

Statistical Comparison of Various Dayside Magnetopause Reconnection X-line Prediction Models

Ramiz A. Qudsi,^{1,*} Brian Walsh¹, J. Broll², Stein Haaland³

¹Boston University, ²Los Alamos National Lab, ³Max-Planck Institute

*(qudsira@bu.edu)

(<https://qudsiramiz.github.io>)



Location of x-line: Models

Magnetic shear [Trattner et al., 2007]:

$$\cos(\theta) = (\mathbf{B}_{\text{sh}} \cdot \mathbf{B}_{\text{msp}}) / (|\mathbf{B}_{\text{sh}}| |\mathbf{B}_{\text{msp}}|)$$

sh: magnetosheath

Reconnection field energy [Hesse et al., 2013]:

msp: magnetosphere

$$E \propto (B_{\text{sh}}^2 \times B_{\text{msp}}^2)$$

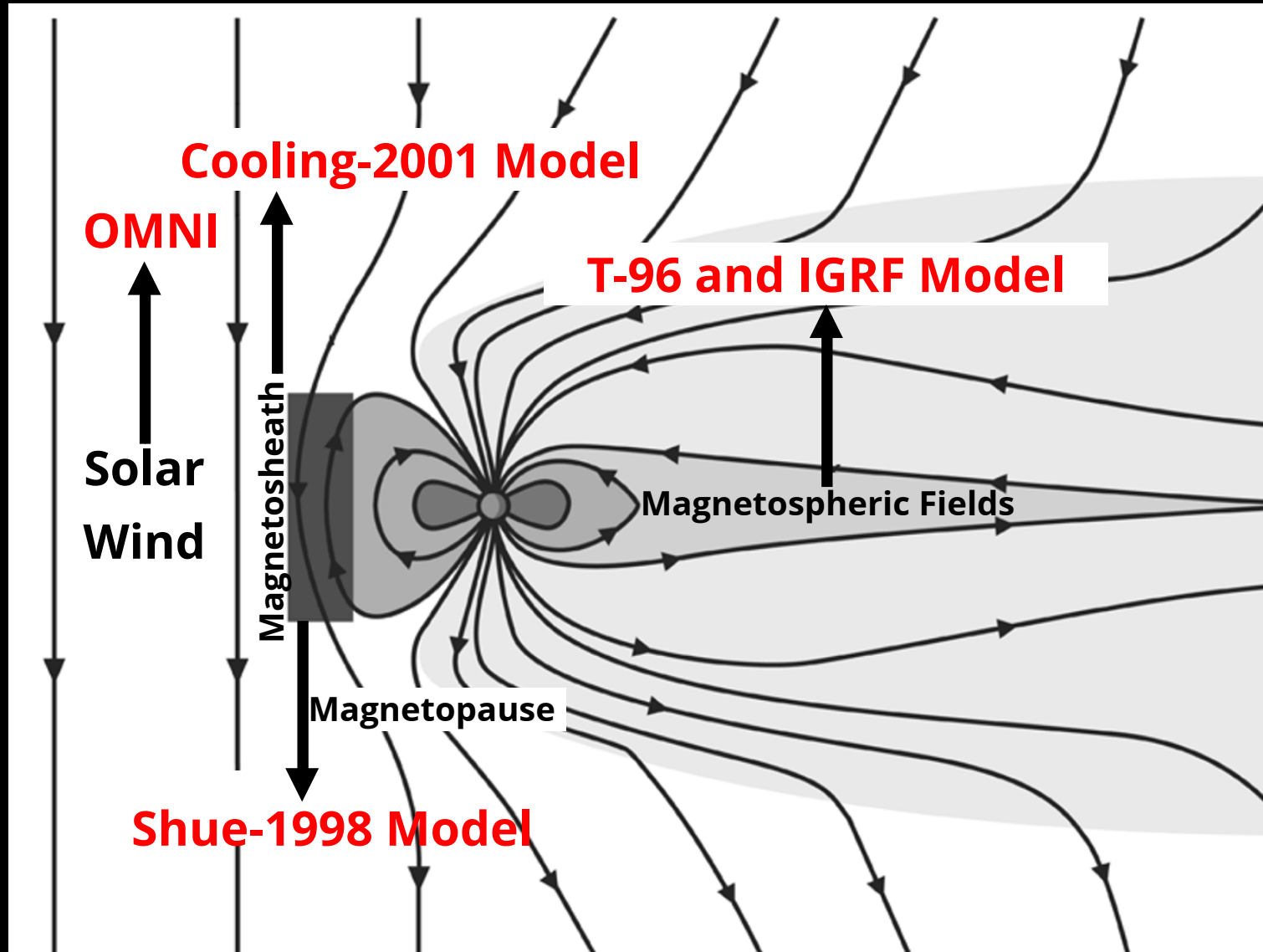
Local field bisection [Moore et al., 2002]:

