Investigation of Different Types of Magnetosheath Jets and their Origin using MMS

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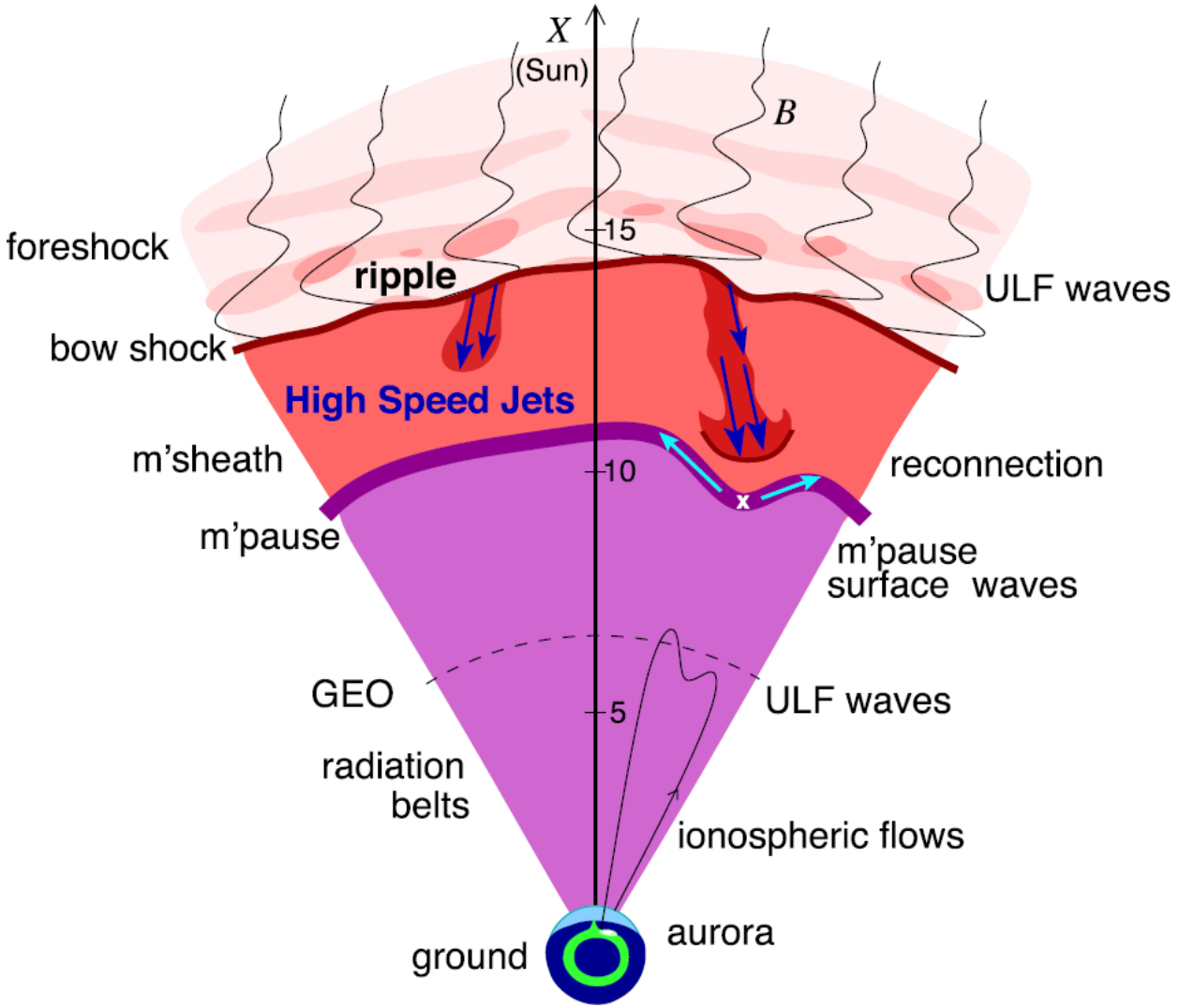
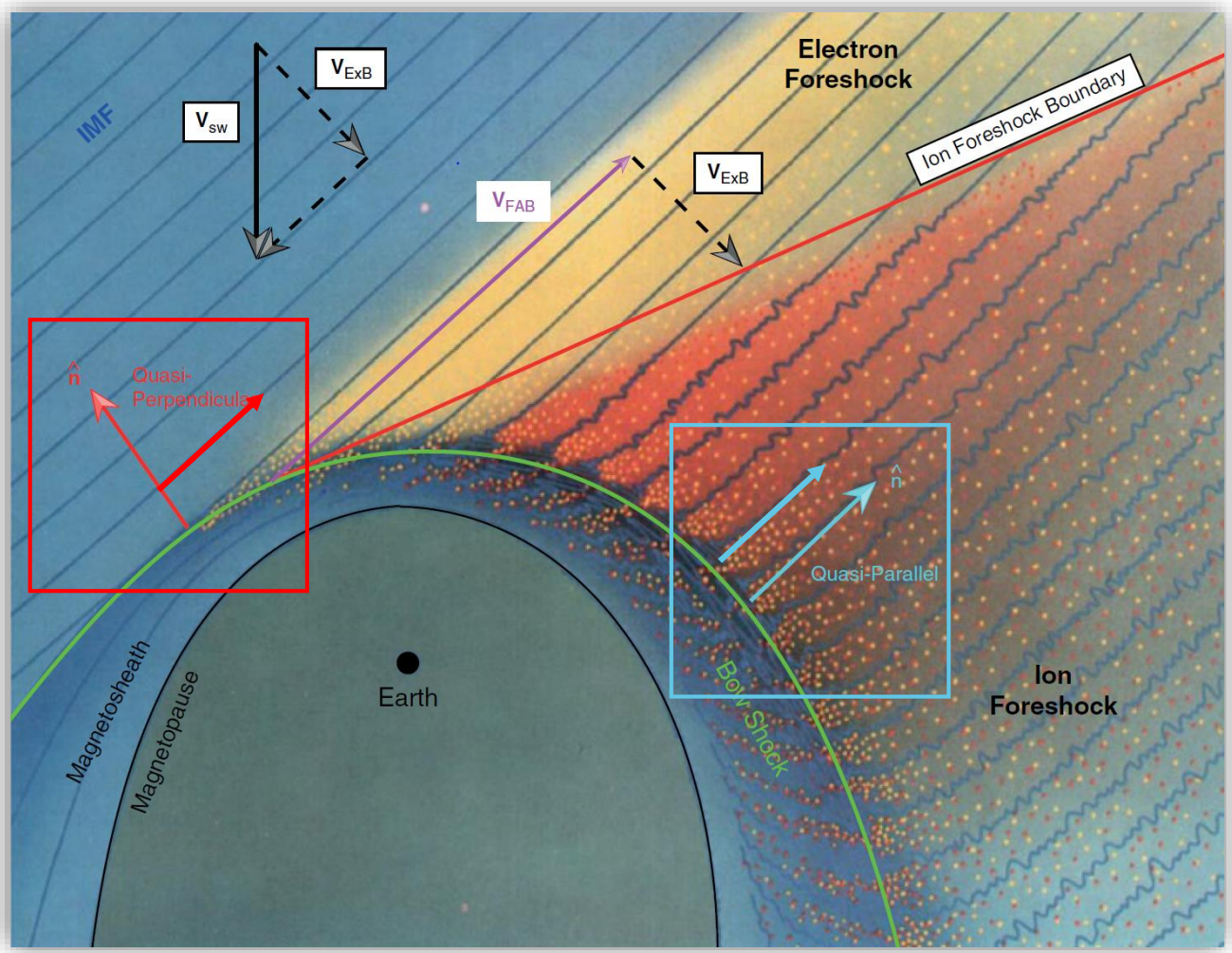
Introduction – Magnetosheath Jets



