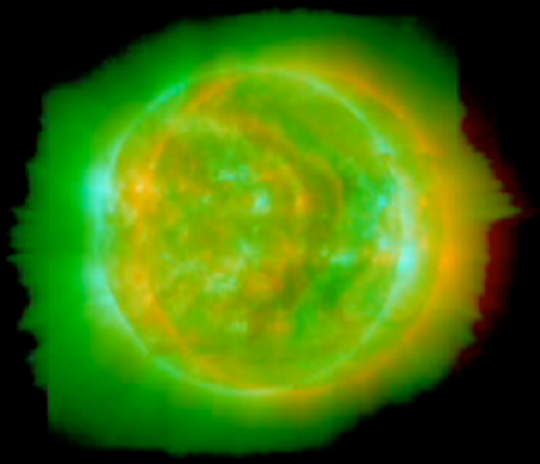
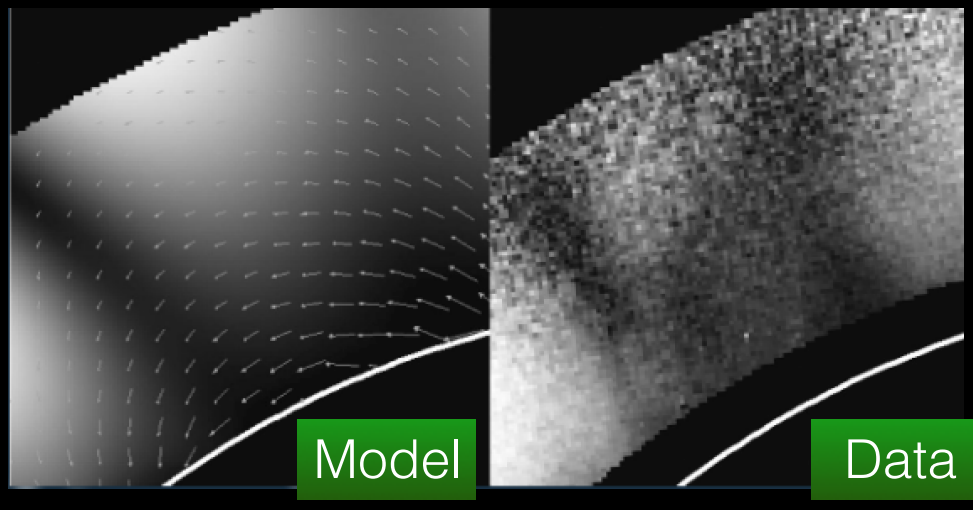
DOC-FM: Data-optimized coronal field model

MHD-model based approach
to forward-fitting the global field

1) Initial guess global magnetic field

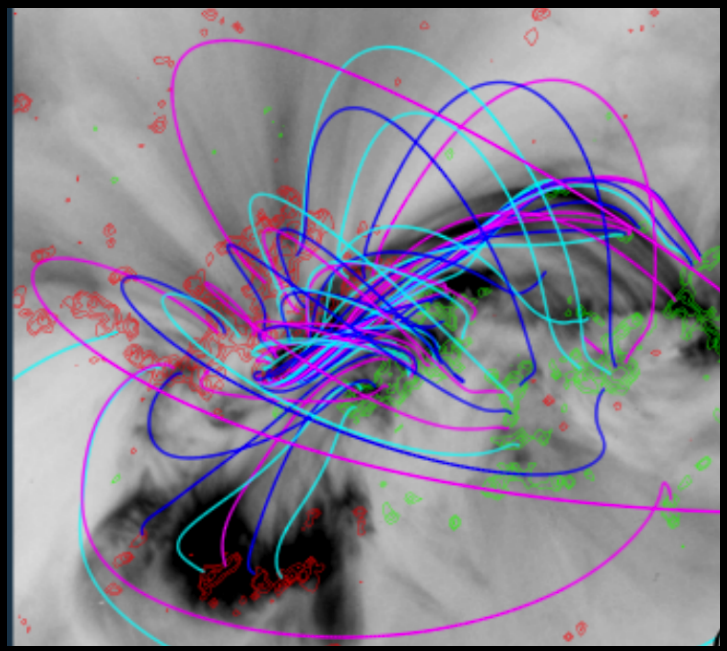


2) Generate synthetic observables



3) Add currents (flux-rope insertion) where synthetic observations don't match data

4) Solve for best fit parameters (location, orientation, strength, height of inserted flux ropes).