$$B_{\text{rec}} = |\mathbf{B}_{\text{msp}} \cdot \mathbf{i}_{\text{xn}}|$$

Exhaust speed [Swisdak and Drake, 2007]:

$$V_A = \left[\frac{B_{\text{sh}} B_{\text{msp}} (B_{\text{sh}} + B_{\text{msp}})}{(n_{\text{p,msp}} B_{\text{sh}} + n_{\text{p,sh}} B_{\text{msp}})} \right]^{1/2}$$

Data:



Methodology

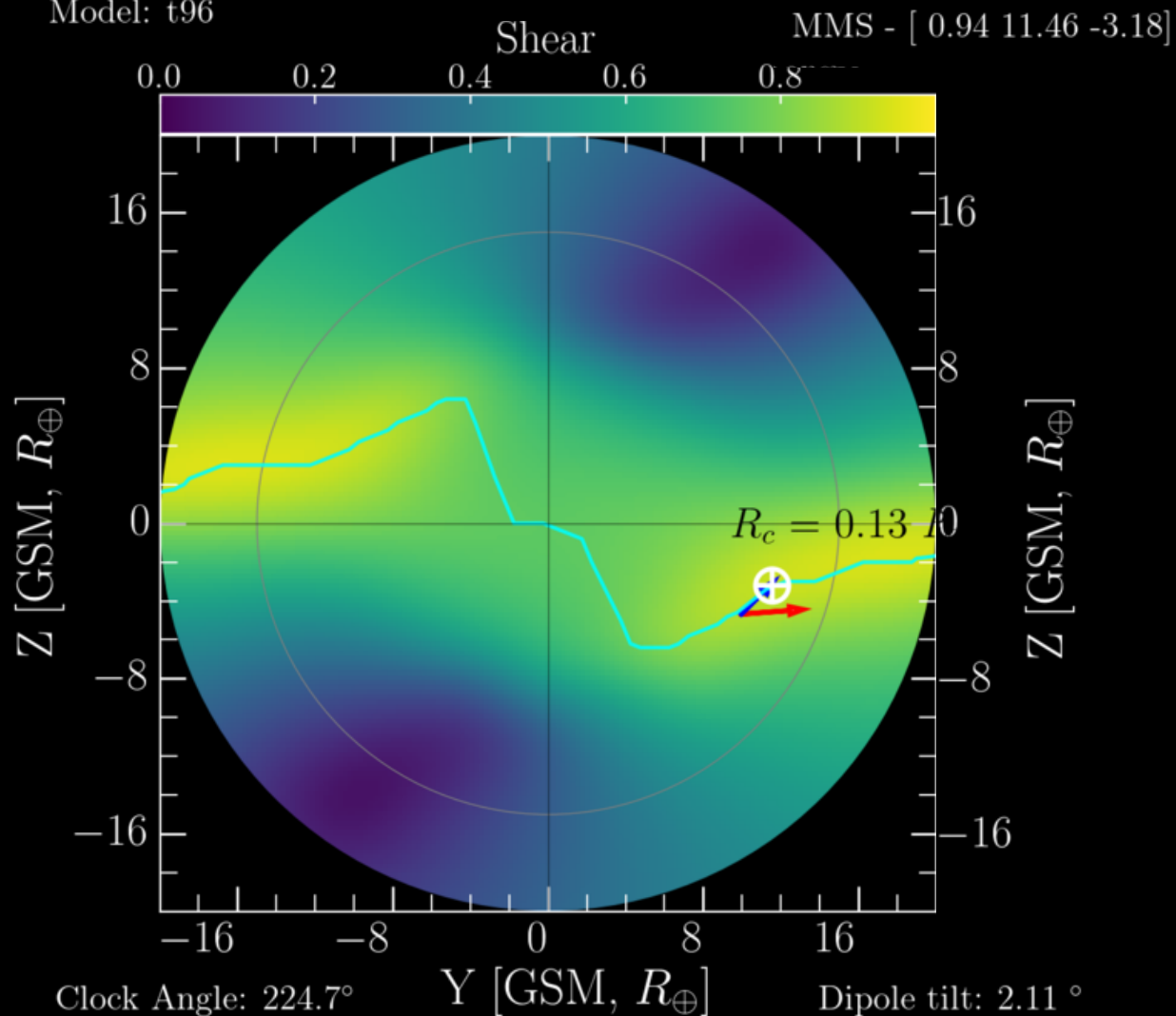
- Look at the instances when MMS observed a jet reversal while crossing the magnetopause. $\langle \Delta V_L \rangle = \pm 70 \text{ km/s}$
- For the observed parameters of IMF, Magnetosheath and Magnetosphere and Magnetopause find the model predicted x-line locations.
- Find the distance of x-line from MMS, along the magnetopause, for different models.
- Look at the statistical distribution of distances (histogram etc.) for different models.