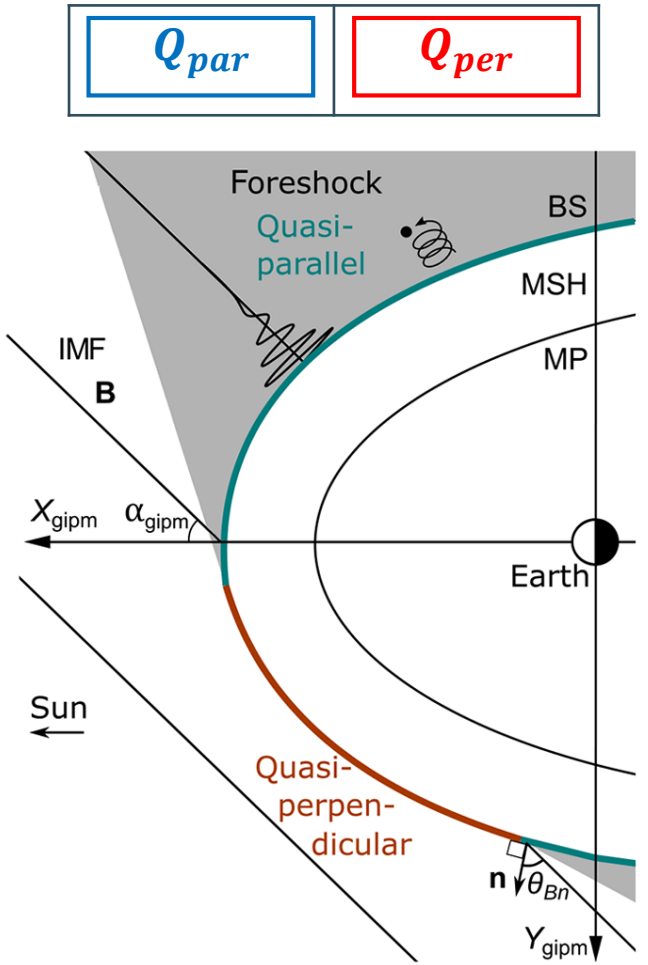
Plaschke F. et al. (2018); sketch by H. Hietala | Space Sci. Rev

Motivation – Main Subcategories



L. B. Wilson (2016) | Geophysical Monograph Series

”Found ~9 times more often behind the Qpar bow shock”



