Diffusion region's structure and evaluation of Ohm's law at the magnetopause with MMS data.

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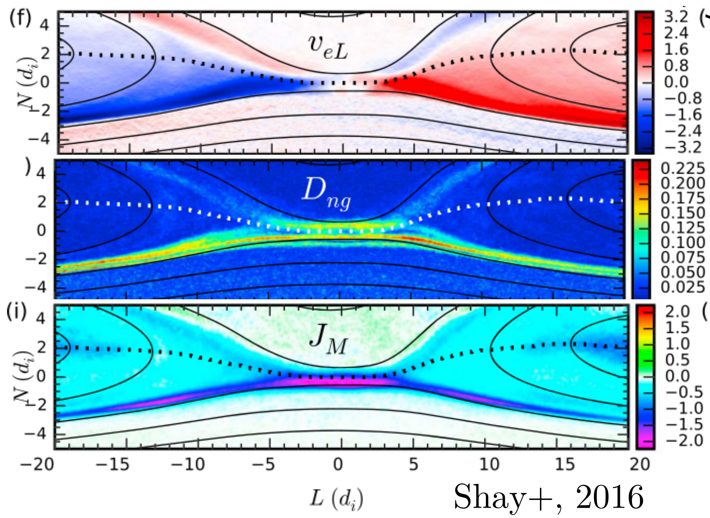
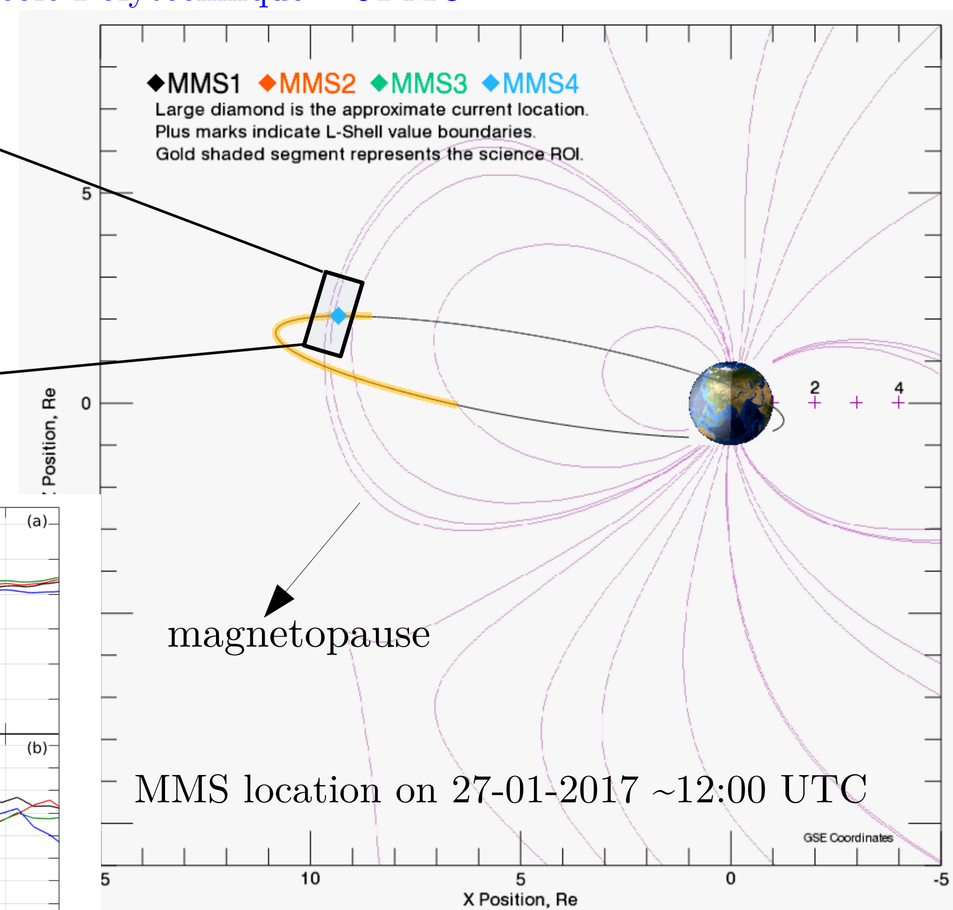


