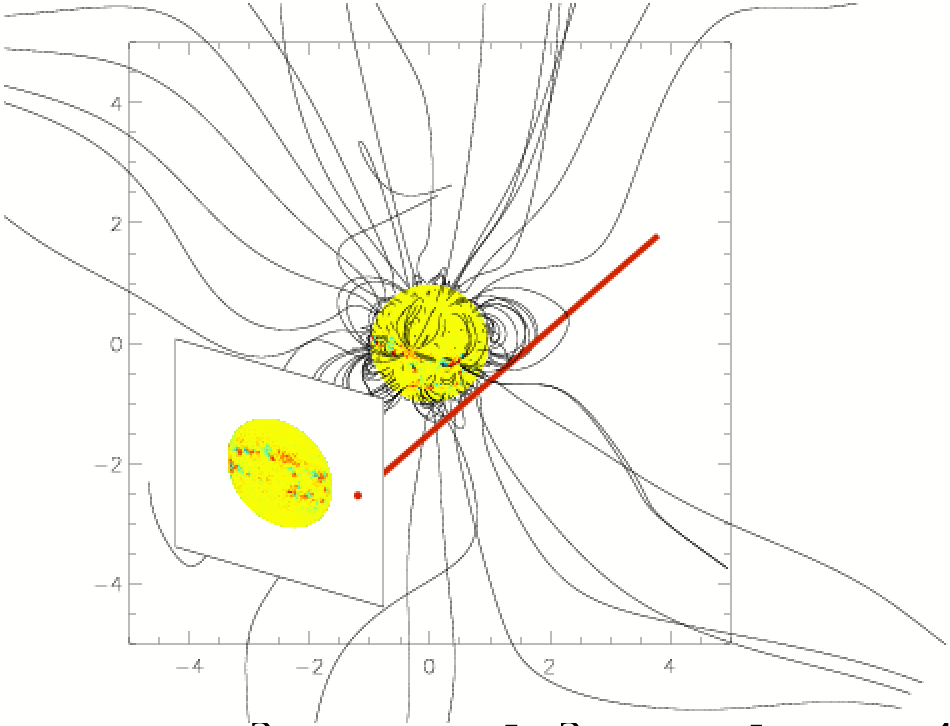
On the reconstruction of the electron density structures in the corona from 1.5 to 4 Rsun



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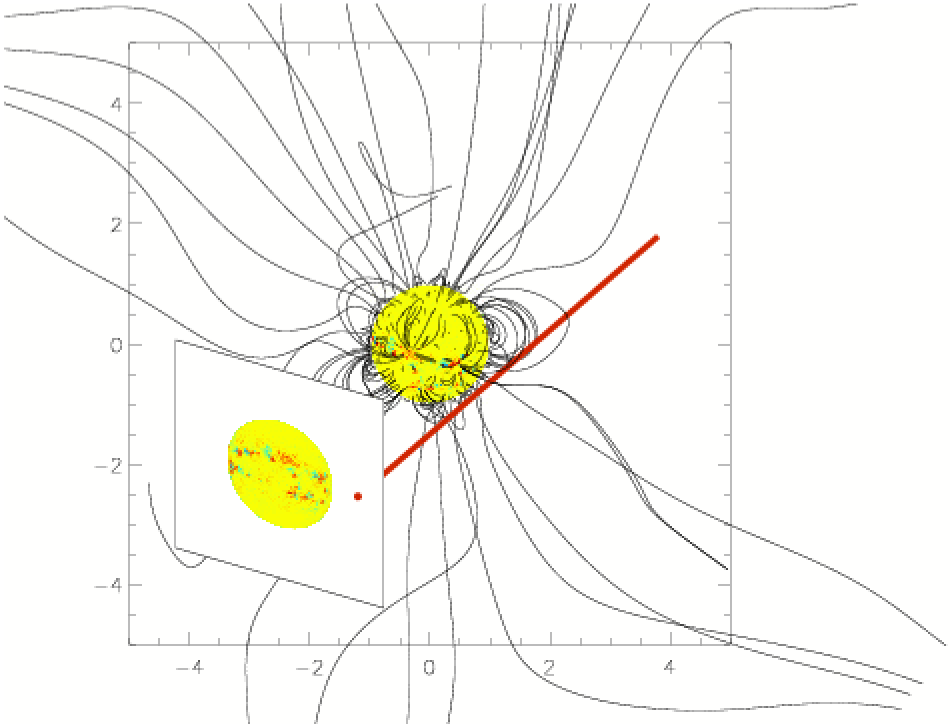
Tomography for the Solar Corona

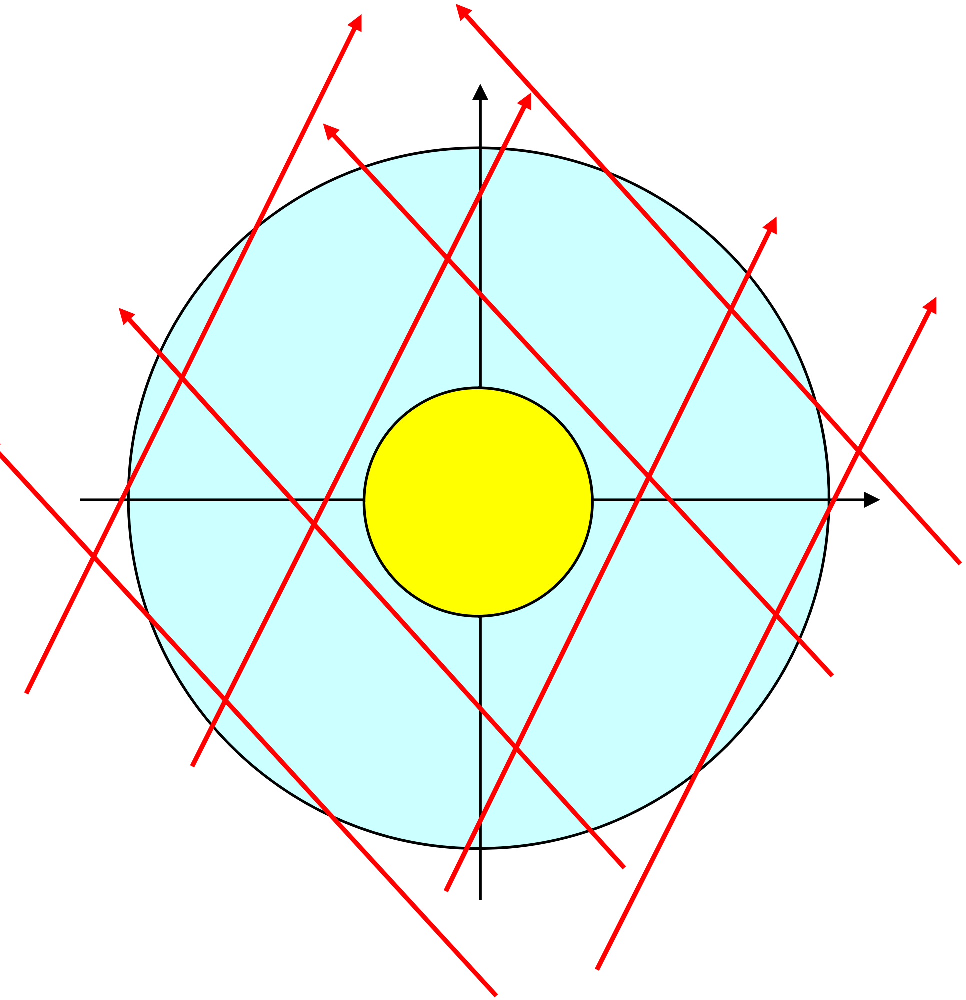
- Problem is badly conditioned, e.g. number of unknown variables exceeds the number of equations
- Noise in the data

⇒ Regularization should be applied

- Stationarity of the corona during the observations must be assumed. Coronal observations are restricted to only one-three view direction in ecliptic plane.