Vuorinen, et al. (2019) | Annales

Classification Procedure in progress

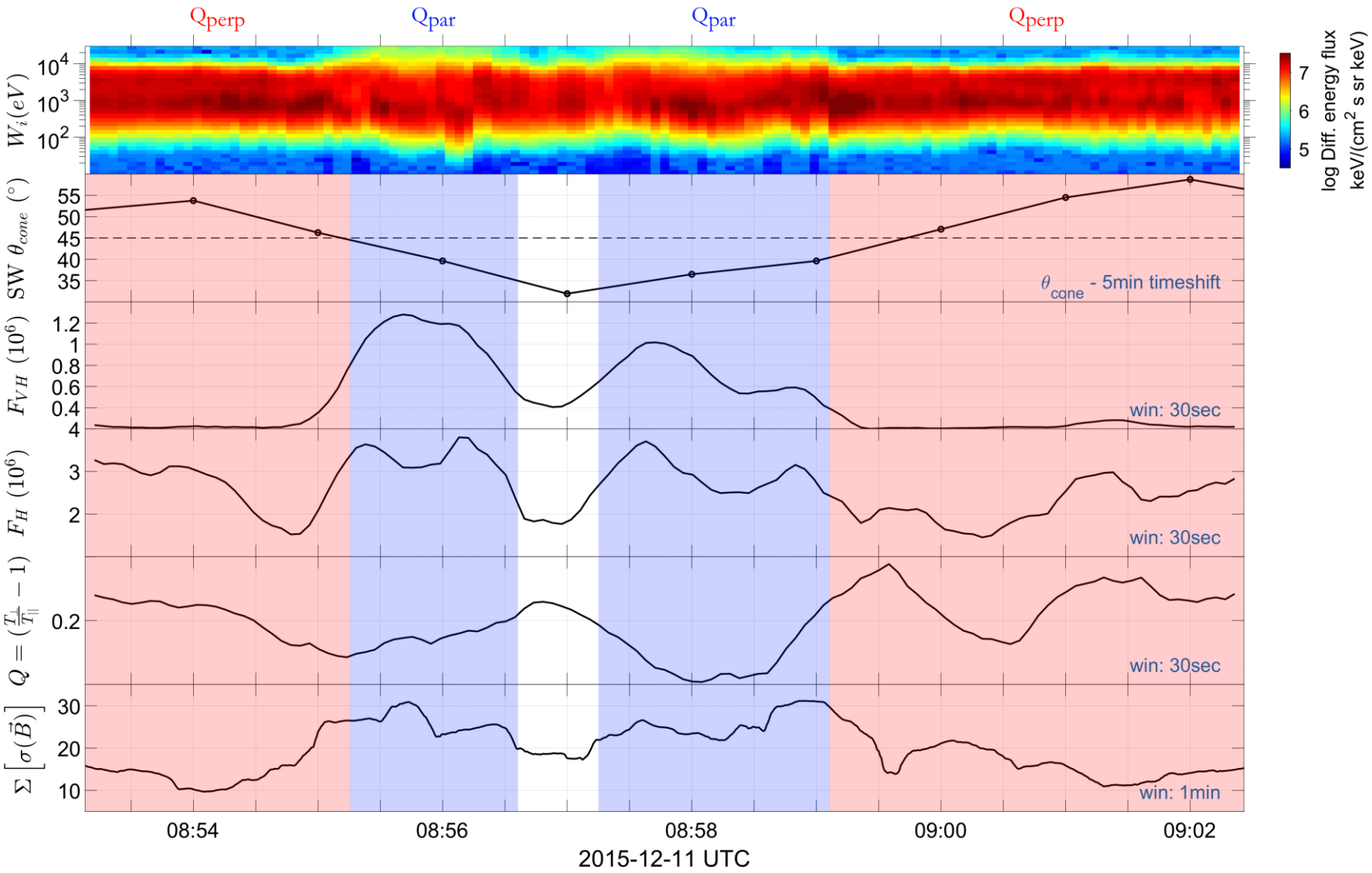
Cone Angle

Very High Energy Flux

High Energy Flux

Anisotropy

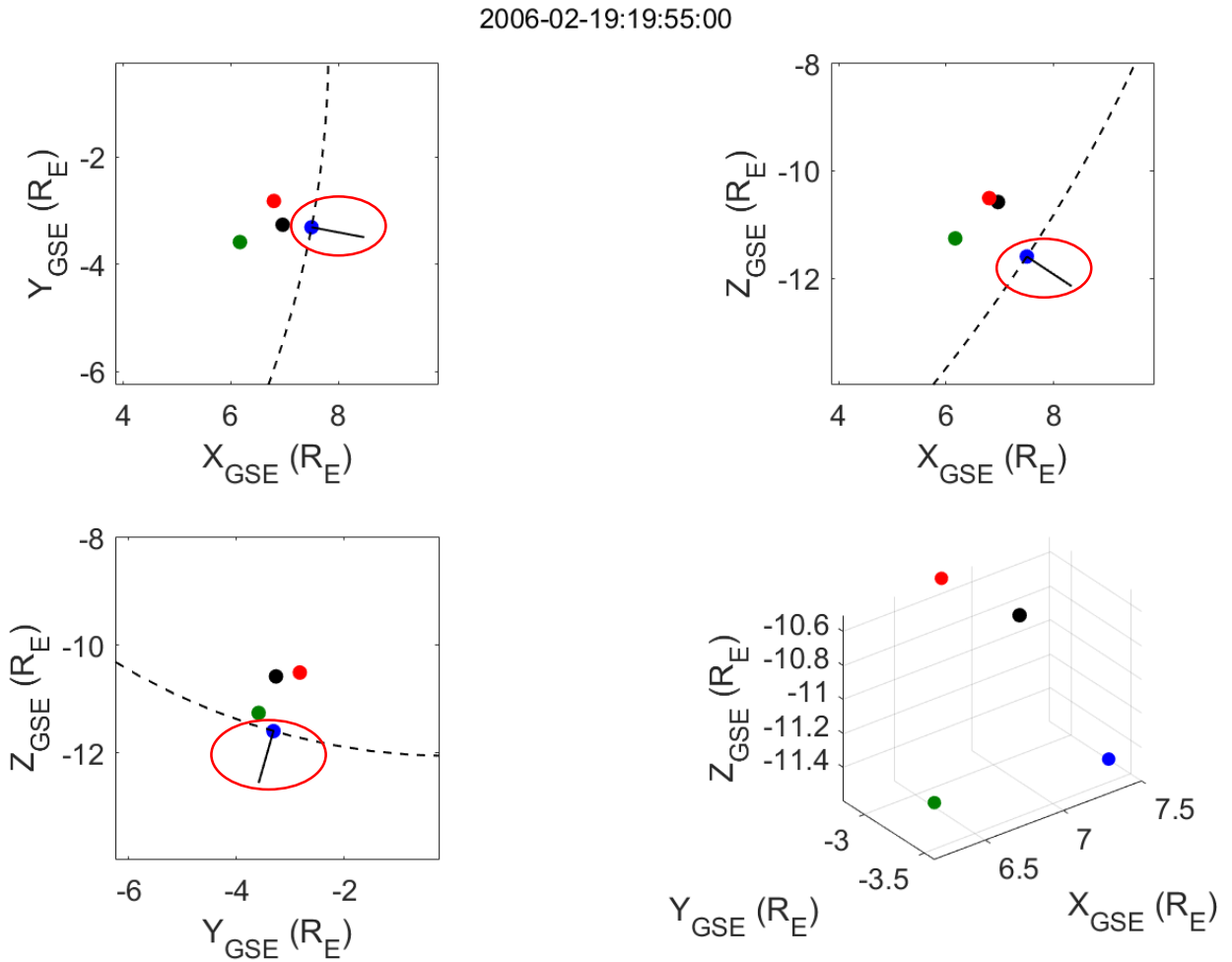
Magnetic Field stdev



Raptis, Karlsson, et al. (2020) | JGR
Karlsson, **Raptis**, et al. (2020) | Ongoing