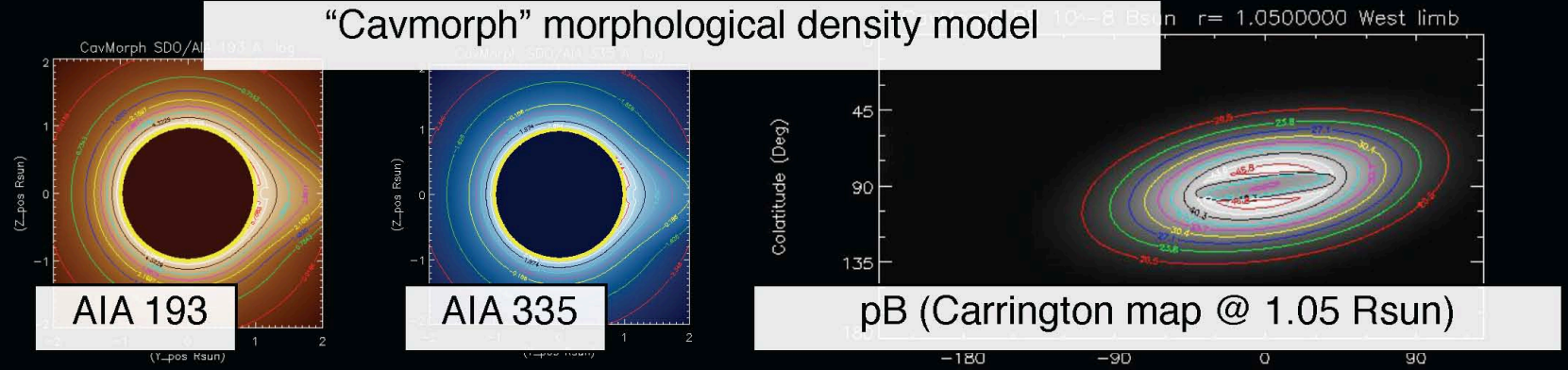


FORWARD modeling

First step in any inverse method: a well-defined forward problem

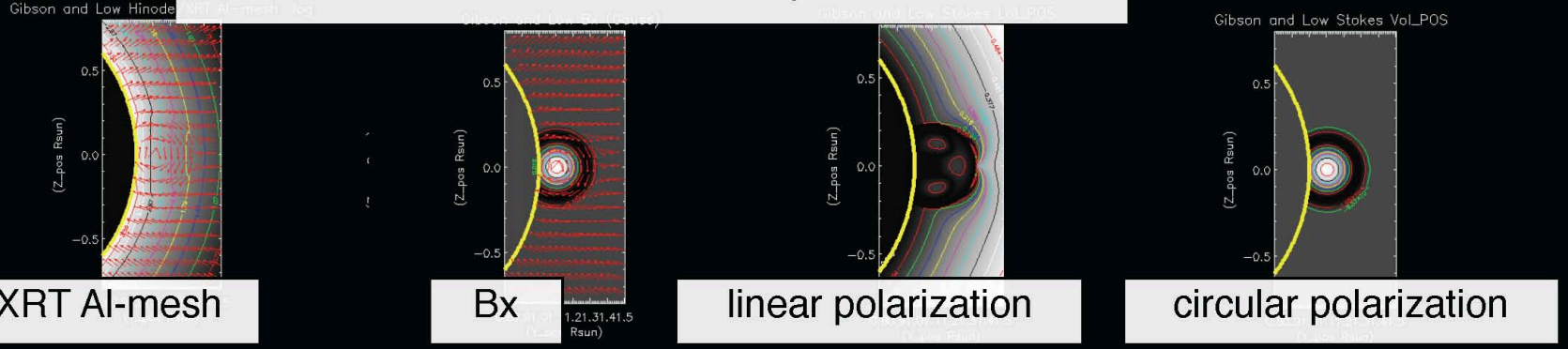
"FORWARD" SolarSoft IDL Codes

"Cavmorph" morphological density model



AIA 193 | AIA 335 | pB (Carrington map @ 1.05 Rsun)