Scalar Field Tomography: Regularization



- Problem is badly conditioned, e.g. number of unknown variables exceeds the number of equations
- Random noise in the data

In result, there is possible no unique reconstruction. Problem is ill-conditioned.

$$F = \sum_{i=1}^{\text{Number of Rays}} \left(I_i^{\text{sim}} - I_i^{\text{obs}}\right)^2 + \mu \cdot F_{\text{reg}} =$$

$$= \left|\mathbf{A} \cdot \mathbf{X} - \mathbf{Y}\right|^2 + \mu \cdot \left|\mathbf{L} \cdot \mathbf{X}\right|^2$$

Tomographic Reconstruction for the Solar Corona

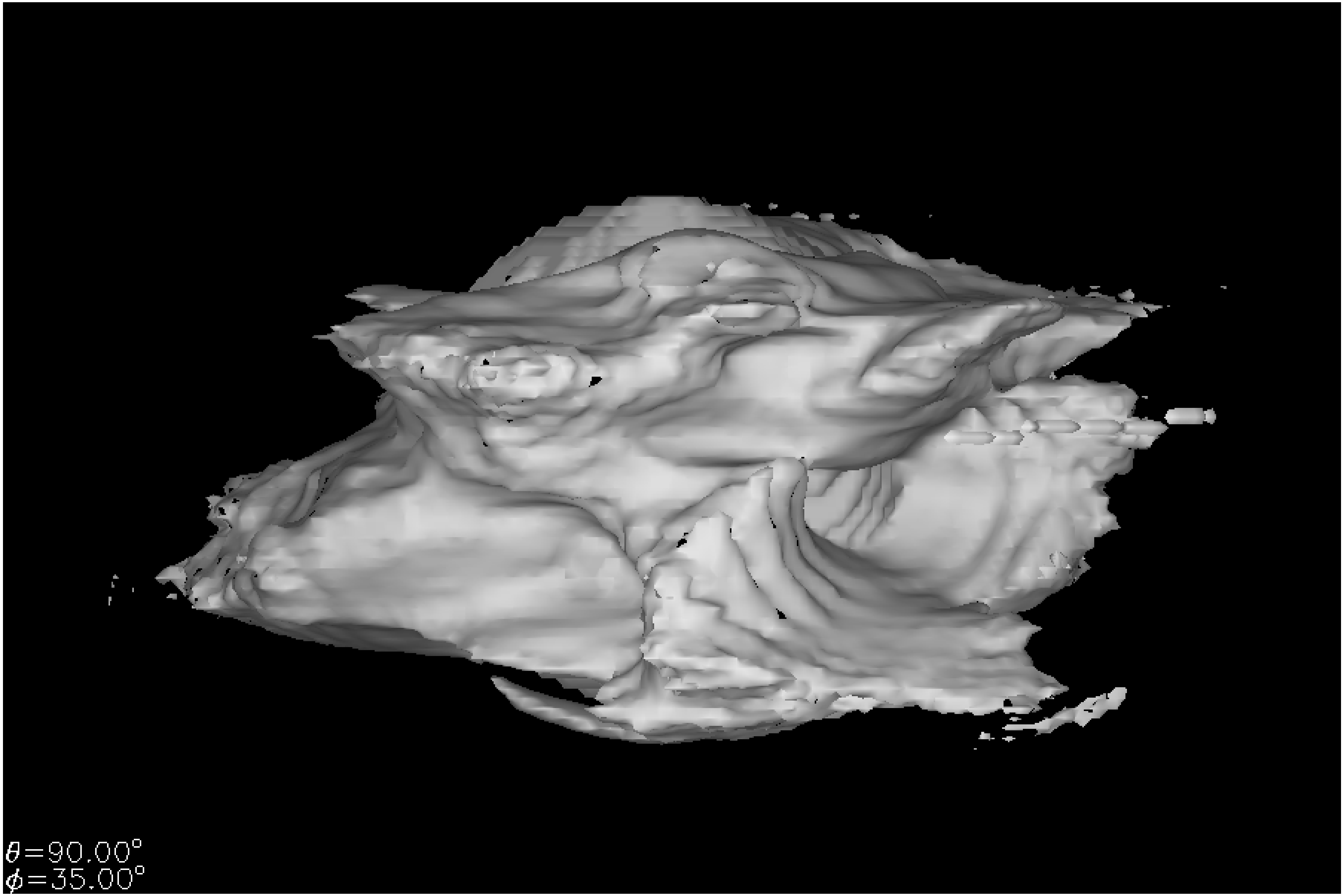
Input:

- COR1B observations: pB images, 341x341 pixels
- Two weeks, ~ twice per day: 3 – 16 July 2007
- Monthly minimum background subtracted
- Starting point for the iterations is flat field (constant density)

Output:

- 3D Electron Density Distribution: 128x128x128 pixels

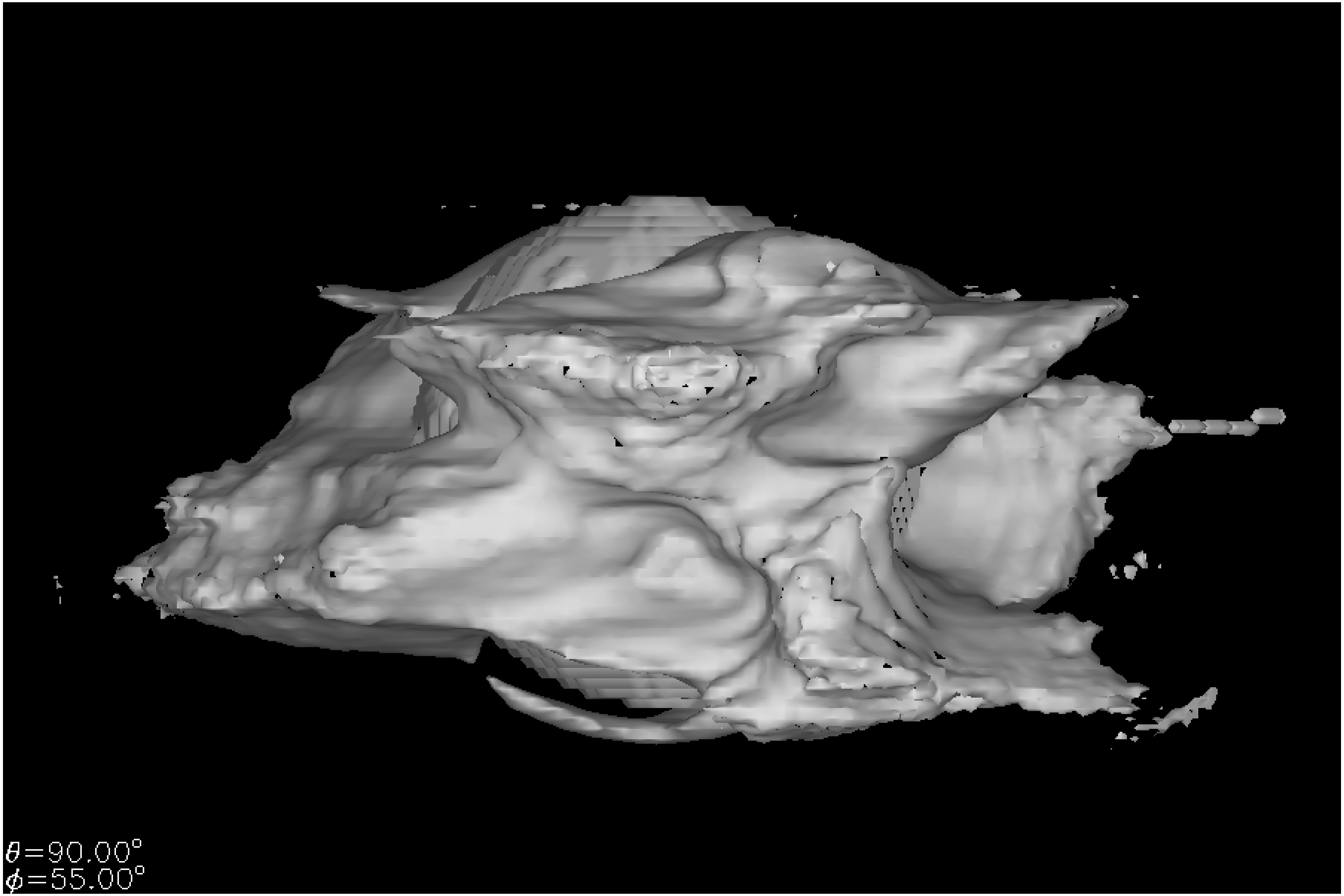
Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