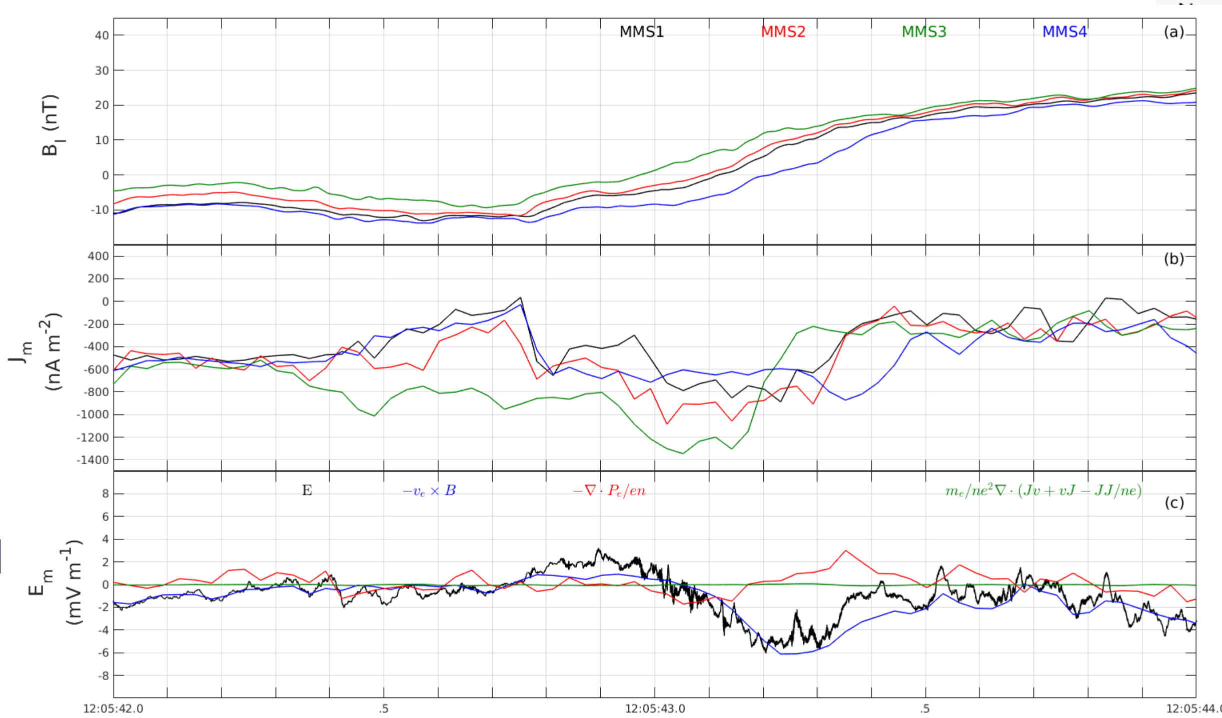
Shay+, 2016

Jet reversal

Agyrotropy

$J_y \sim 1\ \mu A\ m^{-2}$





Diffusion region's structure and evaluation of Ohm's law at the magnetopause with MMS data

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Laboratoire de Physique des Plasmas

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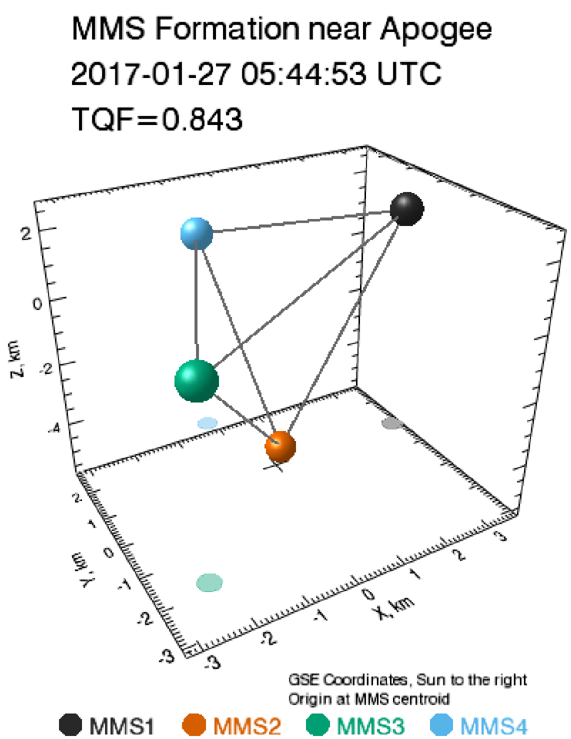
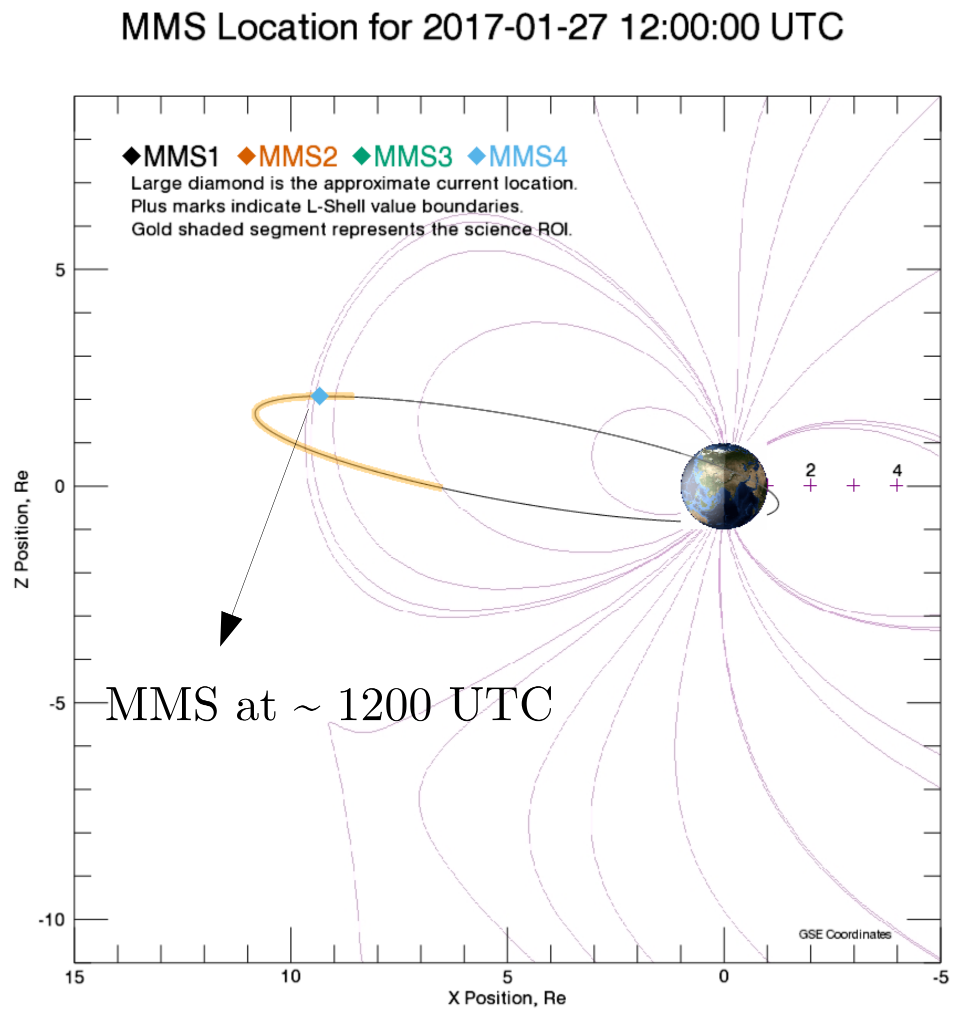
Looking for an Electron Diffusion Region (EDR) encounter