Classification using Cluster

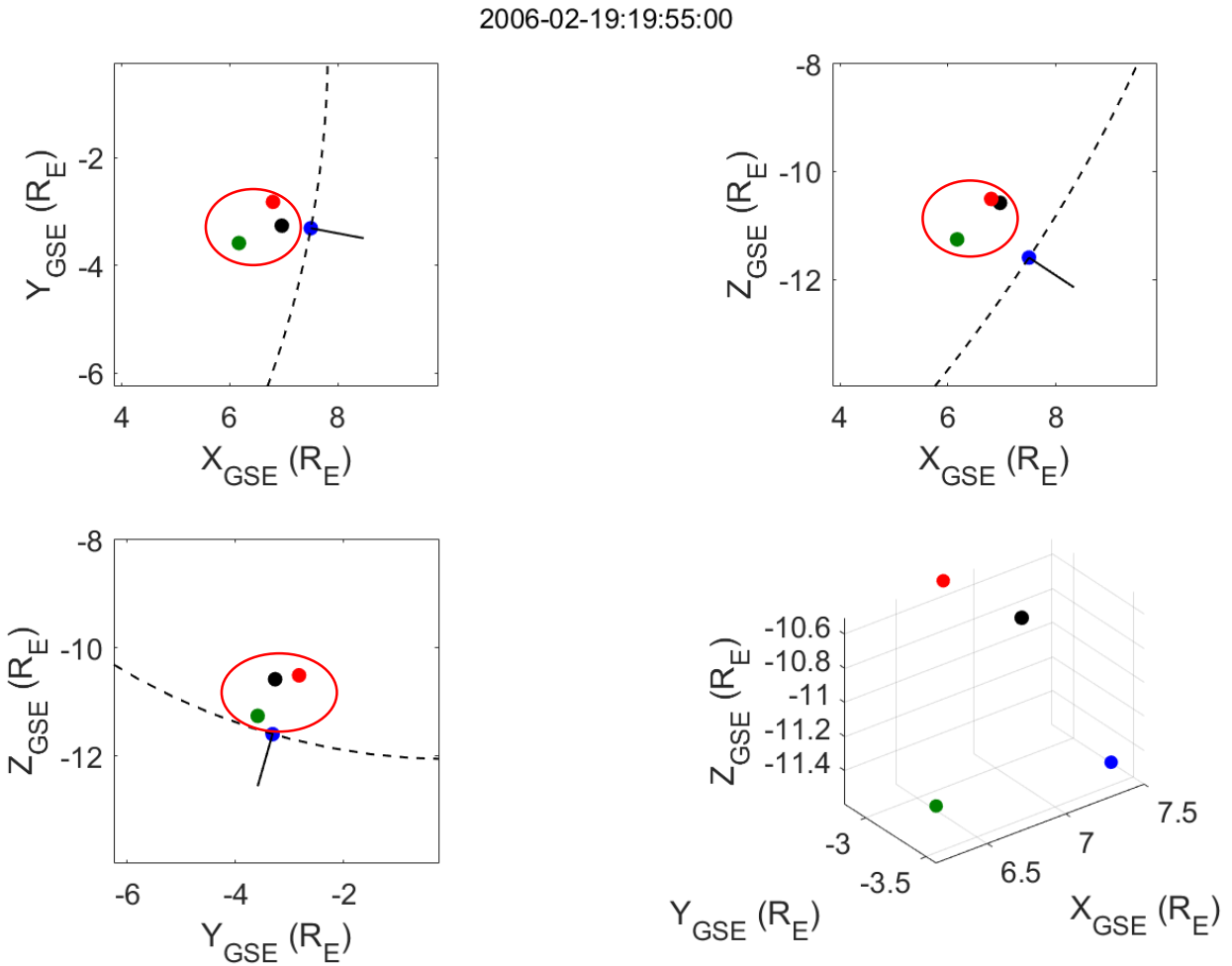
Multispacecraft validation



Karlsson, **Raptis**, et al. (2020) | Ongoing

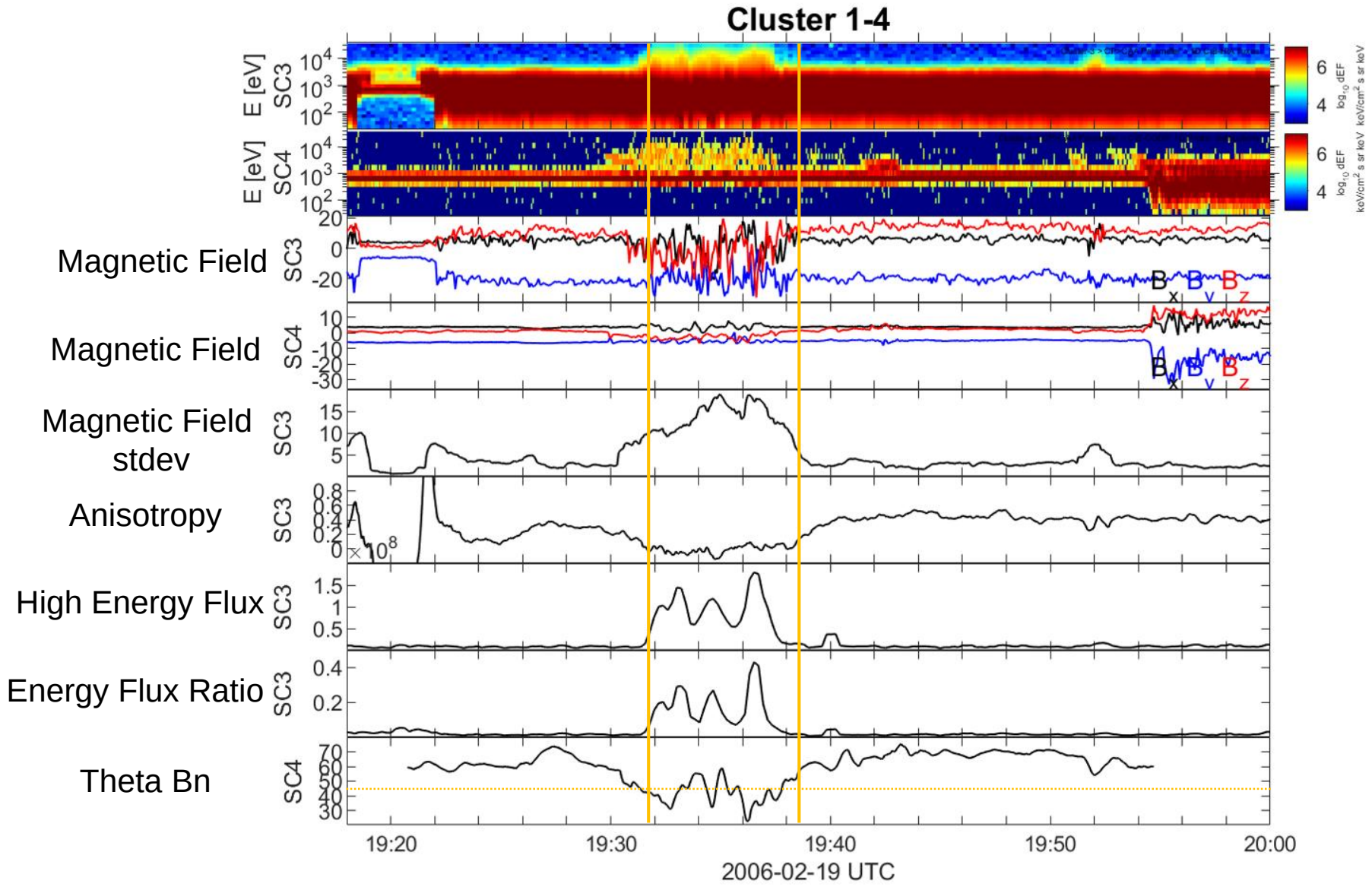
Classification using Cluster