The maximum shear model:

Time range: 2016-10-02 19:57:30 - 2016-10-02 20:07:30

$$B_{\text{imf}} = [-0.63 \ -2.07 \ -2.1]$$

Model: t96

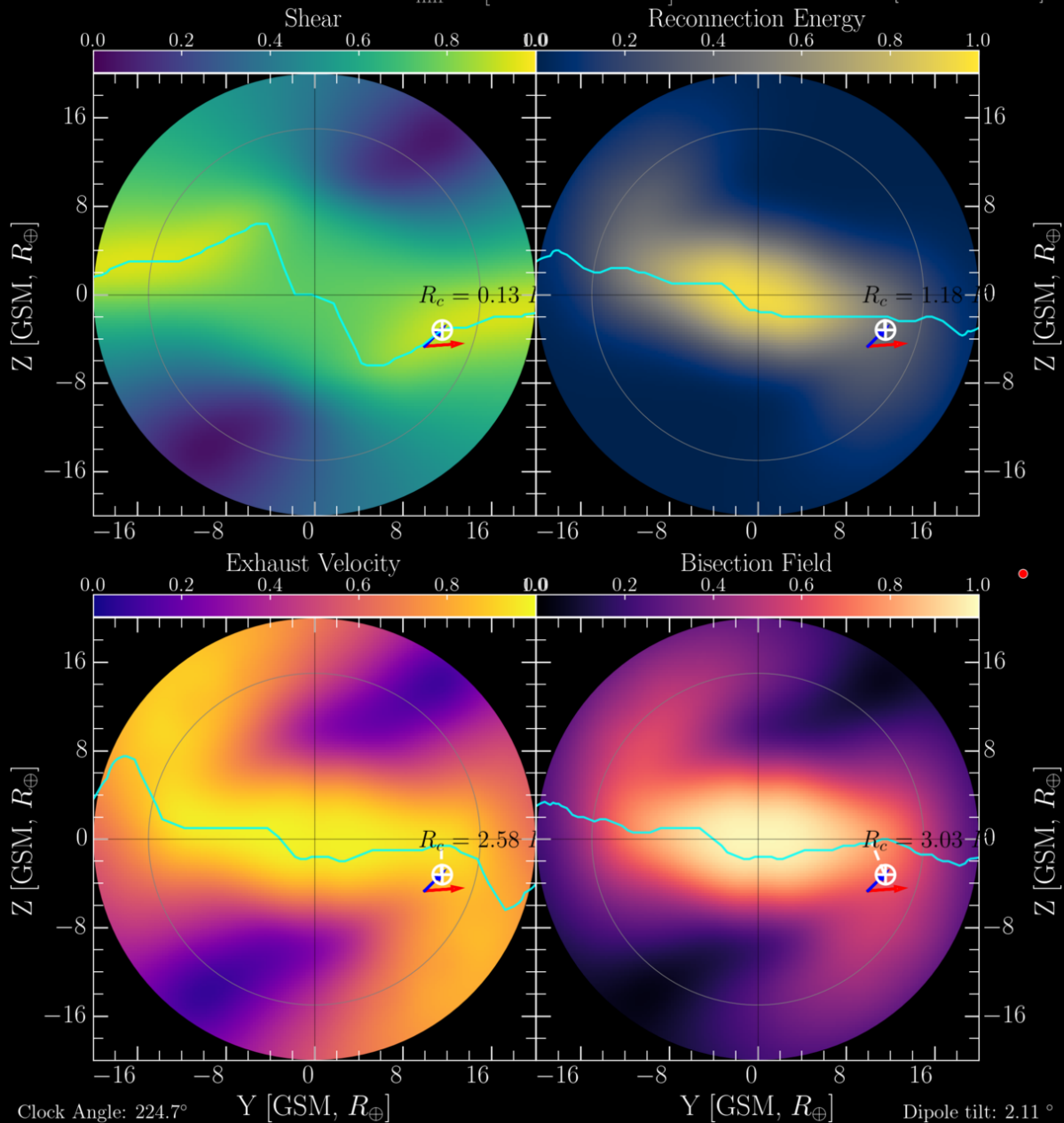


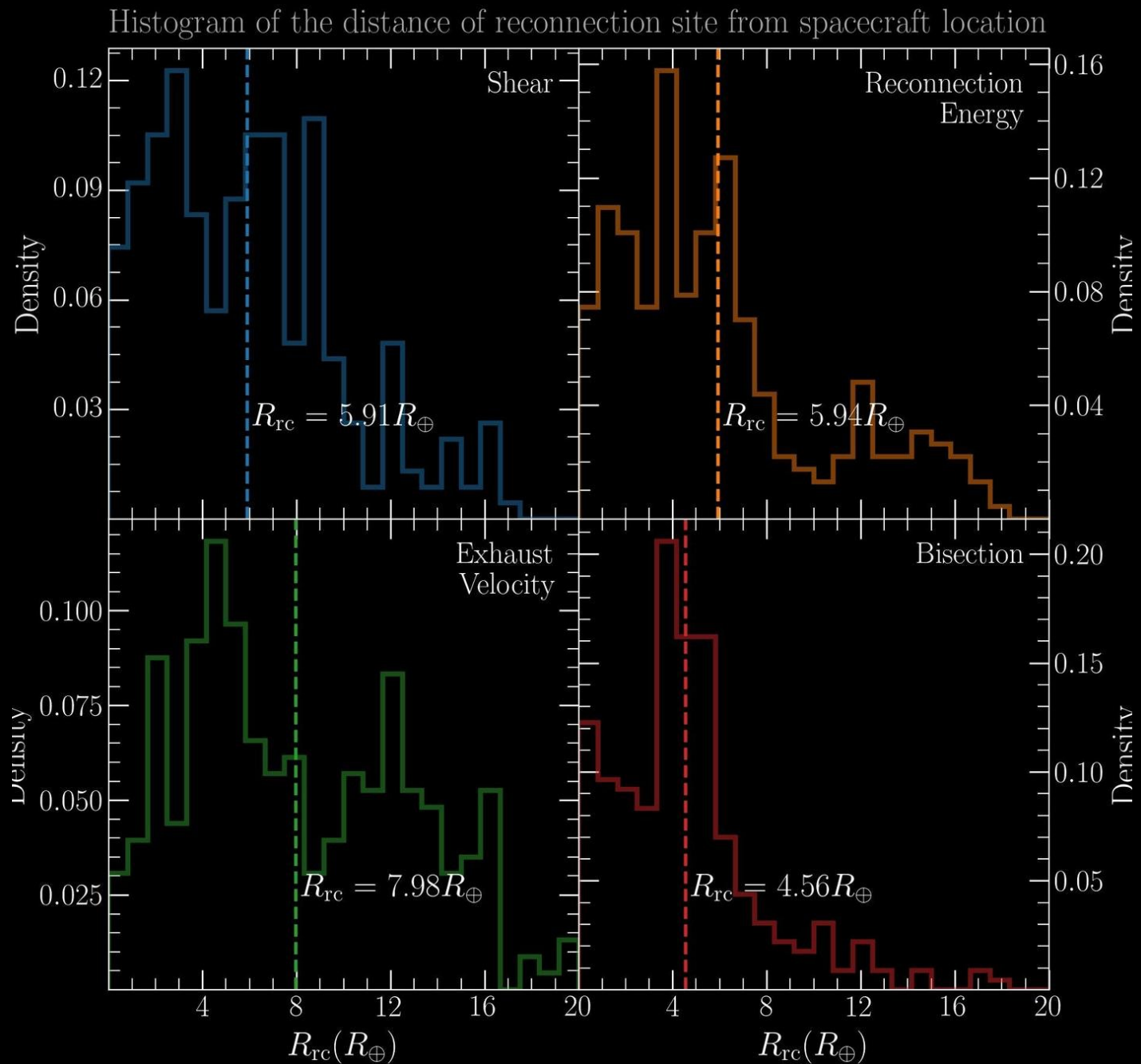