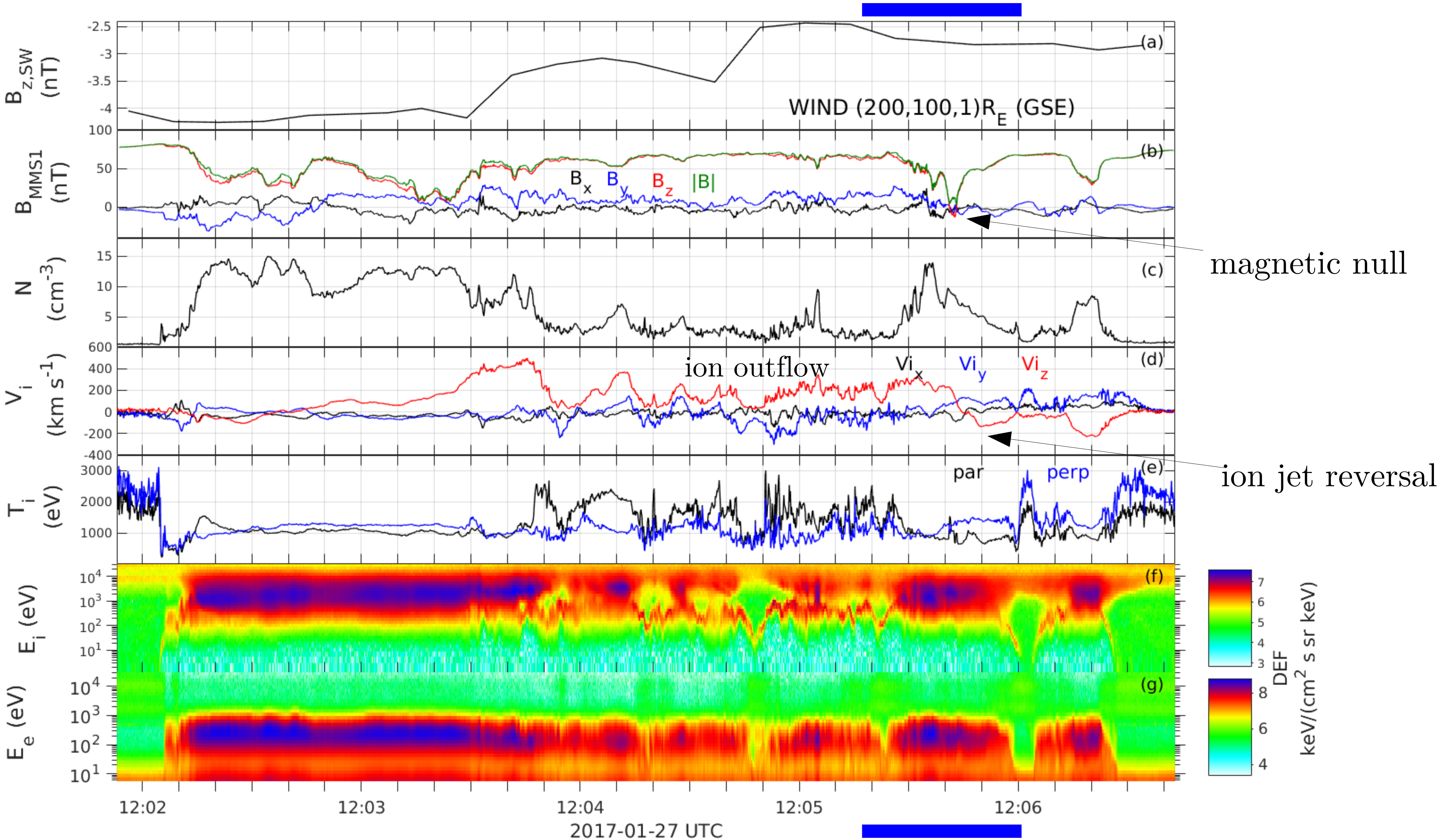
Event on **January, 27th 2017** at ~ 12:00 UTC:

- MMS is near the subsolar point
- Mean spacecraft separation ~ 7 km



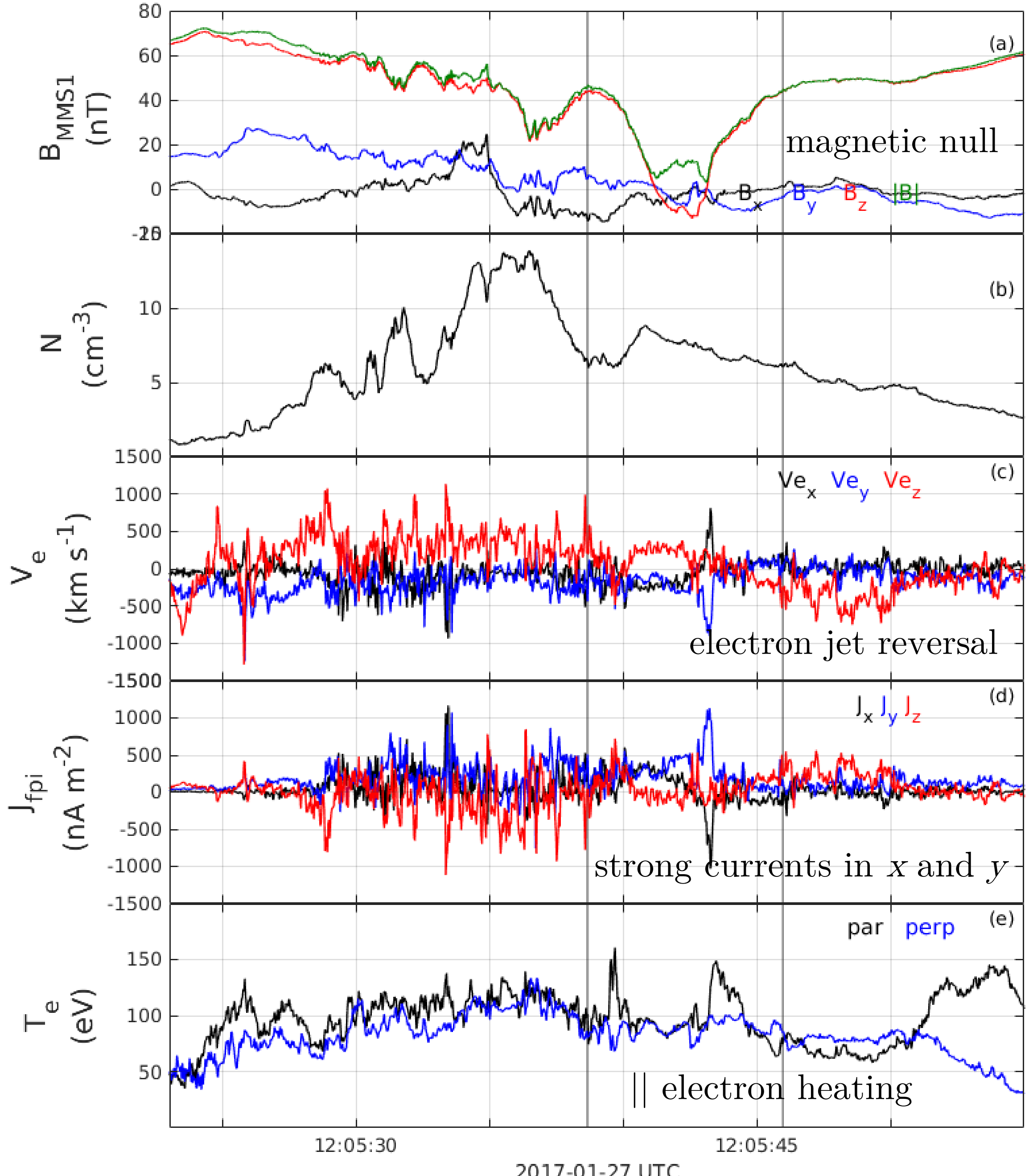


Overview of the event: summary plot

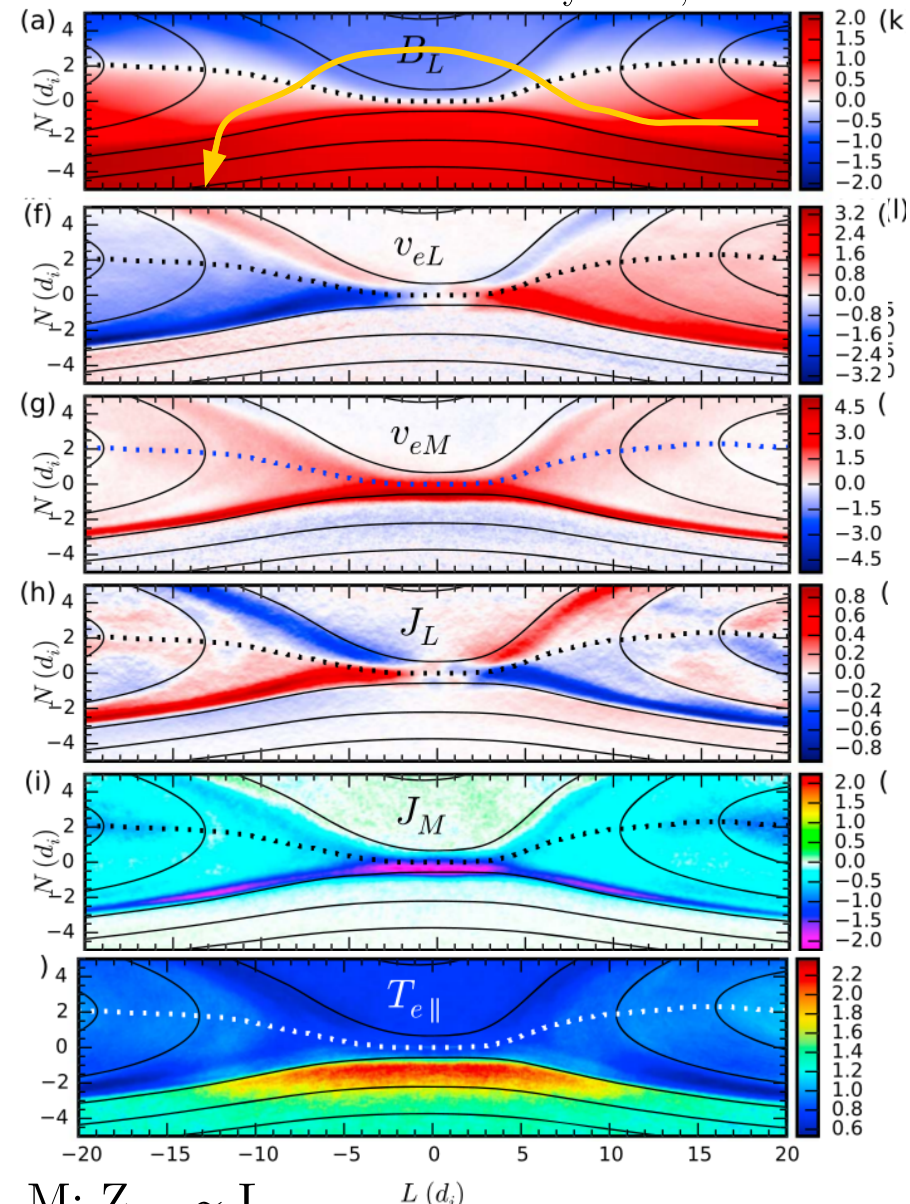


MMS is skimming the MP and spends most of the time in the magnetospheric boundary layer