Gibson&Low MHD flux rope model



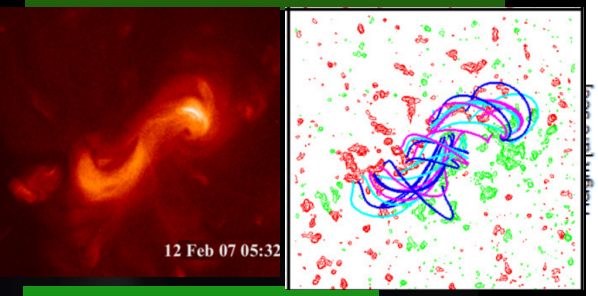
XRT Al-mesh | Bx | linear polarization | circular polarization

Given a distribution of plasma and magnetic fields along the line of sight, synthesizes observables (including polarimetry) from radio to SXR wavelengths

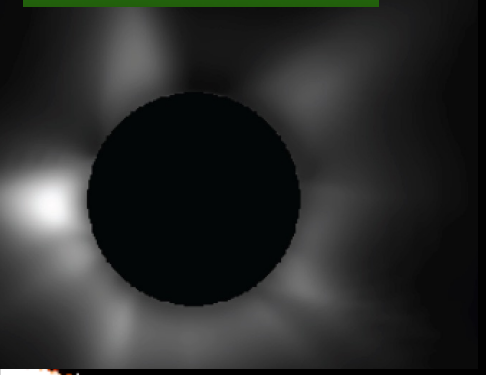
Coming soon: UV spectropolarimetry (Fineschi), Faraday rotation (White)