Multispacecraft validation



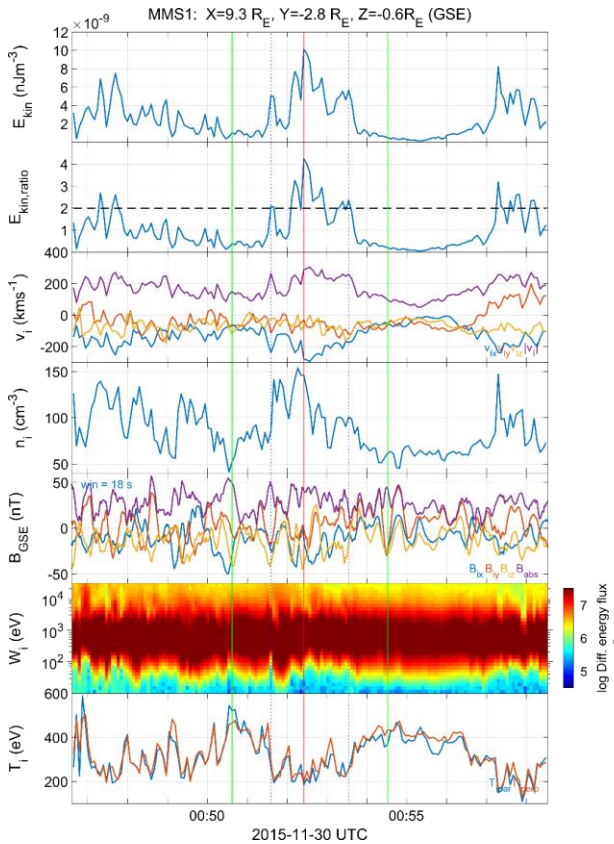
Karlsson, **Raptis**, et al. (2020) | Ongoing

Classification using Cluster



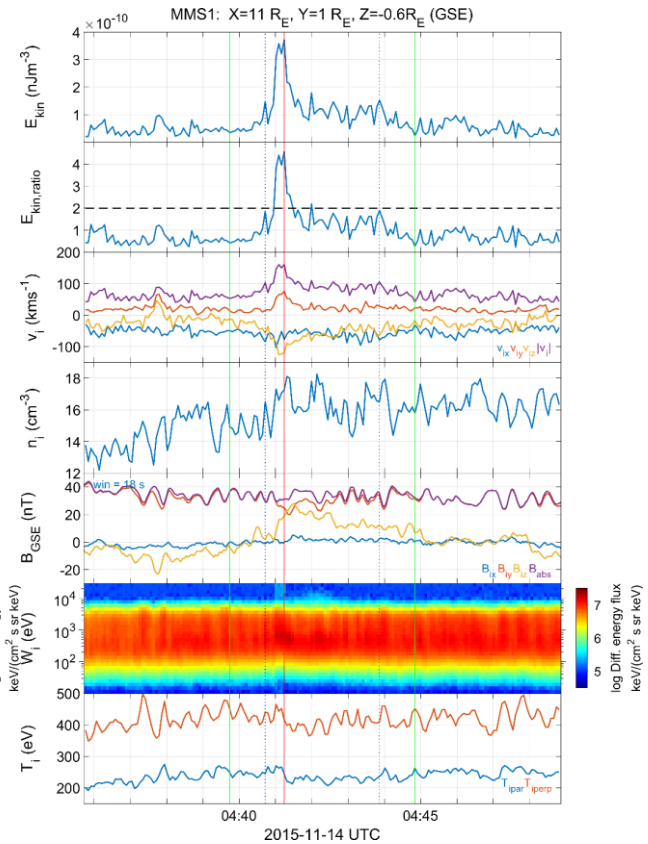
Karlsson, **Raptis**, et al. (2020) | Ongoing