Inner spherical boundary is at 1.5 R_{sun}

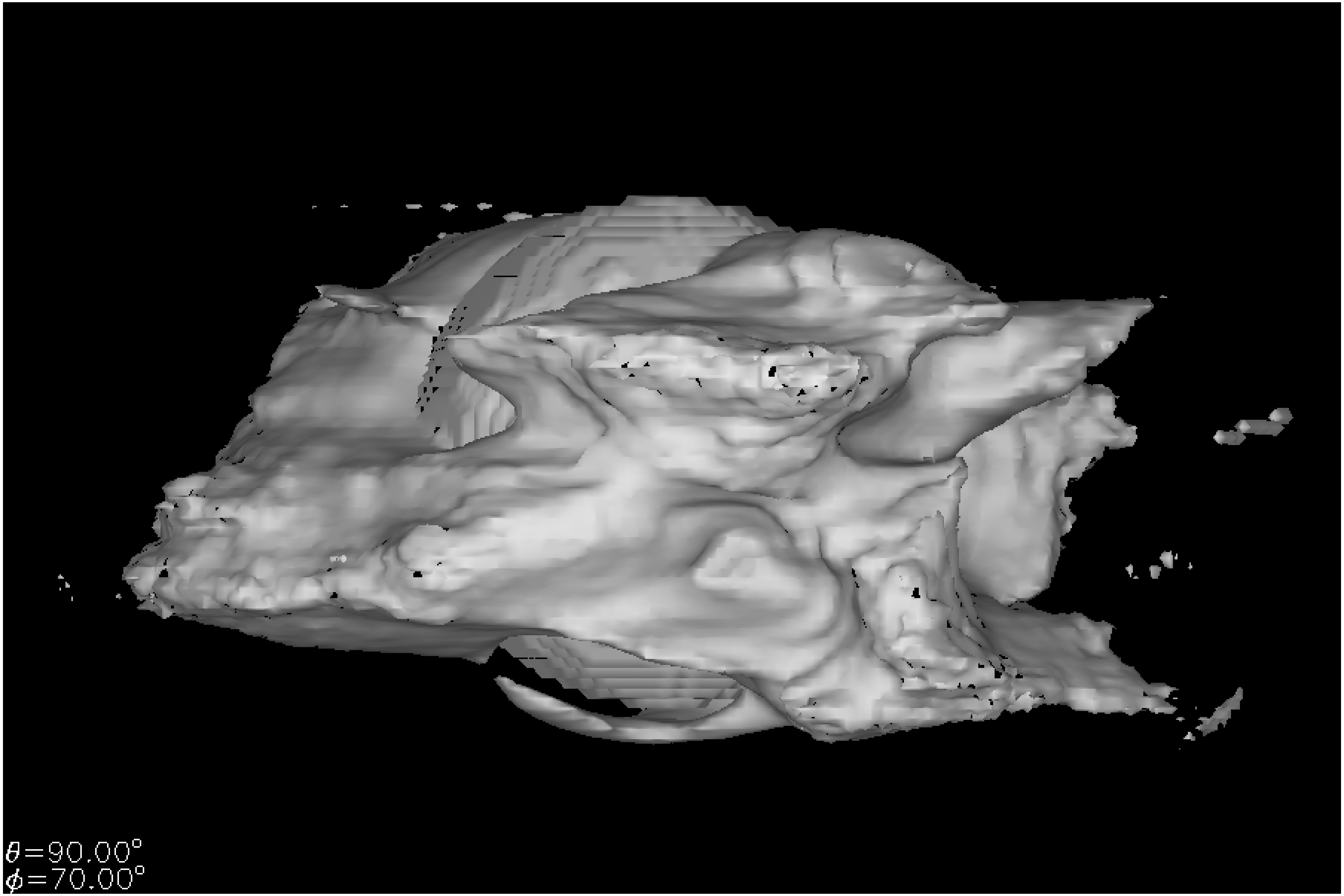
Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

Inner spherical boundary is at 1.5 Rsun

Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

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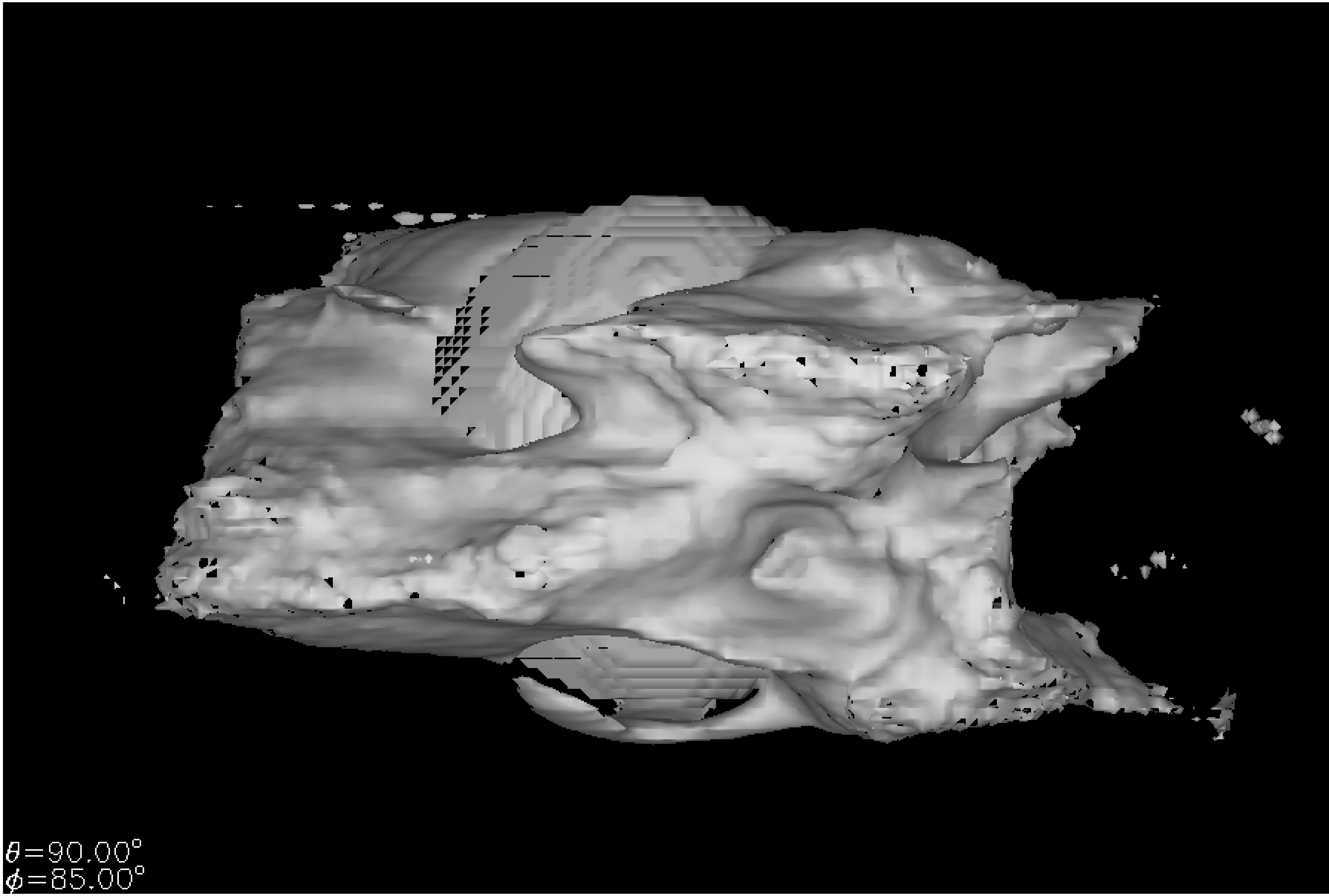
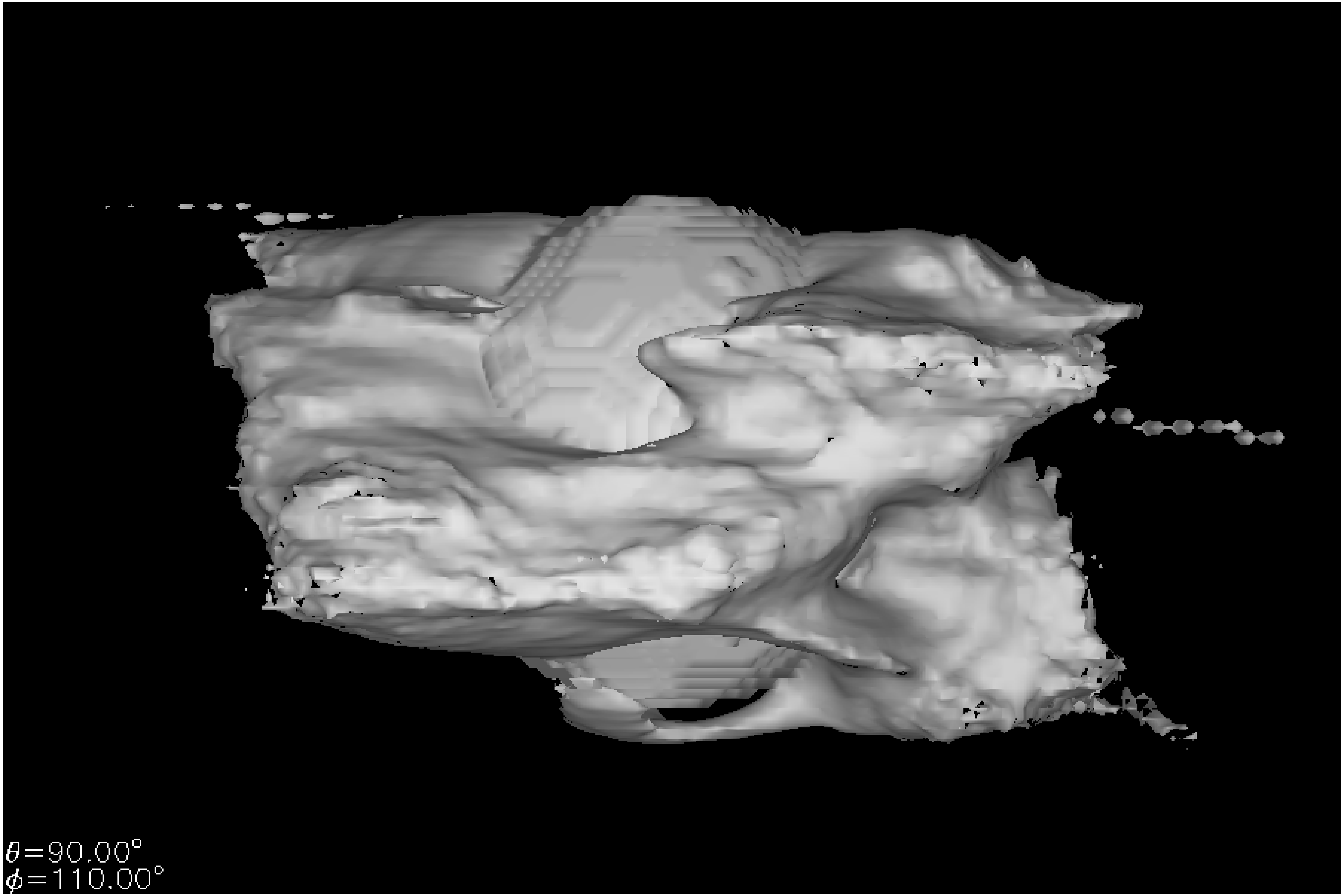
Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