Observations

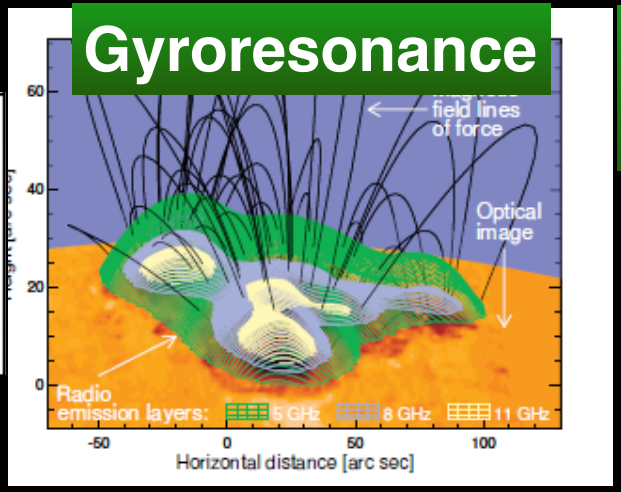
EUV/SXR loops



White light

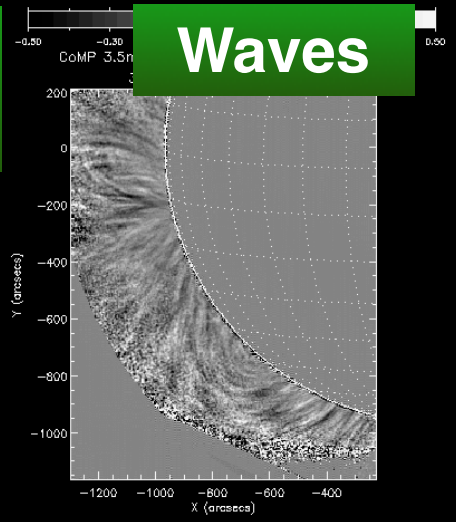


Gyroresonance



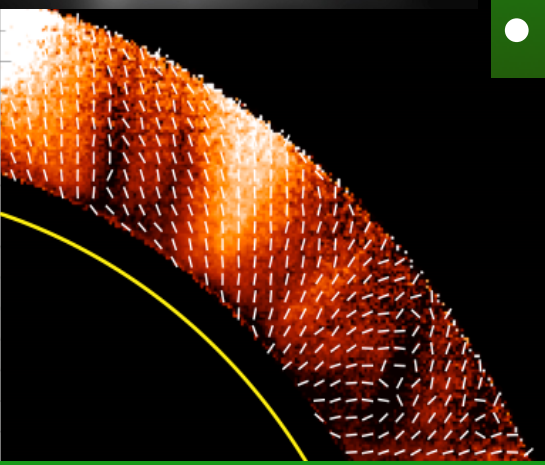
Vlos structure

Waves

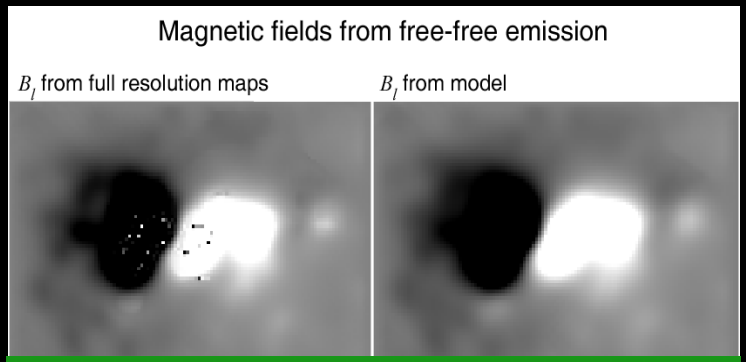


Multi-wavelength data have complementarities:

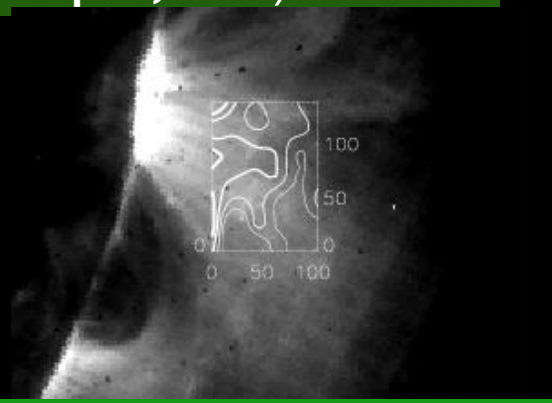
- disk vs. limb, strong field vs. weak field
- different sensitivities to plasma along line of sight
- different parts of vector field ($\mathbf{B_{los}}$, $\mathbf{B_{pos}}$, **IBI**)



Linear polarization (Fe XIII)