Main Categories of Jets



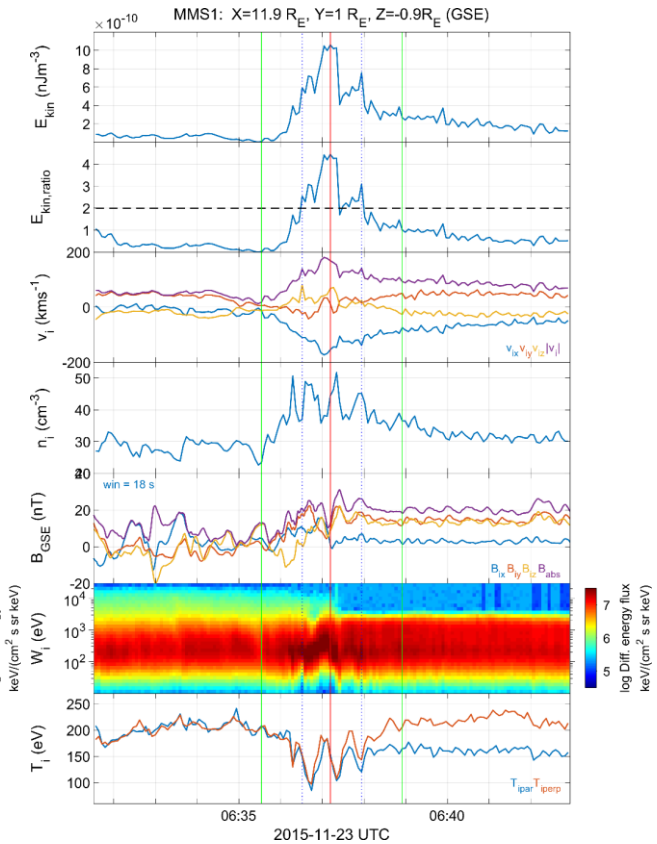
Qpar Jet

Jets found in $Q_{\parallel}$ MSH



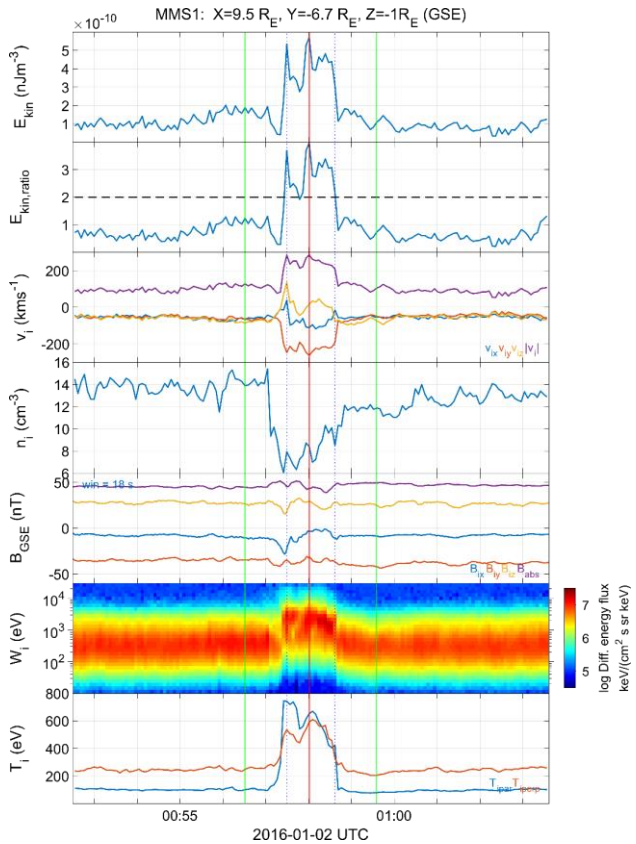
Qperp Jet

Jets found in $Q_{\parallel}$ MSH



Boundary Jet

Jets found in the boundary between $Q_{\parallel}$ and $Q_{\perp}$ MSH



Encapsulated Jet

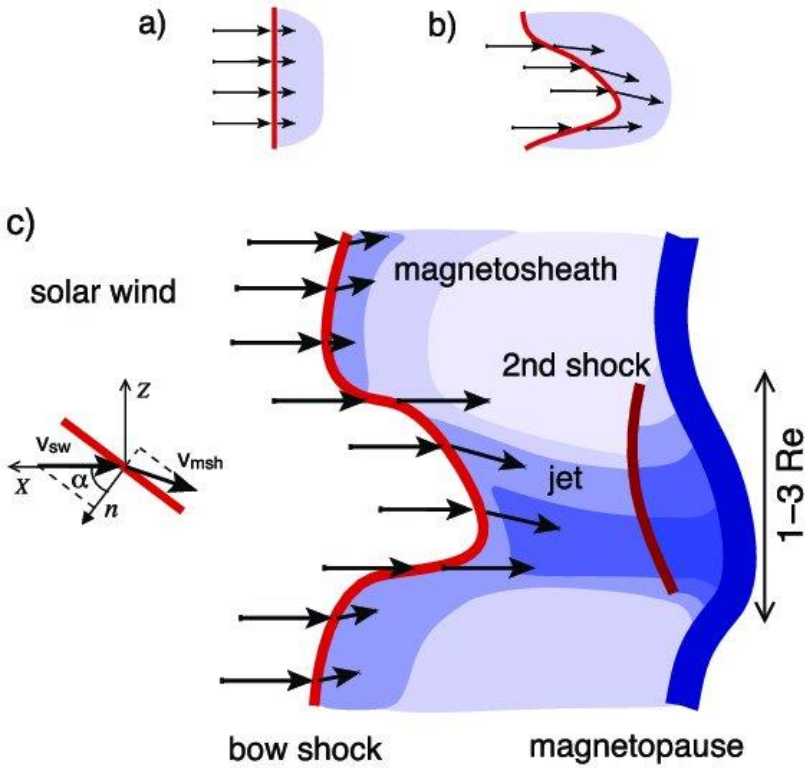
Jets corresponding to $Q_{\parallel}$-like MSH plasma enclosed in $Q_{\perp}$ MSH

Raptis S., Karlsson T., et al. (2020) | JGR
Raptis S., Aminalragia-Giamini S., et al. (2020) | Frontiers