Inner spherical boundary is at 1.5 Rsun

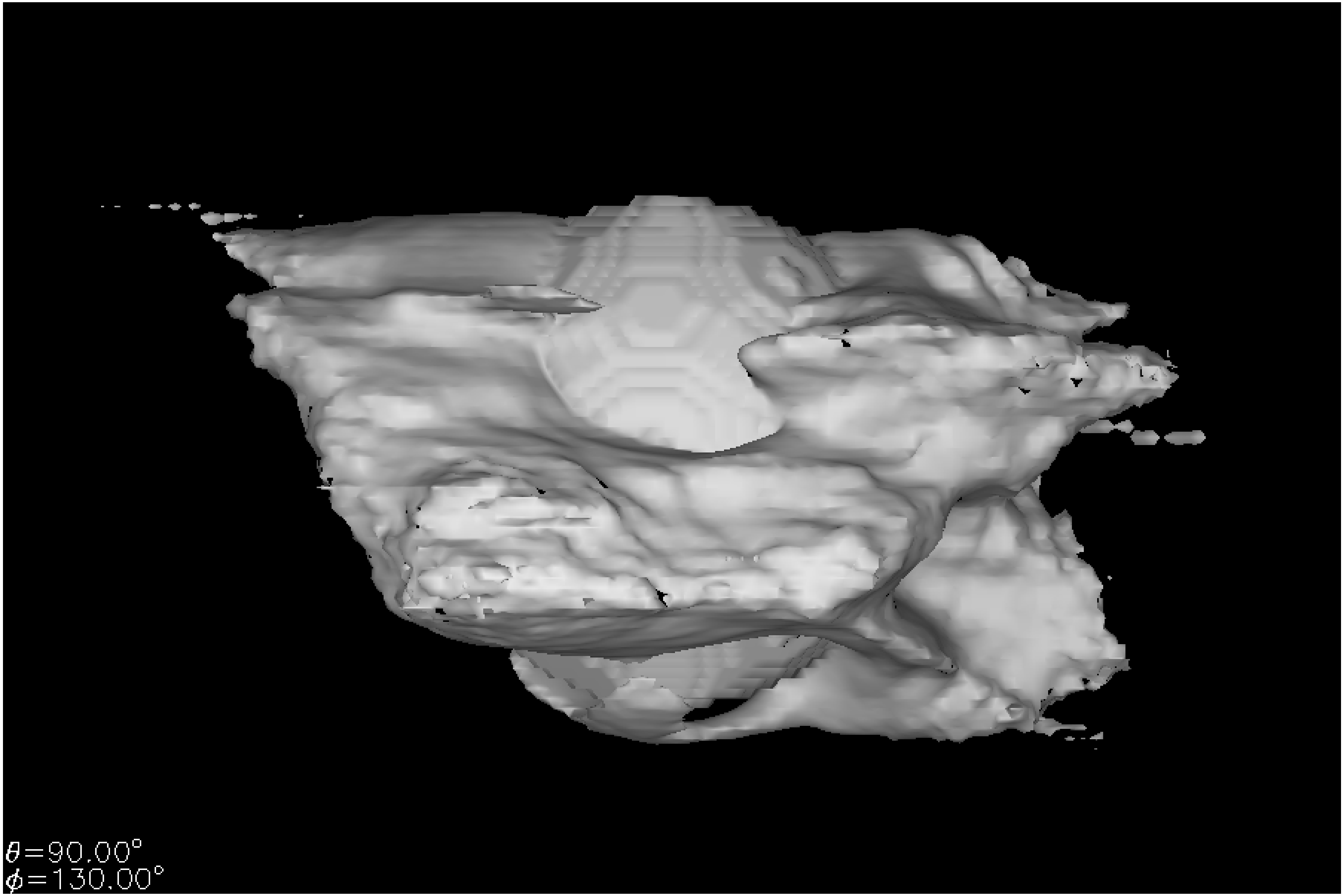
Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

Inner spherical boundary is at 1.5 Rsun

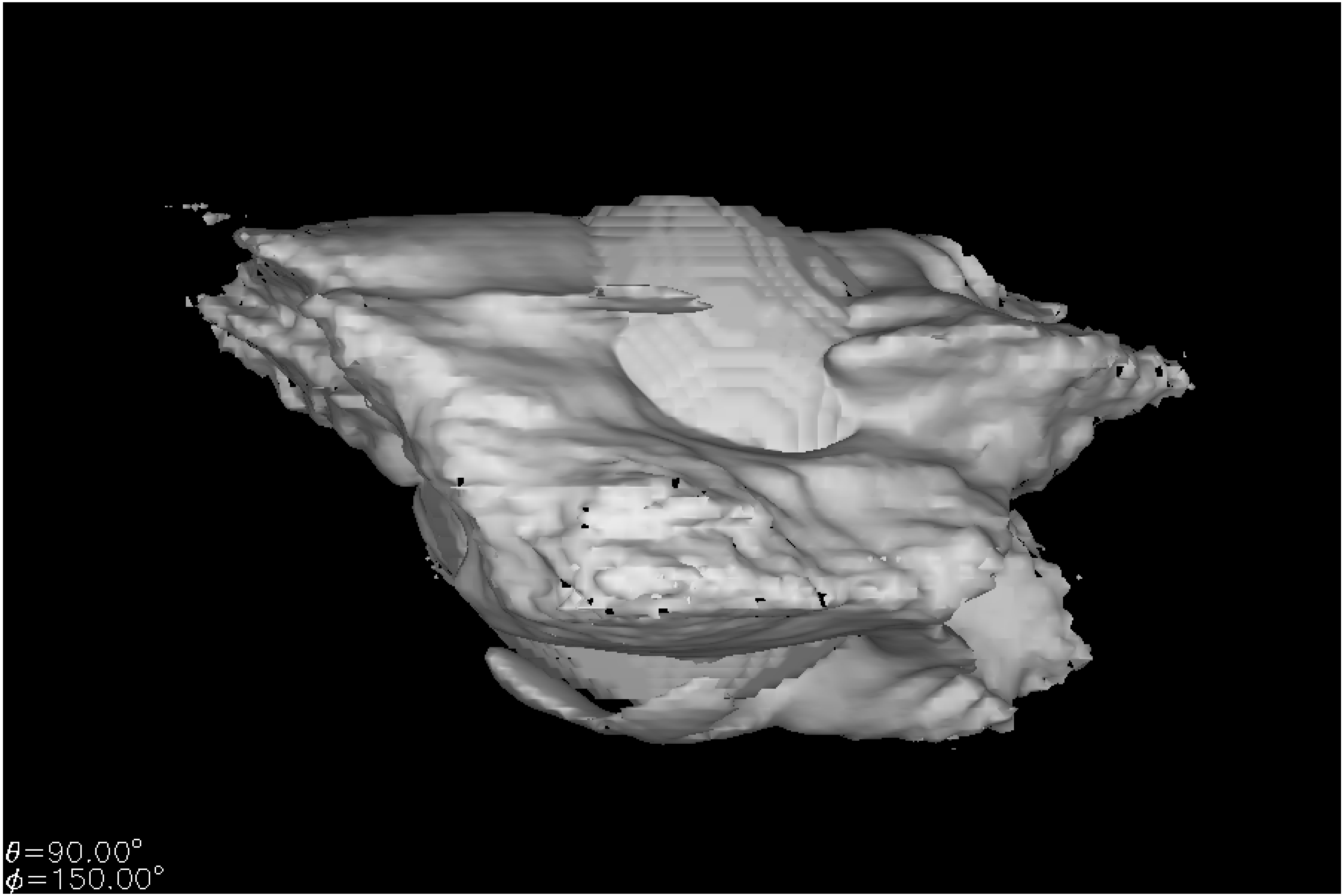
Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3}