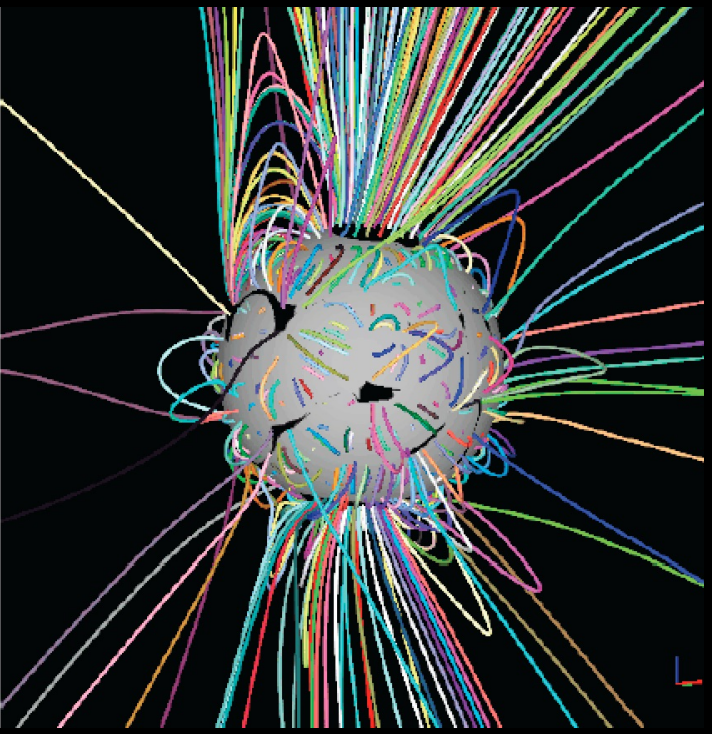
Thermal Bremstrahllung



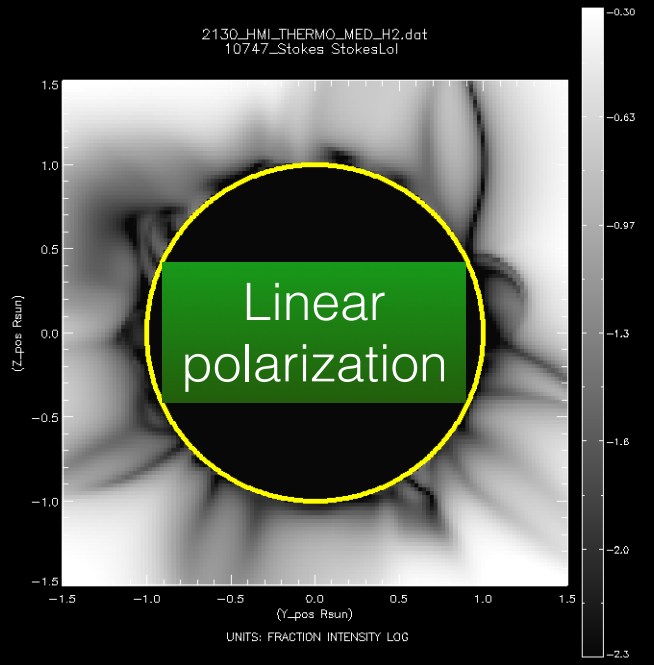
Circular polarization (Fe XIII)

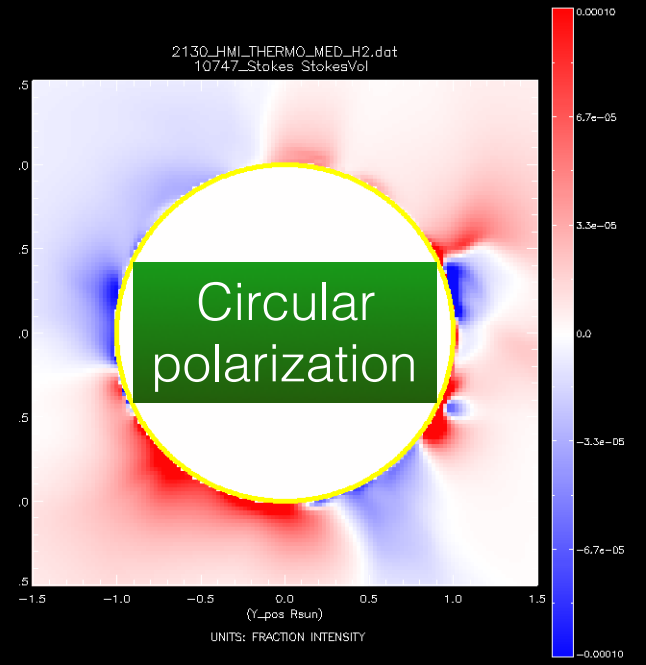
Synthetic test beds

Include both currently existing and potential future observations (that have well-defined forward calculation)