“*Jets are there but we are not 100% sure why and how* “

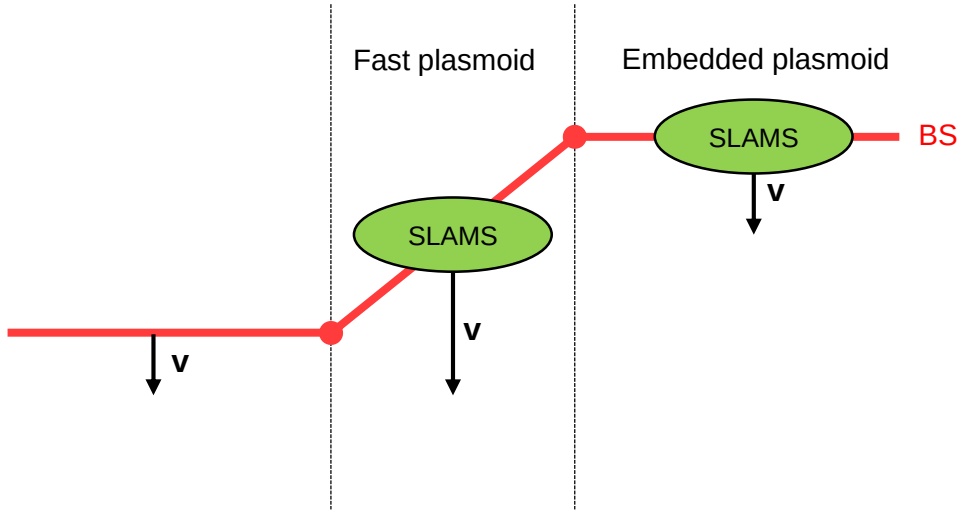
Connecting to existent mechanisms

Bow shock ripples



Faster flow (ΔV) → Less heated (ΔT)

SLAMS penetration

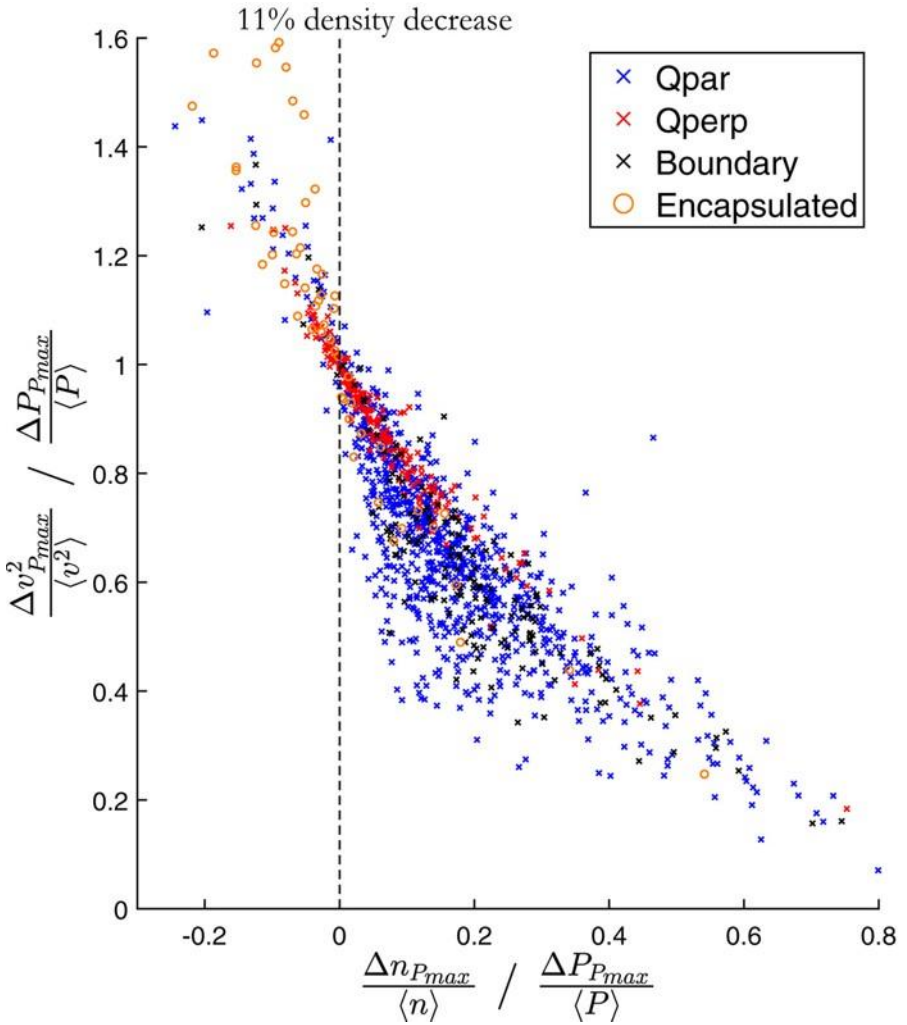


Steepened wave (ΔB) → Density enhancement (Δn)

Qpar : Hietala et al., (2009,2012) | Qperp : Johlander et al. (2016)

Hietala et al., (2009,2012), Karlsson et al. (2015)

Current main results (1)

