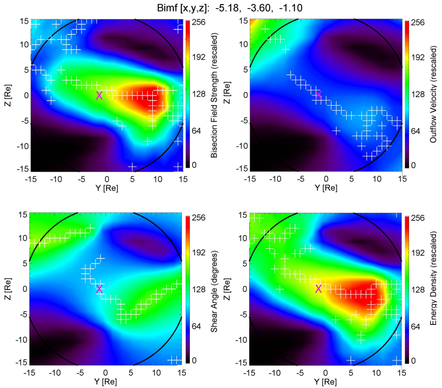
Refining predictions of reconnection X-lines at Earth's magnetopause



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MMS SWT

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Exhaust velocity $\left[\frac{B_{L,sh}B_{L,sp}}{\mu_0 m}\frac{B_{L,sh}+B_{L,sp}}{n_{sp}B_{L,sh}+n_{sh}B_{L,sp}}\right]^{1/2}$

Reconnecting energy $\propto B_{L,sh}^2 B_{L,sp}^2$

. . .

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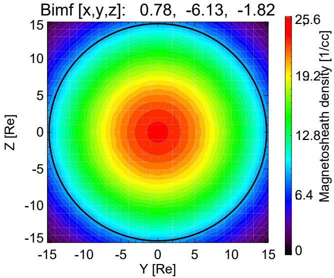
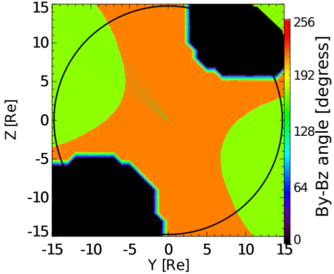
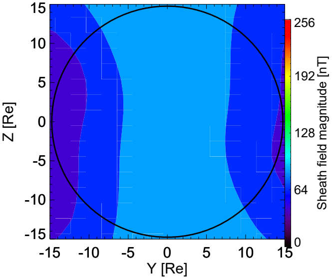
Magnetopause X-line models: ingredients







Estimate quantities (**B**, *n*, etc) for sh and sph on either side of model MP so we can extremize. UL: n_{sh} from gasdynamic model LL: draped sh **B** clock angle UR: draped sh **B** magnitude

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So what's the problem? We have models, they work out, we can go home now…

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location. The largest probable errors include: (1) the size of the dayside magnetosphere being larger/smaller than predicted; (2) solar wind flow angles mapping to a different local time; (3) IMF diffusion into the model magnetosphere altering the orientation of the field lines.

[15] The first of these effects (effect 1) is expected to have the largest uncertainty. Empirical models of the magnetopause have rather consistently found that there is an uncertainty of $\sim\pm 0.5$ R_E in the standoff location of the magnetopause. Since the dayside magnetopause scales self-

We're not always so lucky.

These models have been used for science and for mission planning, and reconnection's locations (& what controls it) is one of the MMS mission goals.

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Conjecture

Functions that predict X-lines better
correspond to
parameters that control X-line location better

How do we determine model quality and uncertainties?

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1. Quality of inputs (SW prop, draping, . . .)

2. Predictive power of outputs, given quality inputs

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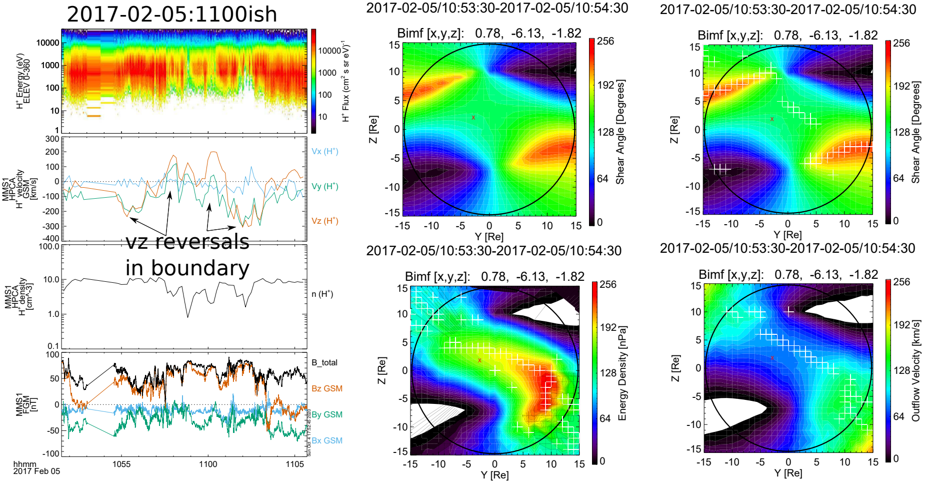
1. Quality of inputs (SW prop, draping, . . .)
   Quality of inputs: we need to make sure that propagated L1 measurements indicate BS nose conditions, that the draping works out, and so on. Full magnetopause crossings let us check draped(propagated(L1)) against observed conditions.
2. Predictive power of outputs, given quality inputs
   Jet reversals give simple tests: ”did the model hit the spot”? We can calculate a model’s P, σ,. . . with a bunch of jet reversals. Do we have a bunch of jet reversals? *Hundreds from just burst interval descriptions.*

Example: 5 Feb 2017



CW from UL: bisecting angle (no line), max shear, max v_{out}, max en

Preliminary results and next steps

So far, only a few events done. Shear, v_{out}, reconnecting energy on about equal footing.

'Lining up' L1, MP features a la Trattner is nontrivial — and too much depends on it for now, which isn't ideal.

Next steps: analyze $\sim$ 100ish reversals, should be enough to bin by

- SW clock angles around 0°, 90°, 180°, 270°
- SW cone angles above and below 45°
- Downstream of $Q \parallel$, $Q \perp$

for the curious (all have been singled out as odd spots, we'll see what's draping's fault and what's model's fault)

The models have different $|B|$ dependences and n is incorporated into the v_{out} so we have a nontrivial span in parameter space