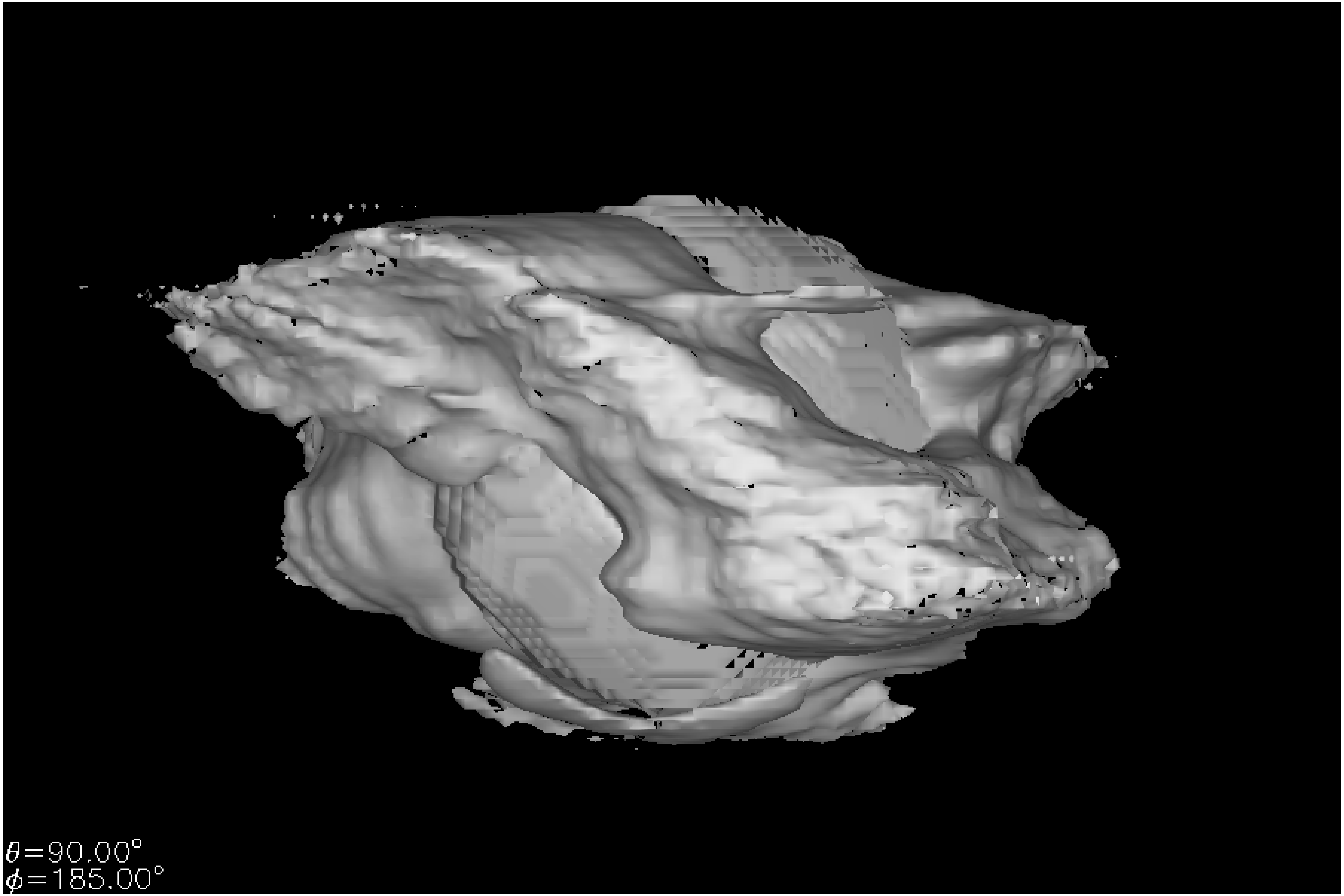
Inner spherical boundary is at 1.5 Rsun

Reconstruction of the Electron Density



Isosurface: N_e=3.6*10^{10} m^{-3} Inner spherical boundary is at 1.5 Rsun

Reconstruction of the Electron Density

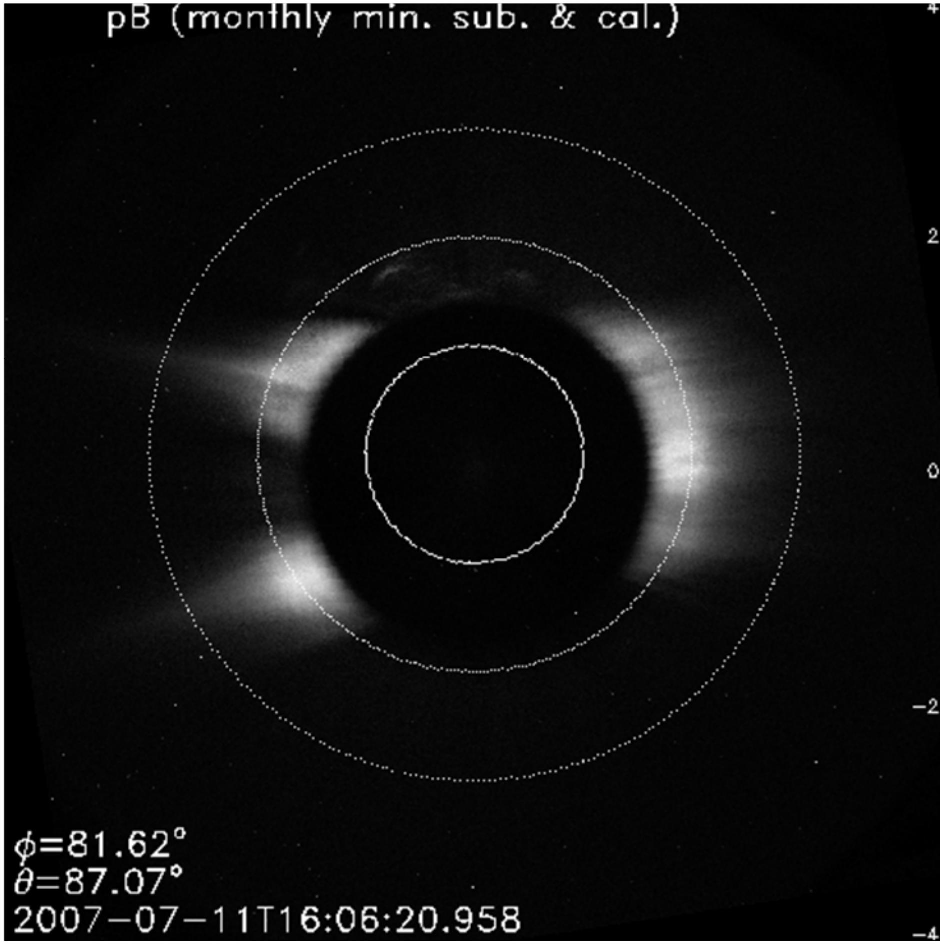


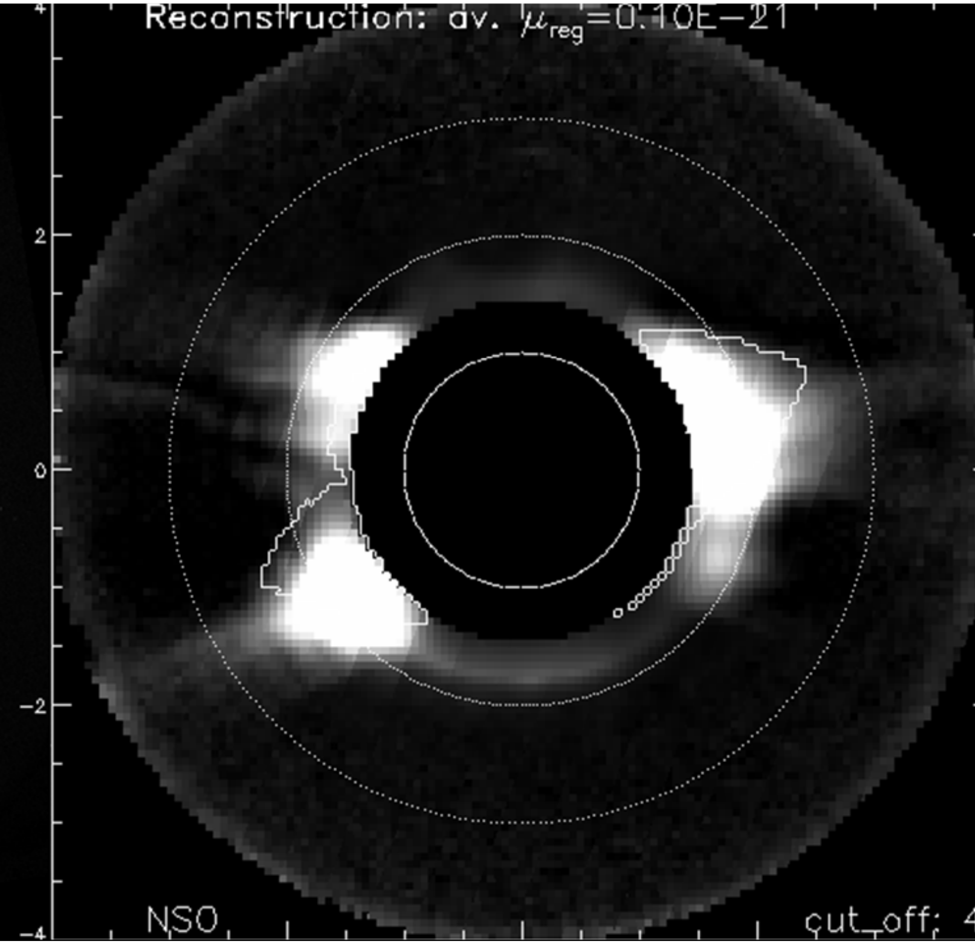
Isosurface: N_e=3.6*10^{10} m^{-3}

Inner spherical boundary is at 1.5 *R*sun

Observation: pB image.

Reconstruction: Vertical cross-section.

