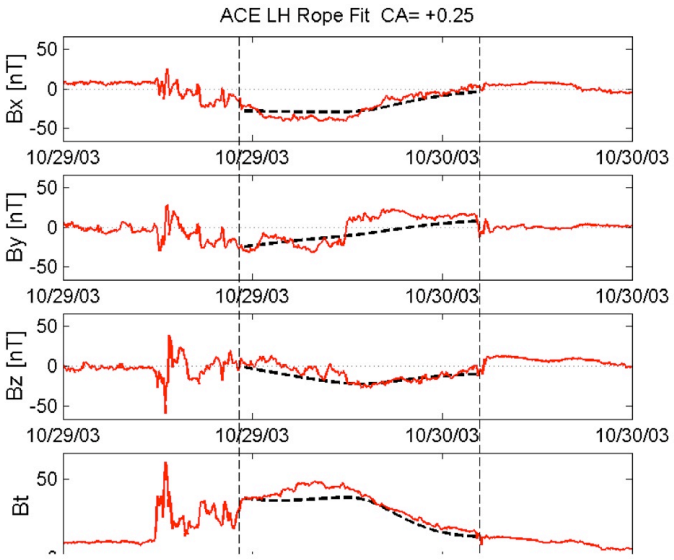
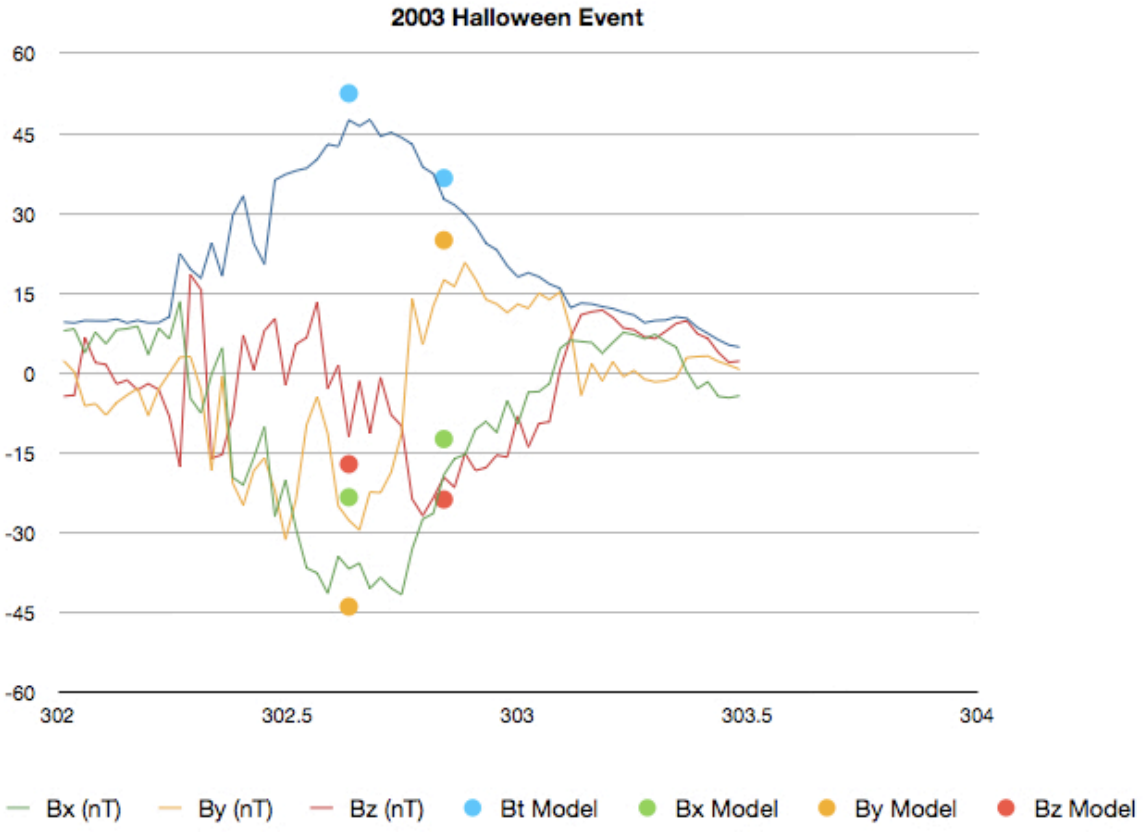
Flux Rope Orientation Test