Fe XIII





Synthetic test beds

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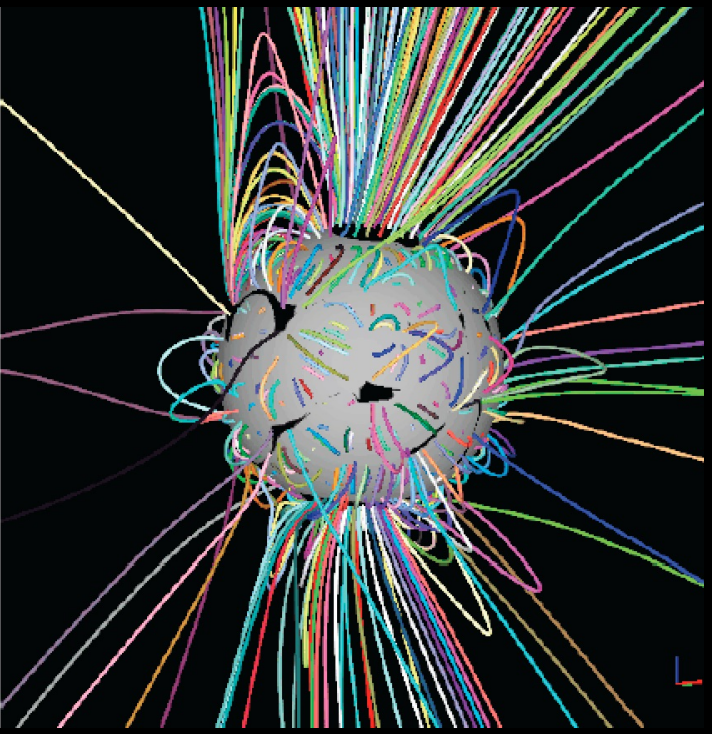
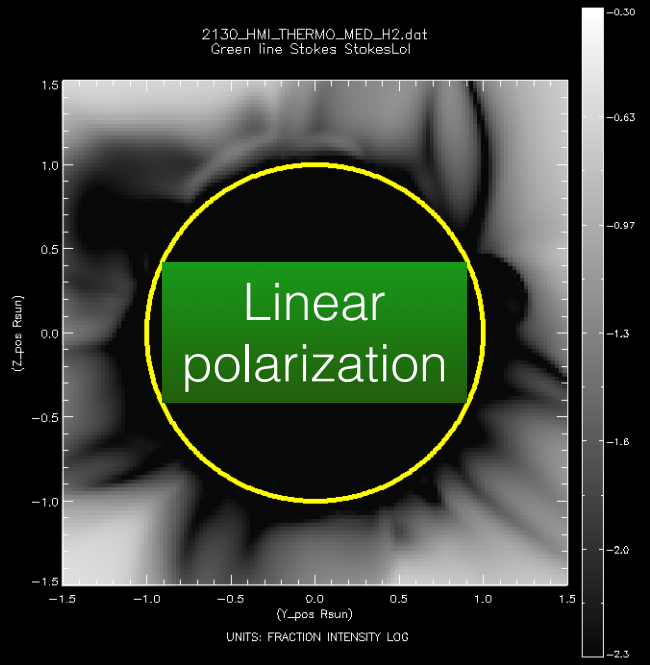
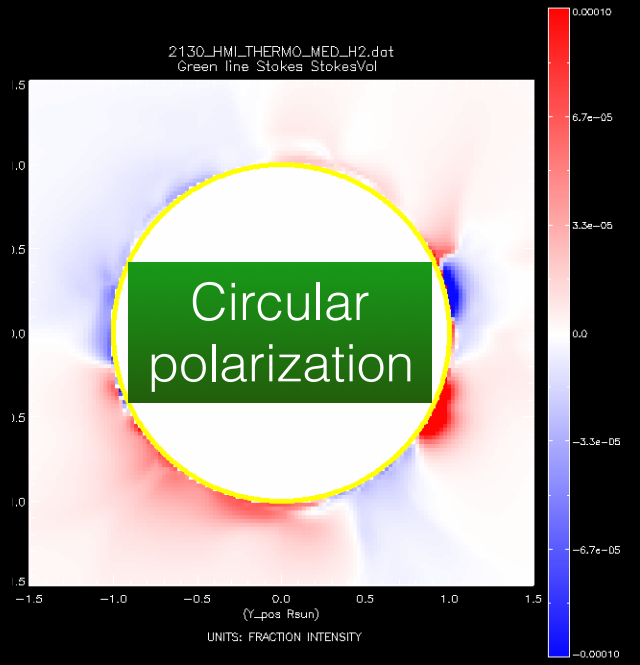