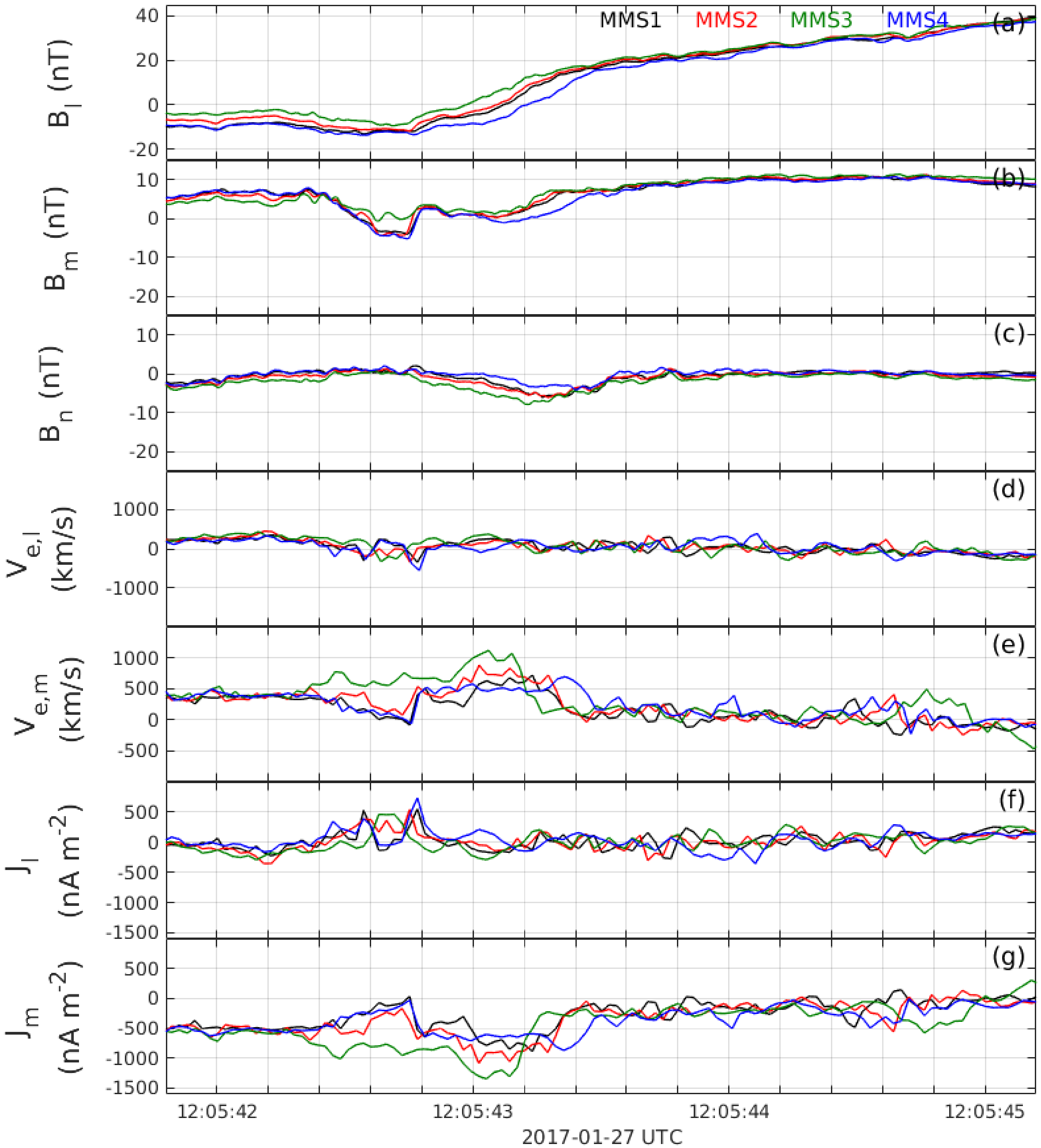
Overview of the event: zoom in



Shay et al., 2016



$X_{GSE} \sim N$; $Y_{GSE} \sim -M$; $Z_{GSE} \sim L$



4 s/c analysis

MMS is skimming MP on the MSH side, then cross the CS. Differences among s/c observed Before 120542.8 are spacial.