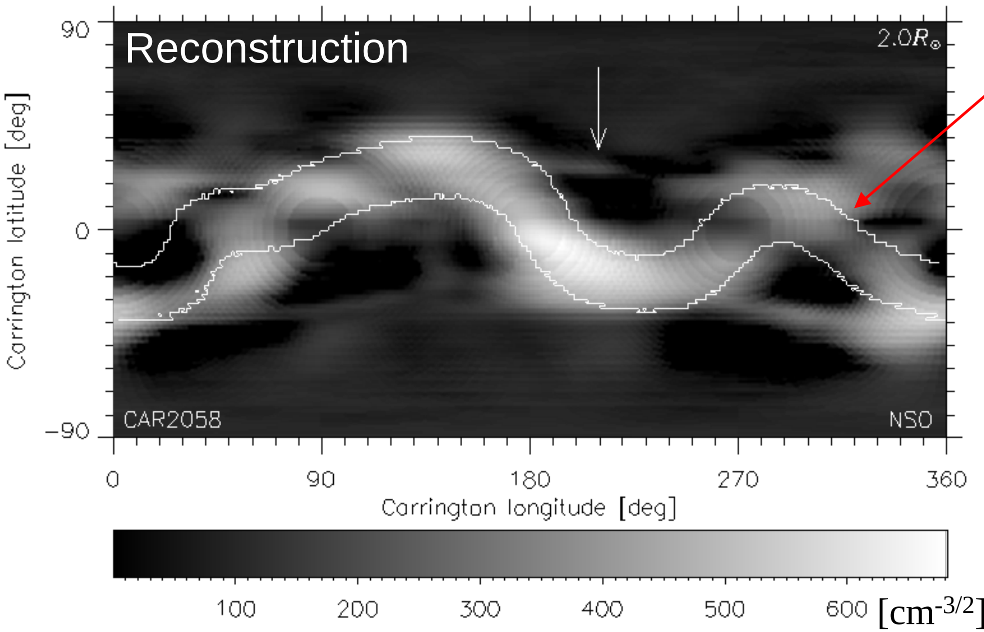


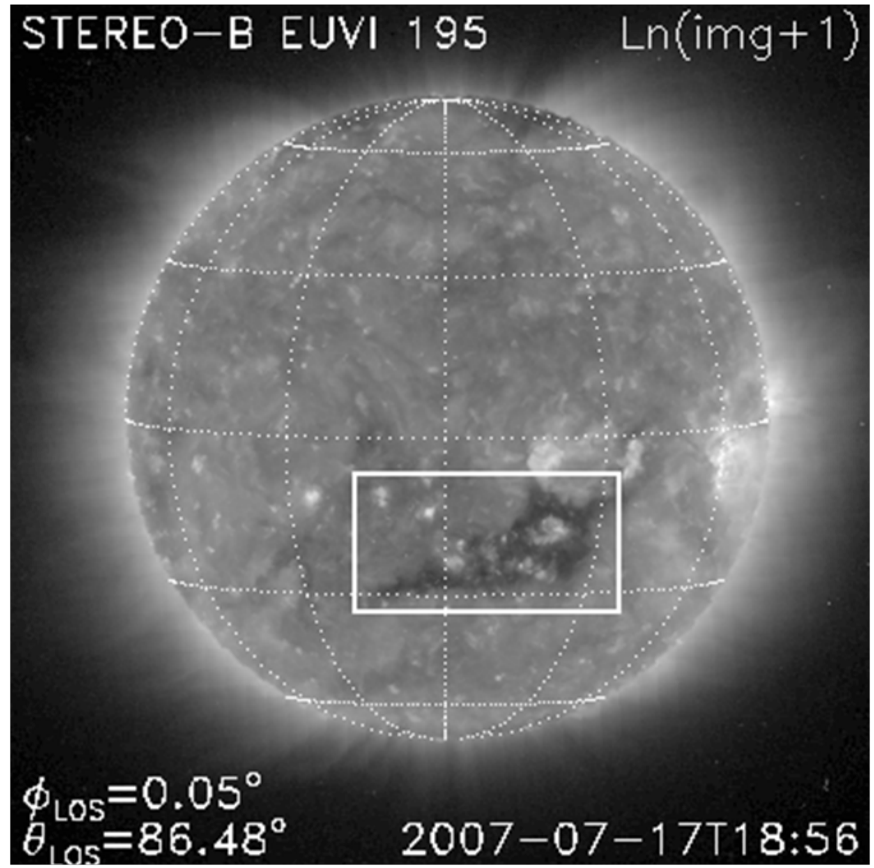


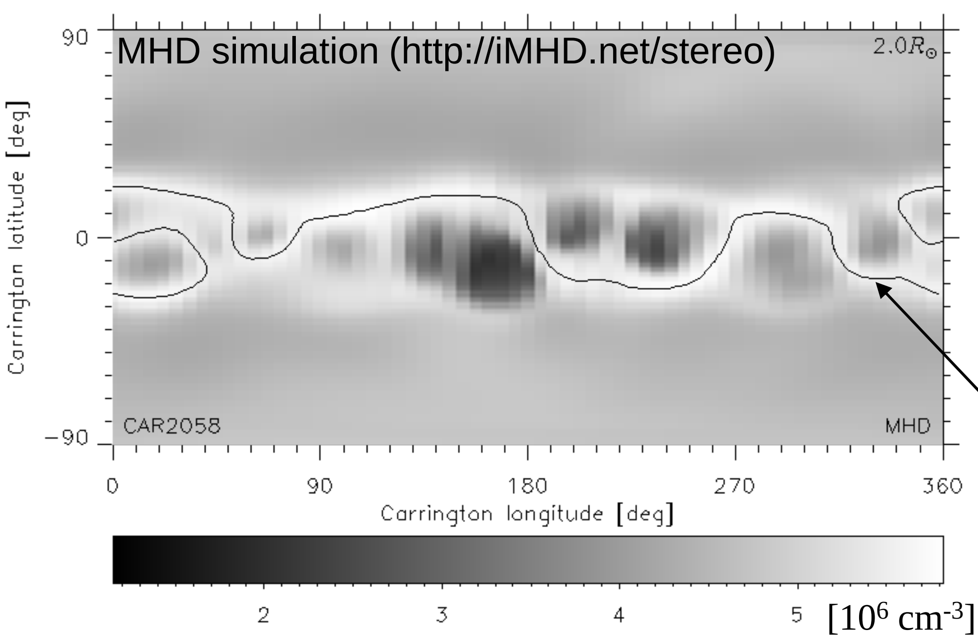
White contour lines are boundary between open and closed magnetic field lines in potential field reconstruction with SS=$2.5R_{sun}$

Spherical cross-section at 2 R_{sun}

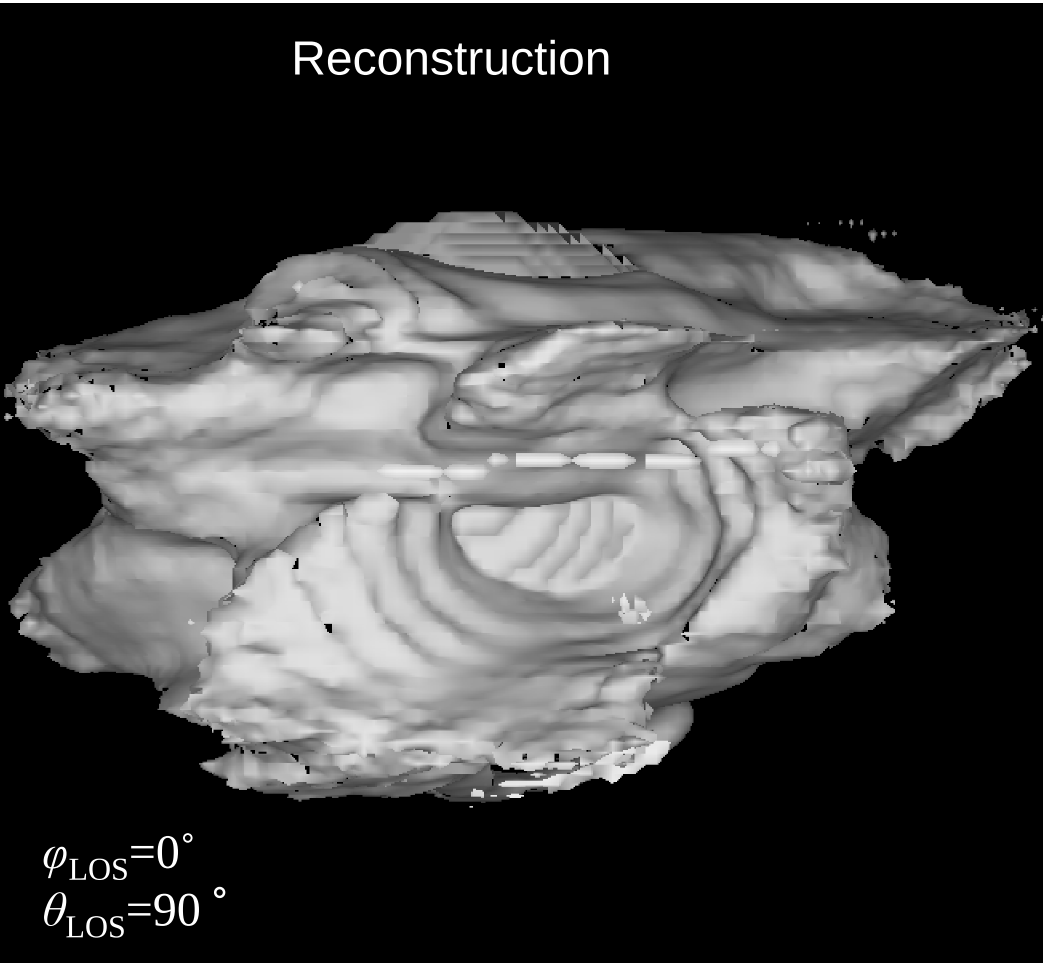
White contour lines are boundary between open and closed magnetic field lines in potential field reconstruction with SS=2.5Rsun

