

Dayside Kinetic Processes in Global Solar Wind-Magnetosphere Interaction

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Research area: SWMI, GSM **Term:** 2016-2020

a venue for joint modeling and experimental efforts

1 Topic

Kinetic processes in the **foreshock**, **bow shock**, **magnetosheath**, and **magnetopause** generate structures and dynamics that can have effects in the whole **magnetosphere-ionosphere** system.

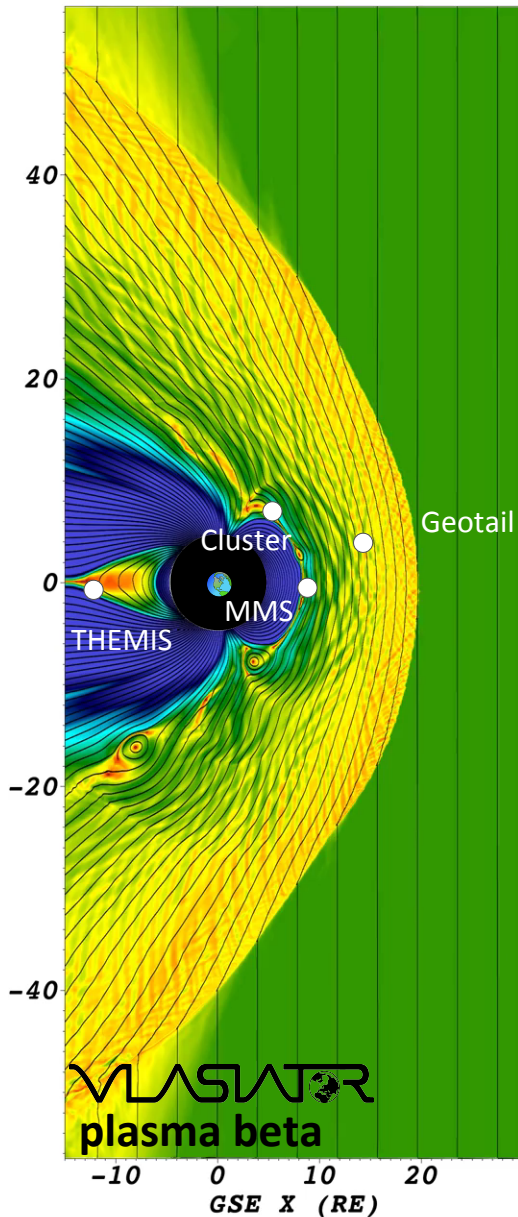
2 Timeliness

Novel global kinetic models

- coupled MHD-PICs
- several hybrid-PICs
- hybrid-Vlasov model
- ...

Unprecedented observations

- MMS
- HSO coordinated conjunctions: THEMIS, VAP, Geotail, Cluster, ground-based observatories,...
- statistics



Schedule

- Part 1: Contributed presentations

1. **Primoz Kajdic:** Upstream transients and their influence on the bow shock and magnetosheath - preliminary results from the Cluster Guest-Investigator campaign
2. **Heli Hietala:** Advances on geoeffectiveness of magnetosheath high-speed jets
3. **Tomas Karlsson:** Do magnetosheath plasmoids exist at Mercury?
4. **Rick Wilder:** MMS observations of cold plasma-driven waves at the reconnecting magnetopause
5. **Yu Lin:** Magnetopause transients under different IMF directions - global hybrid simulations
6. **Yuxi Chen:** Validation of MHD with embedded PIC (MHD-EPIC) simulations against MMS observations

- Part 2: Dayside modeling challenge

- Primary challenge event: southward IMF
- Update on available observations **Heli on behalf of FG co-chairs**
- Discussion on metrics **ALL**

Focus Group goals and deliverables: where are we?

Database of conjunctions
for validation of current and future global kinetic models

Modeling challenges: model-model-obs. comparisons
a short time interval with constant SW conditions
for a spacecraft conjunction from the 1st MMS magnetopause season

Events



events of interest from the MMS era
(storms/SW discontinuities)



Statistics

a set of SW conditions and
validation against obs. statistics

Preparation

- optimal data acquisition during MMS 25Re apogee dayside phase (2017-2018)
- modeling for upcoming dayside missions (THOR, SMILE)

Lead discussions on

- how to make data from large kinetic models easily accessible to the community
- how to achieve kinetic effects in operational space weather models