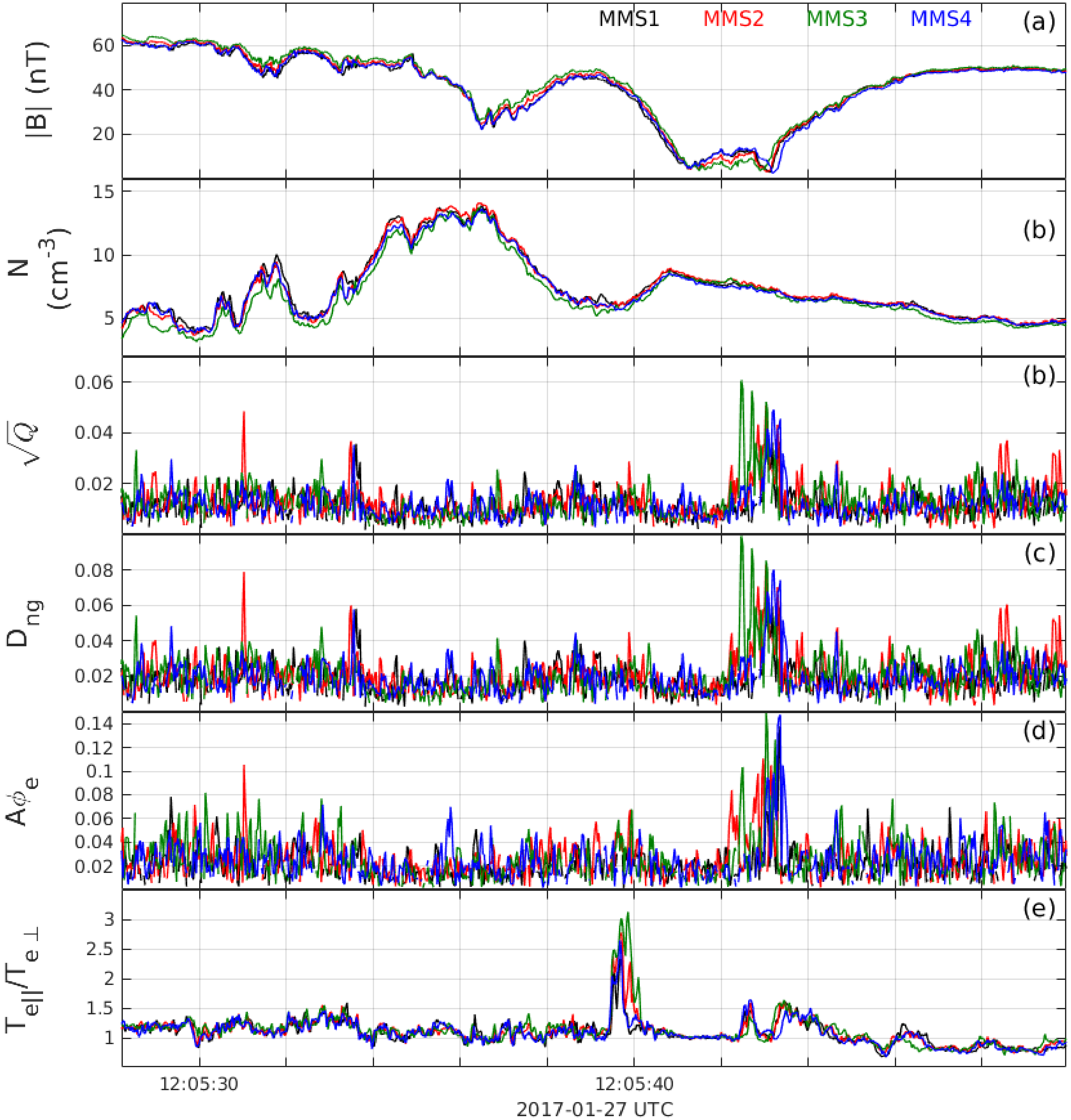
Mean s/c separation ∼ 7 km

- Differences in B_m among the s/c: $B_{m,MMS3}$ ∼ 0 nT while it reaches 5 nT for the other s/c
- $V_{e,m}$ (and J_m) is higher for MMS3

$$\mathbf{LMN} = \begin{pmatrix} 0.05 & 0.03 & 0.99 \\ -0.30 & -0.95 & 0.04 \\ 0.95 & -0.30 & -0.04 \end{pmatrix}$$

$$V_{MP} \sim 40\ (0.96\ \ -0.25\ 0.08)\ km/s$$

$$d_{CS} \sim 0.6\ s\ 40\ km/s \sim 24\ km \sim 12\ \delta_e$$



EDR signatures

$$P = \begin{pmatrix} P_{||} & P_{12} & P_{13} \\ P_{12} & P_{\perp} & P_{23} \\ P_{13} & P_{23} & P_{\perp} \end{pmatrix}$$

$$D_{ng} = \frac{\sqrt{8(P_{12}^2+P_{13}^2+P_{23}^2)}}{P_{||}+2P_{\perp}}$$

Aunai et al., 2013

$$\sqrt{Q} = \sqrt{\frac{P_{12}^2+P_{13}^2+P_{23}^2}{P_{\perp}^2+2P_{\perp}P_{||}}}$$