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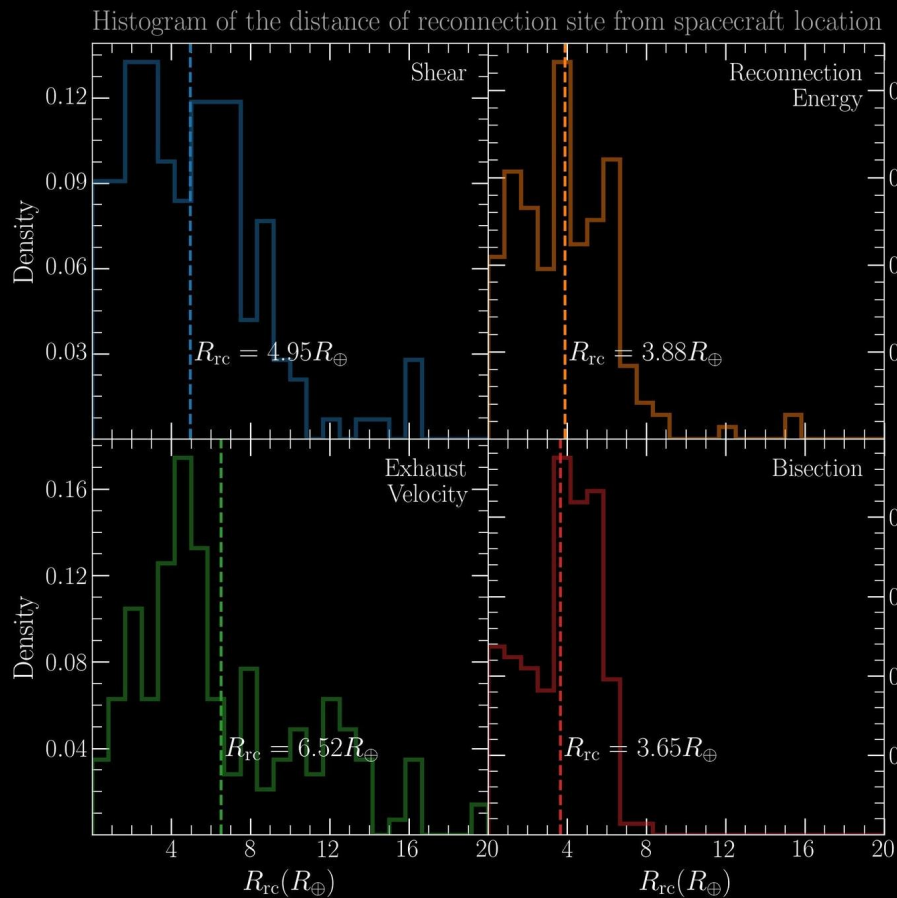
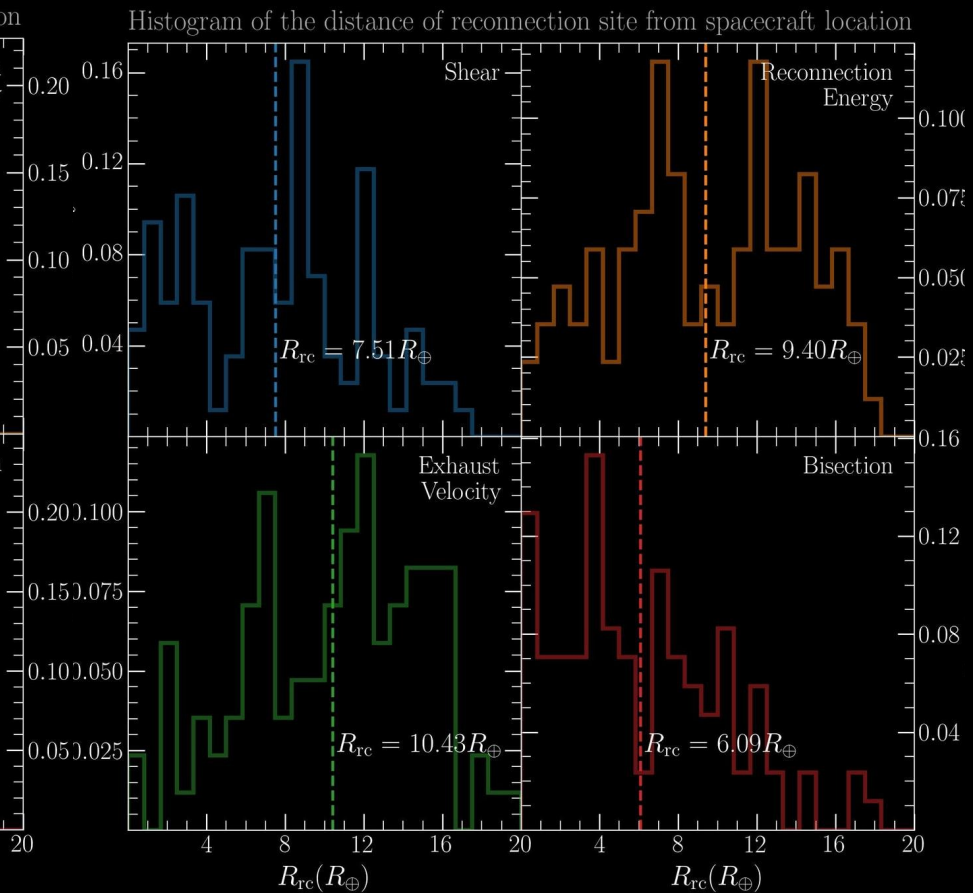
Model: t96

$B_{\text{imf}} = [-0.63 \ -2.07 \ -2.1]$

MMS - [0.94 11.46 -3.18]





$B_z < 0$

 $B_z > 0$


Discussions:

Statistically, bisection field model seem to perform better than other models for different IMF and magnetopause conditions.

For negative z-component of IMF, reconnection energy and bisection field models both give very similar statistics.

For positive z-component, shear and bisection model seem to do the best job of predicting the expected x-line

Thank You!



Link to the presentation