Required Parameter for Sheath region Studies

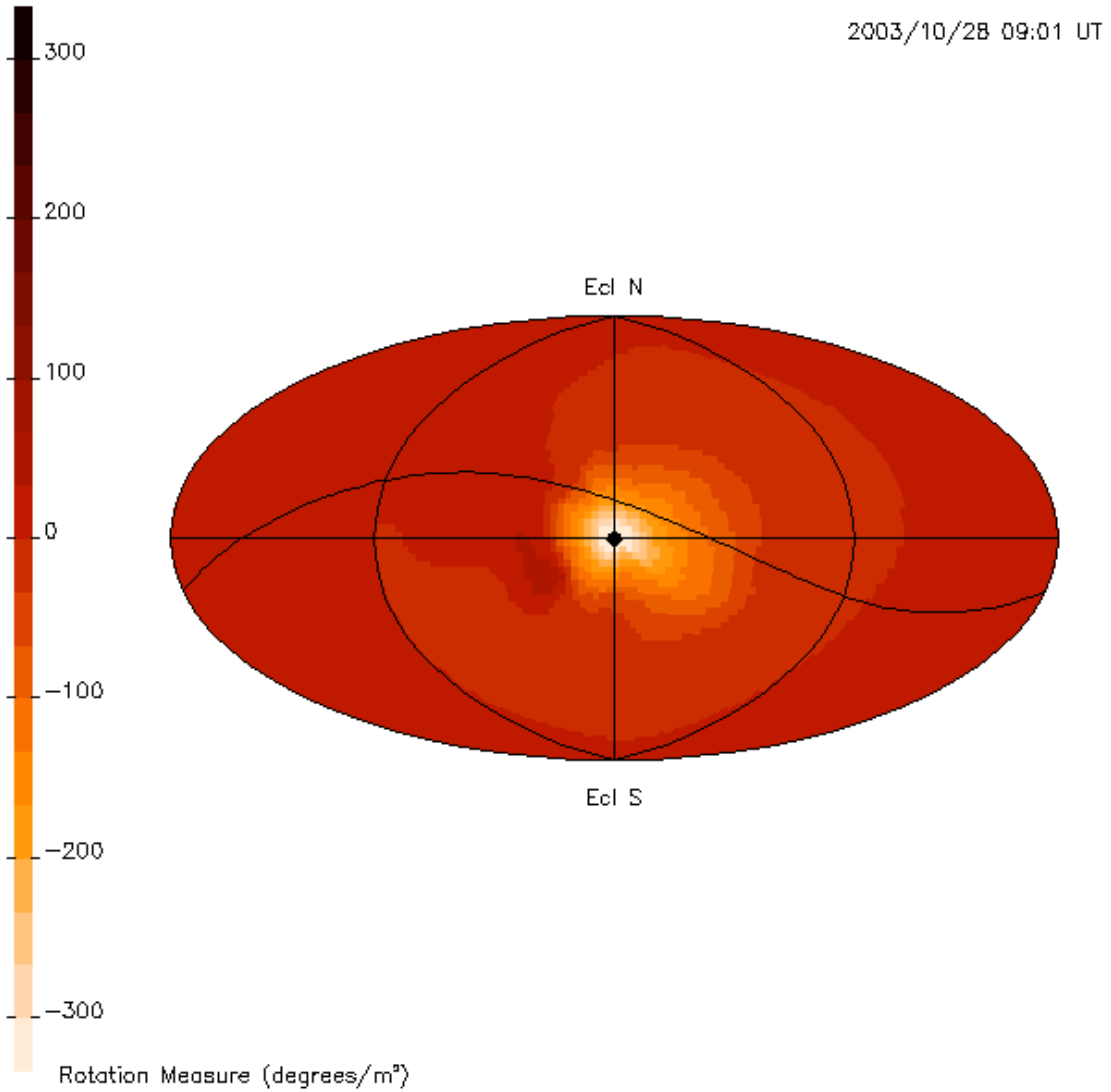
- The boundary between studying the sheath versus the flux rope is where the ratio

$$\frac{\langle N_{rope} B_{||rope} \rangle}{\langle N_{sheath} B_{||shea} \rangle} = 1$$

- Basic flux rope orientations can be achieved at > 1
- Sheath studies likely require << 1

Further Issues

- Note that the CME rotation measure values generally varied between ±3 degrees/m^2
- The background Faraday rotation for the (assumably) static corona was as large as -300 deg/m^2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Rotation Measure (degrees/m²)
Ecl N
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Conclusions

- The UCSD Solar Physics Model measures the Faraday rotation observations that would be obtained from a CME
- Tests on the sheath construction shows that the average FR within the CME must be greater than within the sheath for general measurements to be made of the flux rope orientation
- FR measurements of CMEs is further dependent on the sensitivity of the observing equipment and the density of radio sources in the sky