Swisdak, 2016

$$A\phi_e = \frac{2|P_{\perp,1}-P_{\perp,2}|}{P_{\perp,1}+P_{\perp,2}}$$

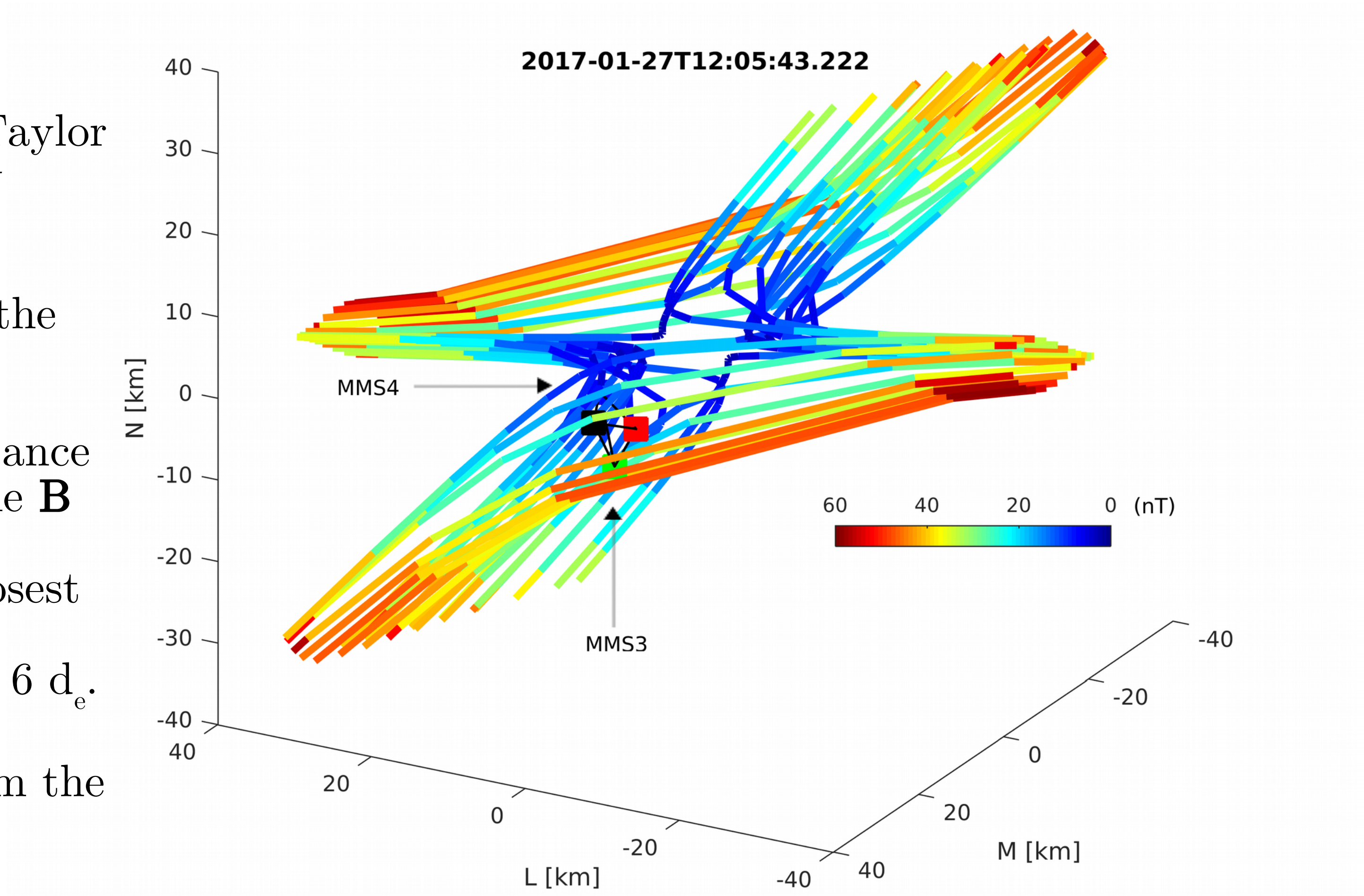
Scudder and Daughton, 2008

Magnetic field topology: the FOTE method

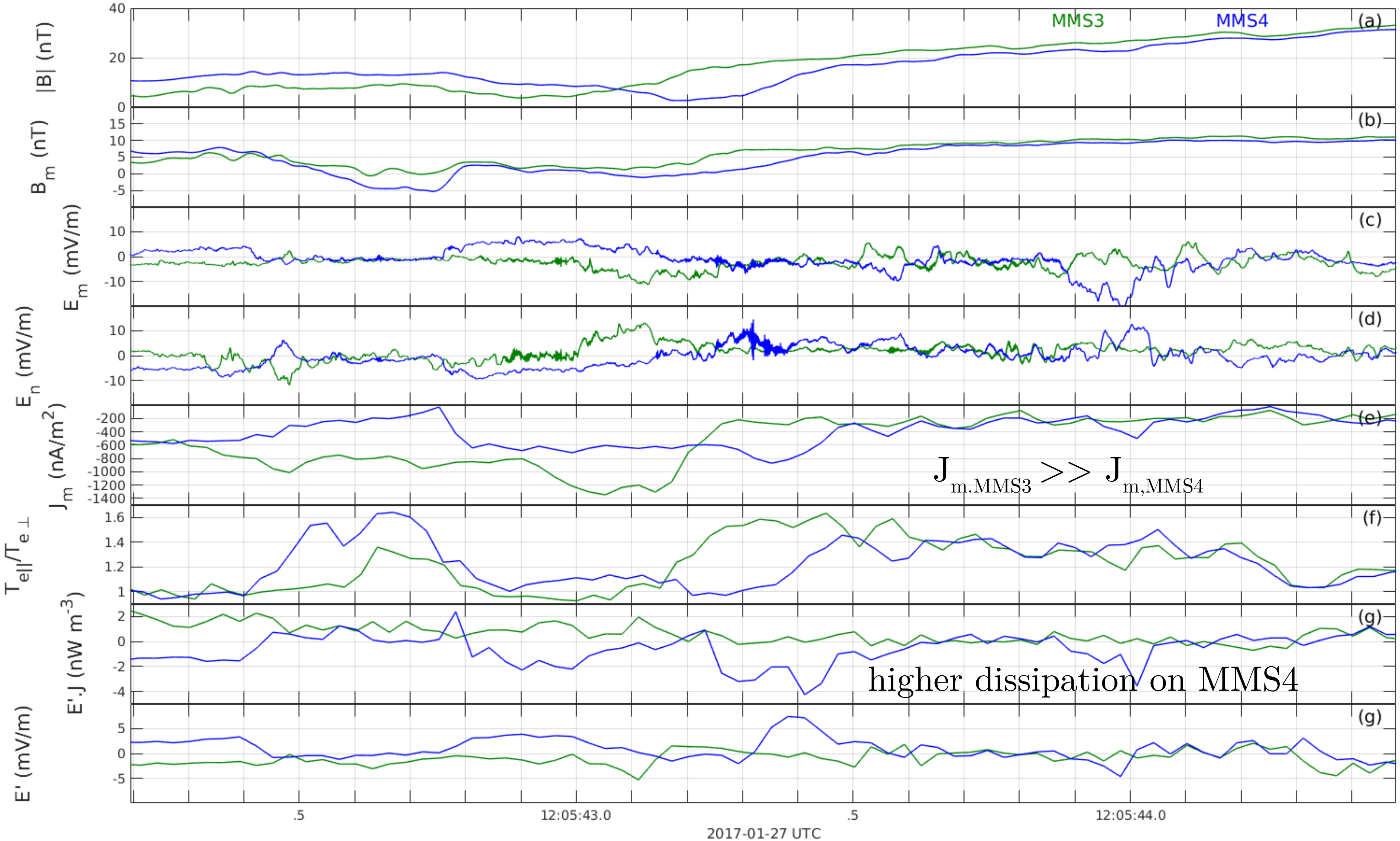
We use the First-Order Taylor Expansion method [*Fu et al.,2015, 2016, 2017*] to reconstruct the field topology in proximity of the magnetic minimum.