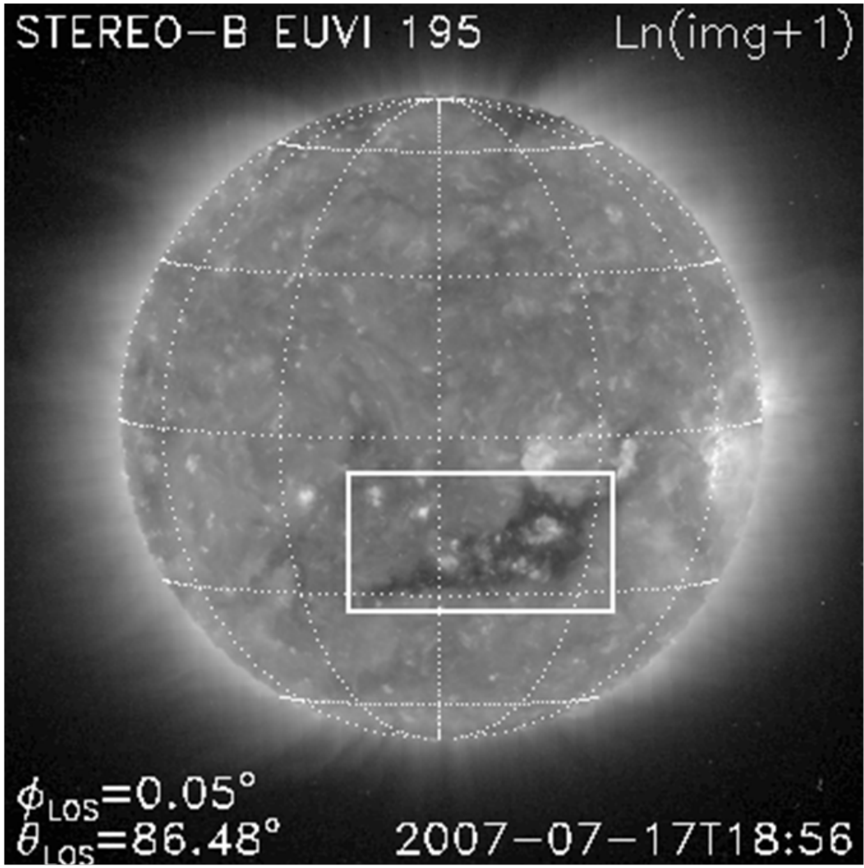




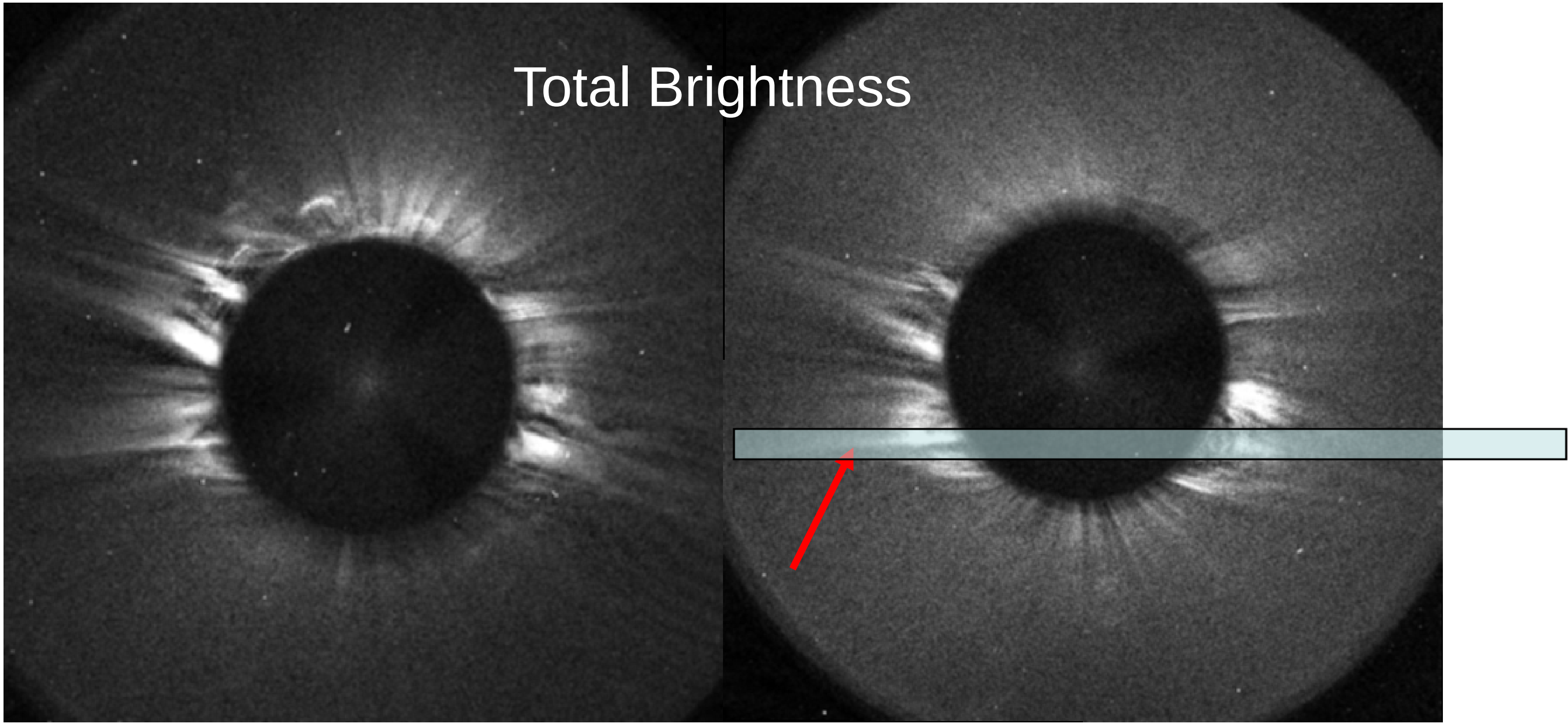


Black contour line is the magnetic neutral line


Reconstruction
φLOS=0°
θLOS=90 °

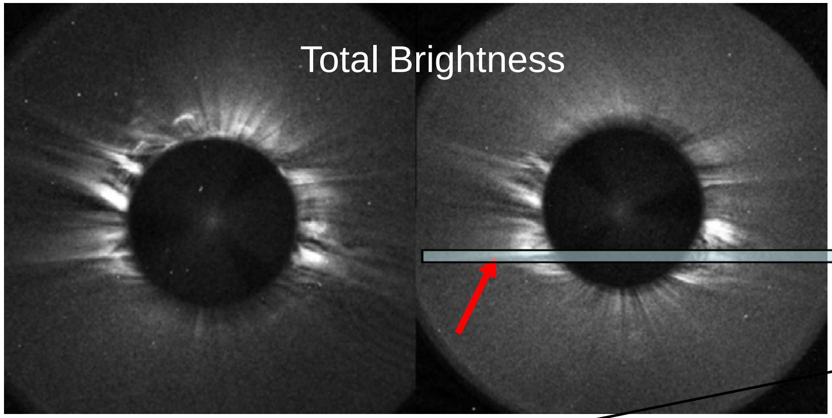

STEREO-B EUVI 195
Ln(img+1)
ϕLOS=0.05°
θLOS=86.48°
2007-07-17T18:56

3D Electron Density: Streamer



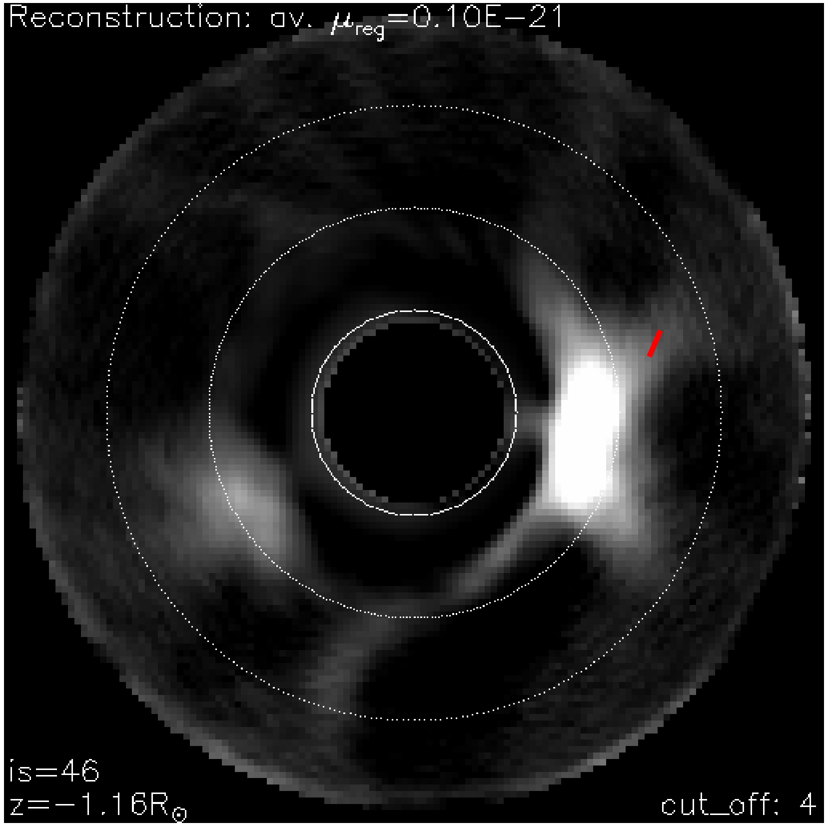