Aims

for the first Dayside Modeling Challenge

- **Collect** coordinated in situ and remote observations to assess the dynamics of the magnetospheric system and for model validation
- **Quantify** agreement/disagreement between datasets and models
- **Determine** reasons for data/model, model/model, and data/data differences
 - development of model
 - development of observatories
- **Advance** our understanding of multi-scale plasma processes and their role in SW-magnetosphere interaction

Update on the search of candidate events

1. Primary challenge event:

2015-11-18 01:50-03:00 UT purely southward IMF event, MMS-Geotail magnetopause conjunction with SuperDARN radar observations, presented at the Summer Workshop

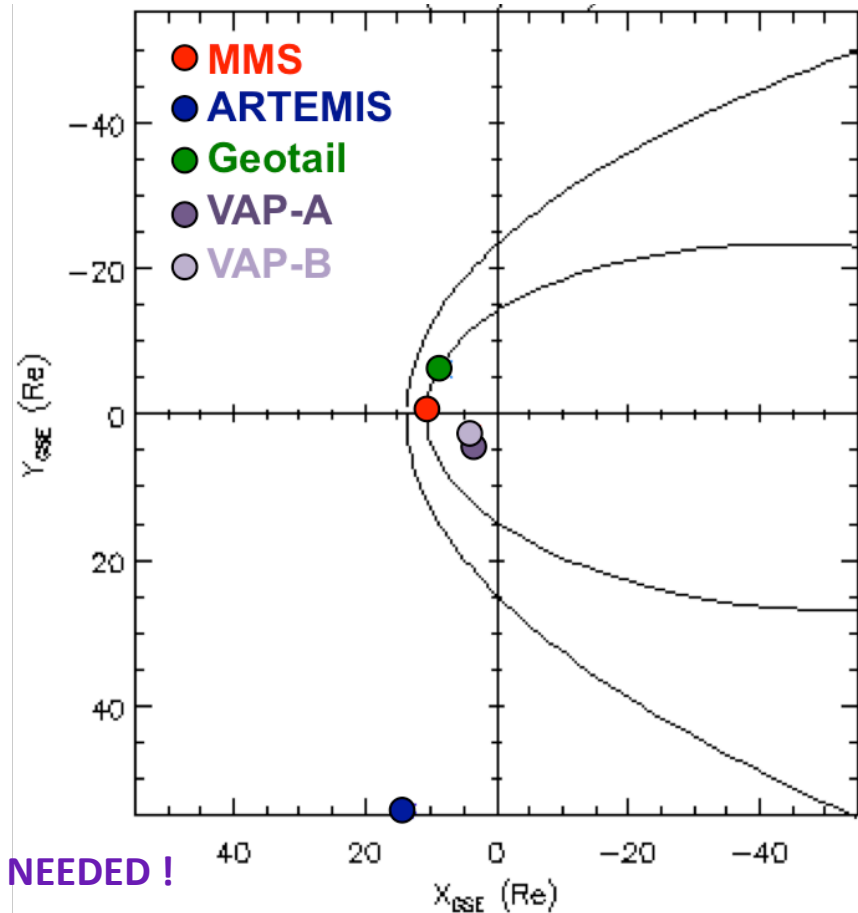
- We have searched the first MMS dayside season, and haven't found other such southward IMF events that would merit to be put up for a vote.
- To be considered part of the challenge, we expect you to have results for this event before you move on to any secondary/follow-up events. This will ensure that we'll have enough comparable simulations.

2. Secondary challenge events:

- Significant IMF By component: two candidate events (**vote**)
 - 2015-10-02 presented in the Summer Workshop
 - 2016-01-09
- Quasi-radial IMF: two candidate events (**vote**)
 - 2015-11-30
 - 2016-01-04
- Note 1: We have identified one potential Parker spiral type event (2015-12-04), but the B_z was mainly northward. We **welcome community comments and input on this IMF geometry**.
- Note 2: We have not been able to find a clean northward IMF event requested in the Summer Workshop. We will continue to look for one during the second MMS dayside season and **welcome community input**.