Fe XIV





Synthetic test beds

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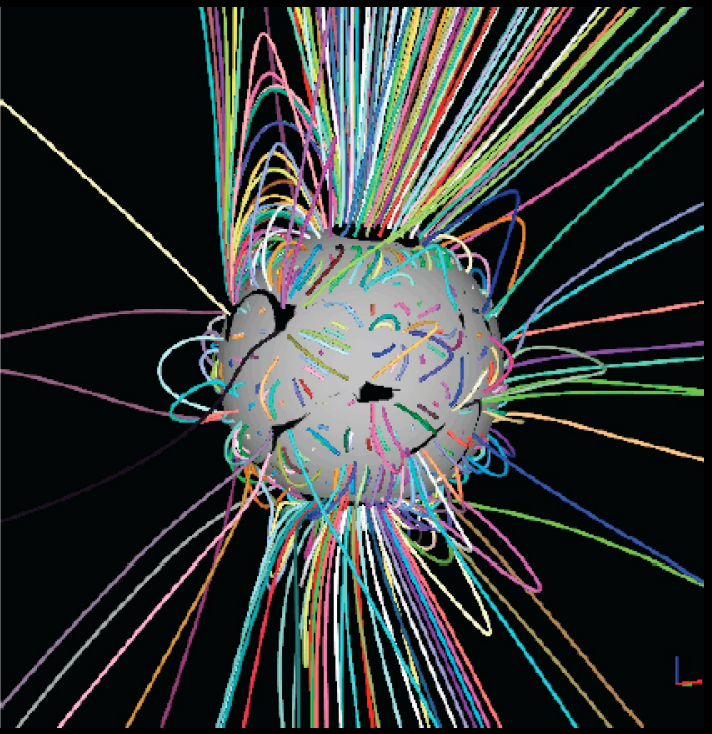
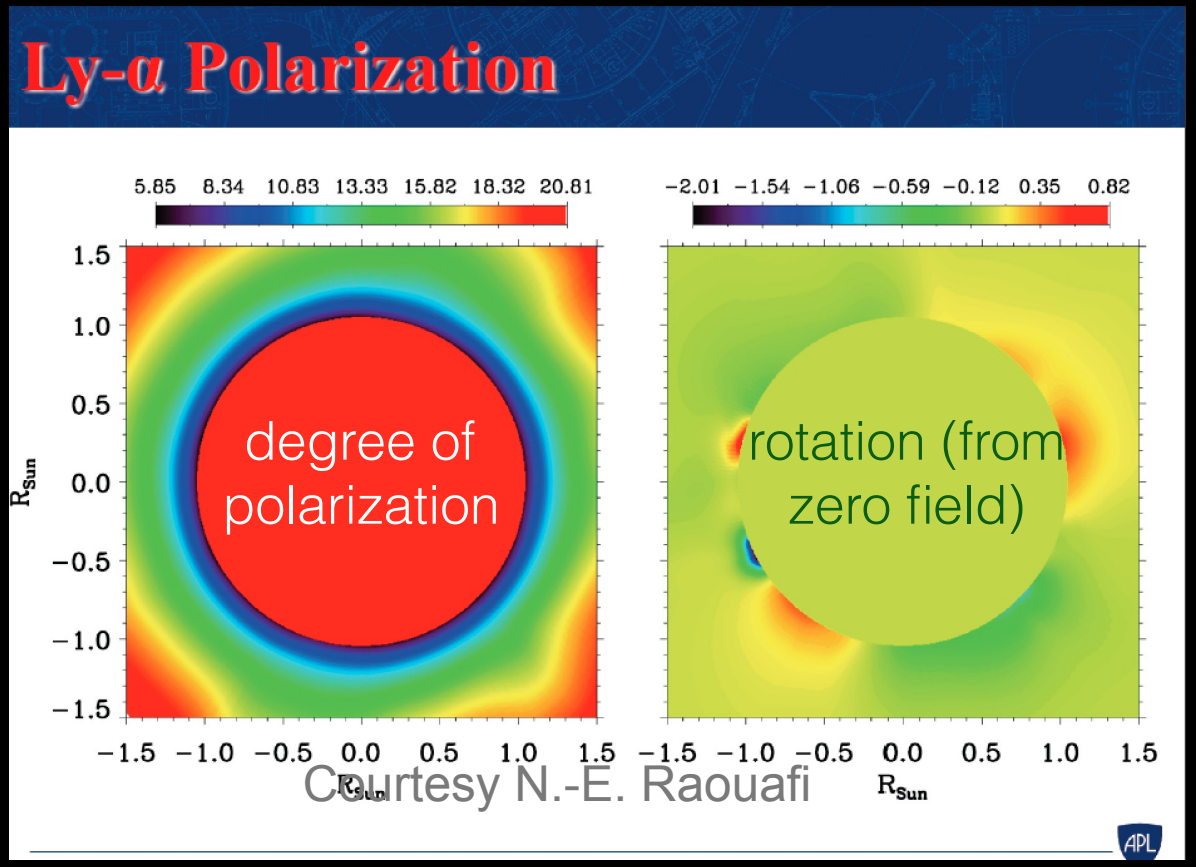
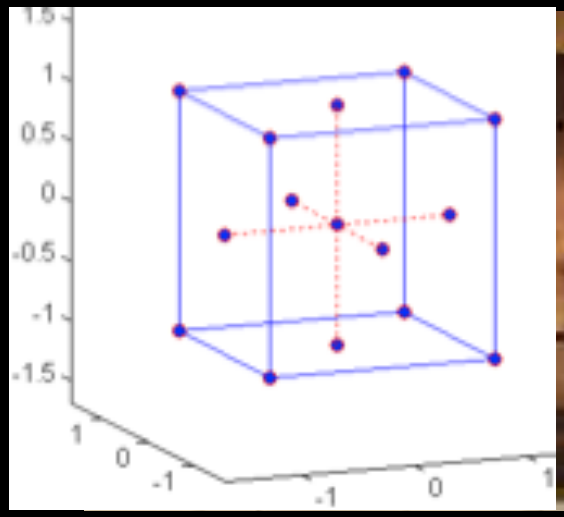
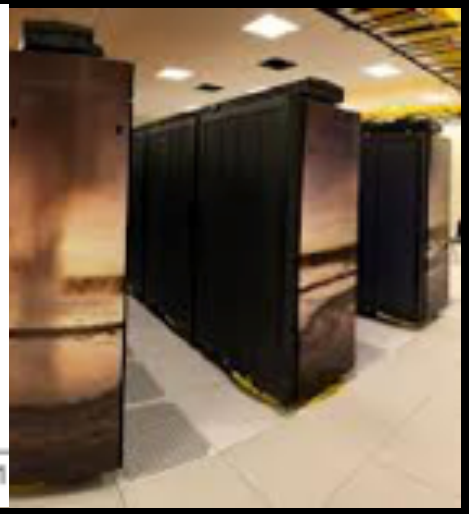




Combining multi-wavelength observations constrains the global solution more tightly and reduces the need for using coronal rotation to compensate for line-of-sight ambiguities.

Optimization methods (HAO-CISL collaboration)





Design efficient methods for searching parameter space

Take advantage of “embarrassingly parallel” aspects of the problem

Effectively utilize different sensitivities to different observations.

Solve for statistical ensemble of maximum-likelihood solutions with associated uncertainties

Applying these methods to synthetic test-beds allows up to seek the optimum set of observations to constrain the problem