3D Position of the streamer has been found by triangulation method

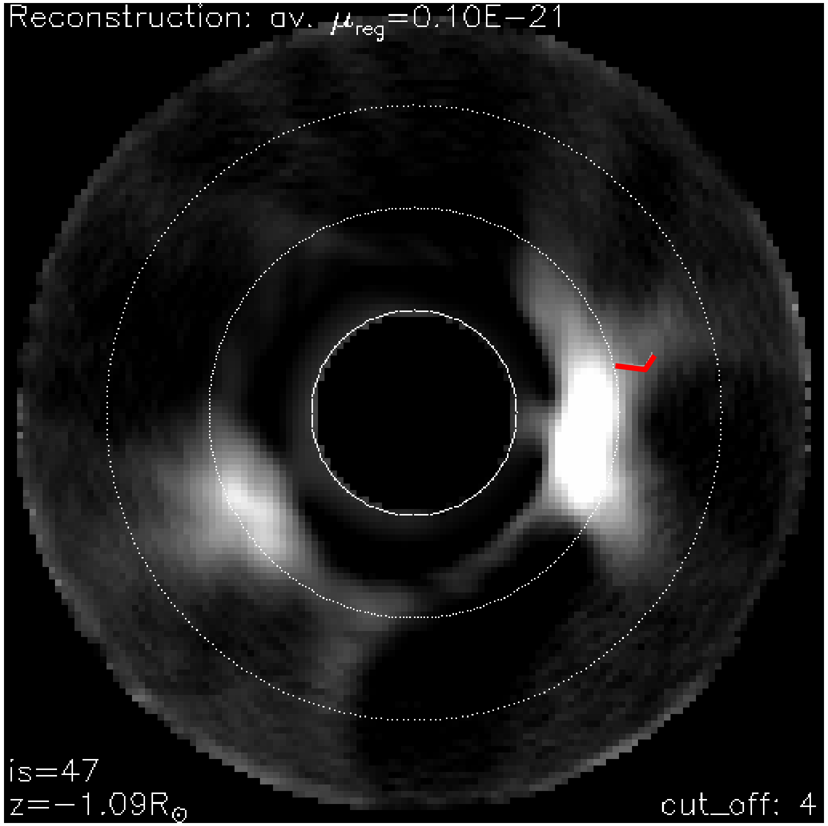
3D Electron Density: Streamer



Cross-section by plane perpendicular to z-axis (carrington system)

Red lines on pictures below are the streamer's positions found by triangulation method





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