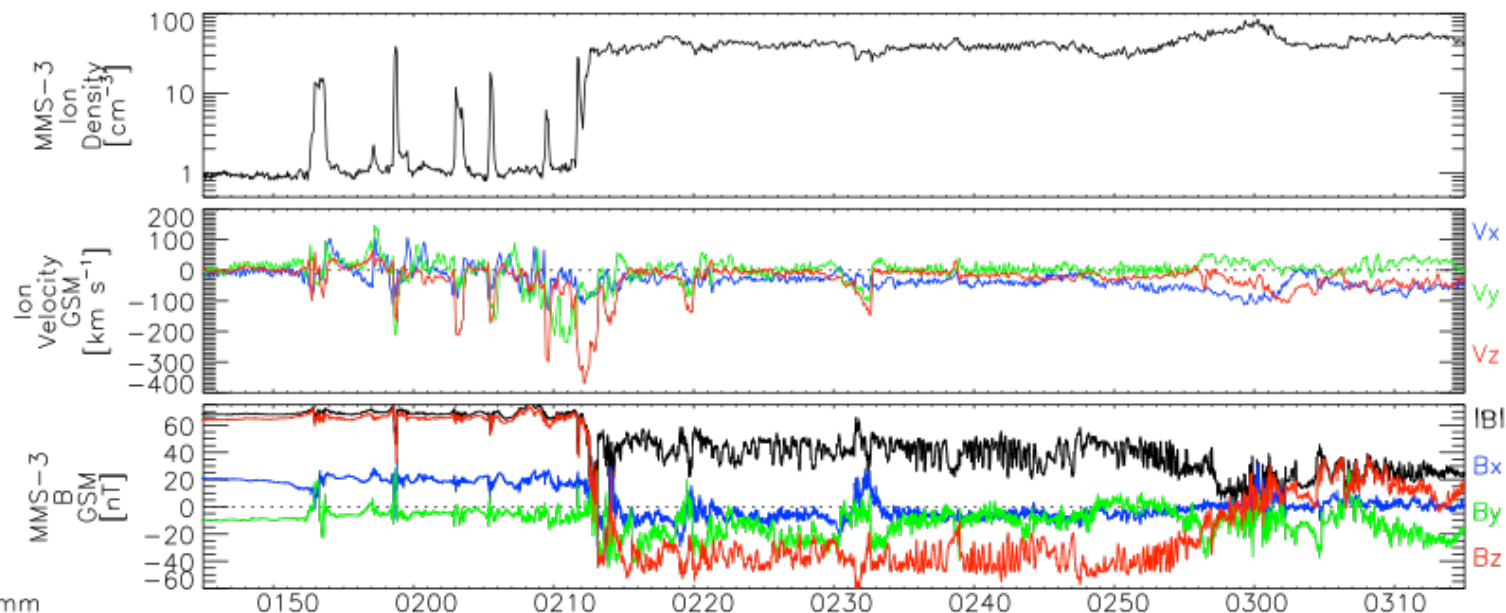
Primary challenge event: 2015-11-18 southward IMF 01:50-03:00 UT

- ARTEMIS SW observations
 - $V_{SW} \sim 370\text{km/s}$
 - $n_{SW} \sim 8\text{-}9\text{ cm}^{-3}$
 - IMF $\sim [0, 0, -5]\text{ nT}$
 - exact timing of discontinuities would require further analysis
- MMS-Geotail magnetopause conjunction
 - both observe southward reconnection jets
 - X-line estimated to be at $Z_{GSM} \sim +2R_E$ due to dipole tilt [Kitamura et al., JGR 2016]
 - MSH mirror mode activity **MORE ANALYSIS NEEDED !**
- SuperDARN radar data
 - dawnward flow enhancements **MORE ANALYSIS NEEDED !**



Primary challenge event: 2015-11-18 southward IMF

- **Heli: MMS observations:**
preliminary analysis
 - some **5+ FTEs** during this event
 - properties could be used for metrics
 - **MORE ANALYSIS NEEDED**
- **Andrew Dimmock:**
Observational THEMIS statistics
 - this type of large southward IMF events ($B_z \sim -5$ nT) are quite rare
 - not possible to produce maps of the equatorial magnetosheath properties
 - Some **individual intervals** can be pulled out to improve the obs coverage



Discussion on metrics

- potential metrics for obs-model comparisons:
 - location of the magnetopause
(based on MMS and Geotail crossings)
 - location of the X-line
(northward of the sc, estimated to be at $Z_{\text{GSM}} \sim 2R_E$)
 - properties of the FTEs observed by MMS
(including their periodicity)
 - magnetosheath magnetic field power spectrum
 - properties of the magnetosheath mirror mode waves

rank? other suggestions?

- metrics for model-model comparisons?
suggestions?
- metrics for comparing different observations?
suggestions?

Thank you!

Please remember to write down your email!