The smallest s/c-null distance is in correspondence of the **B** minimum
MMS4 and MMS2 are closest to the nulls,
$|R_{MMS4} - R_{null}| \sim 12$ km $\sim 6\ d_e$.

MMS3 is the furthest from the null.



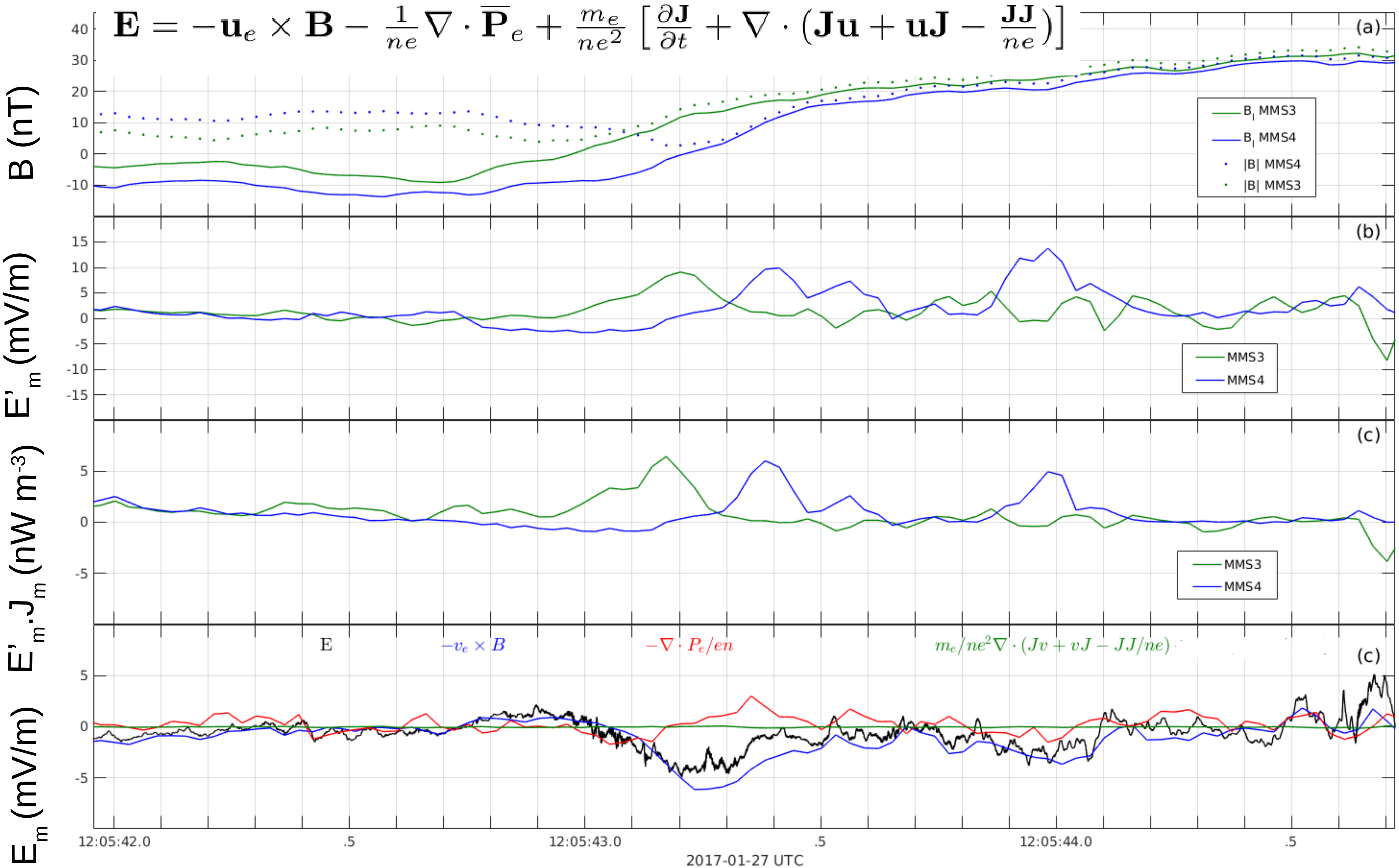
MM3 and MMS4 comparison



MMS3 shows a larger J_m while MMS4 observes higher dissipation.

In the proximity of the null electrons show clear sign of demagnetisation, especially for MMS4.

Ohm's law evaluation



The pressure term is the dominant one. It has to be underlined that all the terms are averaged over the four spacecraft.

Conclusions

- We presented a study of a magnetopause crossing showing signatures of an EDR encounter nearby a magnetic null.
- Differences among spacecraft are seen even at a mean inter-spacecraft separation of $\sim$ 7 km.
- The FOTE method is used to reconstruct the magnetic field topology: the null to be close to MMS ($\sim$12 km). MMS4 and MMS2 are the Closest to the null, MMS3 is the furthest.
- MMS3 and MMS4 both show deviation from the frozen-in condition (on electron scales). Yet, observations are sensitive to the E field calibrations.
- We computed then Ohm's law in the null region showing the role of the pressure term. Yet, all the terms are averaged over the 4 points.

Possible interpretations:

- Not all the s/c cross the EDR: the characteristic length of the EDR is comparable to the inter-s/c separation.
- All the s/c are inside the EDR: differences among s/c suggest that EDR has a <u>complex</u> structure.

Ongoing/future work: analysis of the distribution functions; wave analysis.