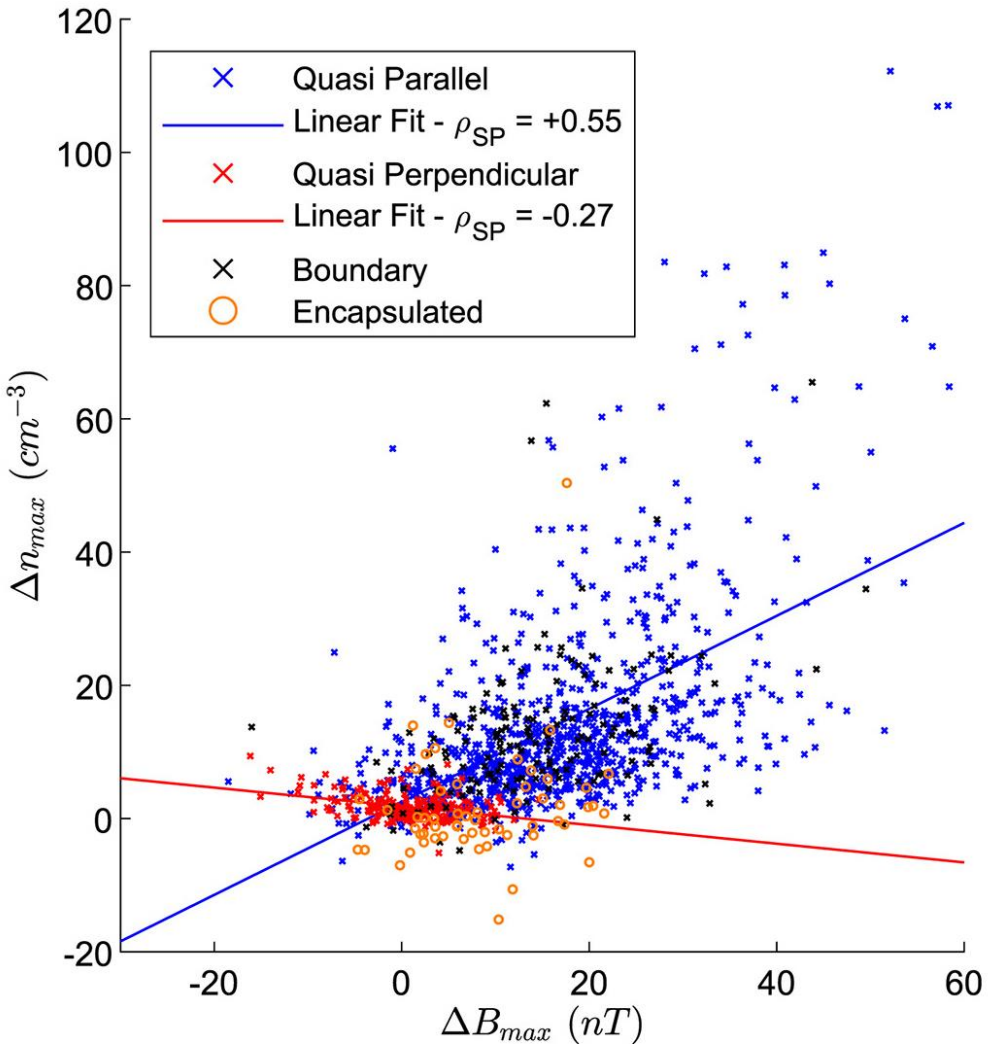


Raptis S., Karlsson T., et al. (2020) | JGR
Raptis S., Aminalragia-Giamini S., et al. (2020) | Frontiers

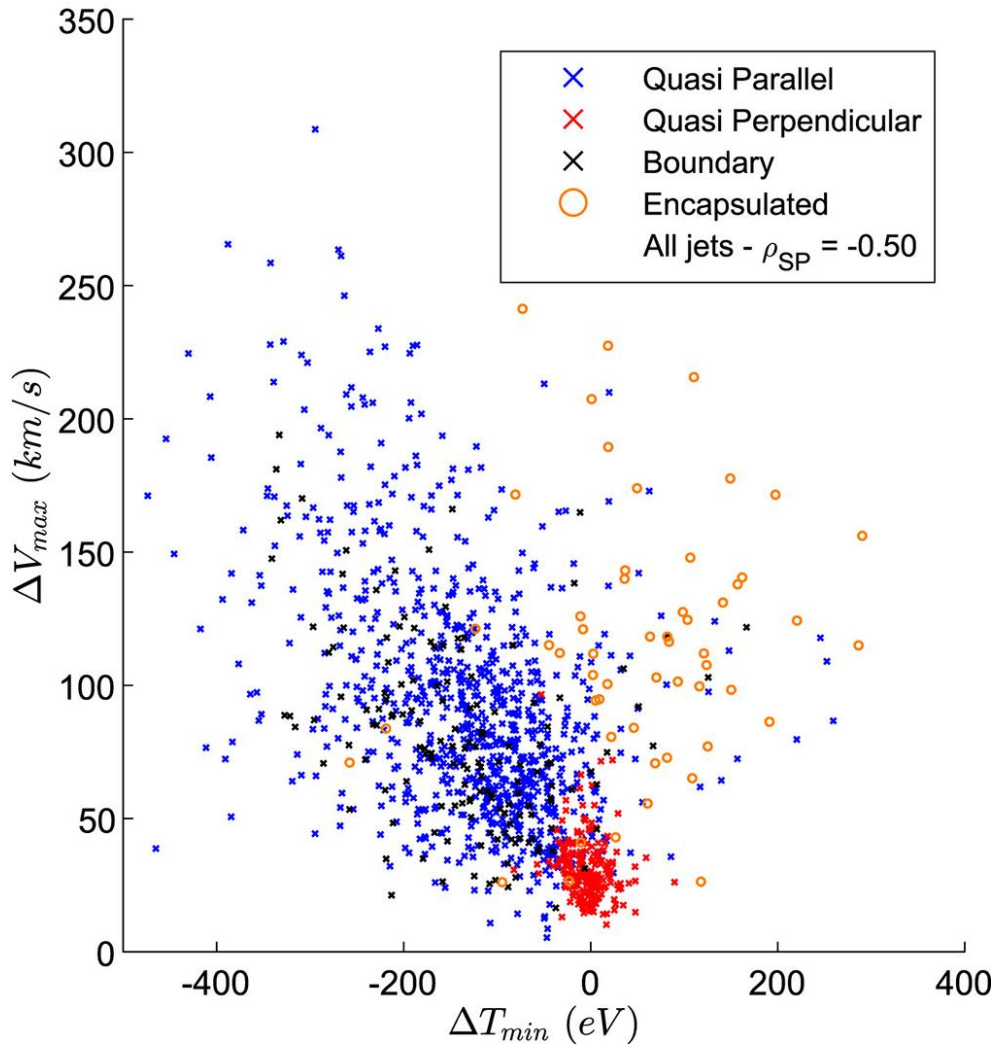
Current main results (2)

$$\Delta X = \mathrm{X_{jet}} - \langle \mathrm{X_{BG}} \rangle_{5\mathrm{min}}$$

SLAMS



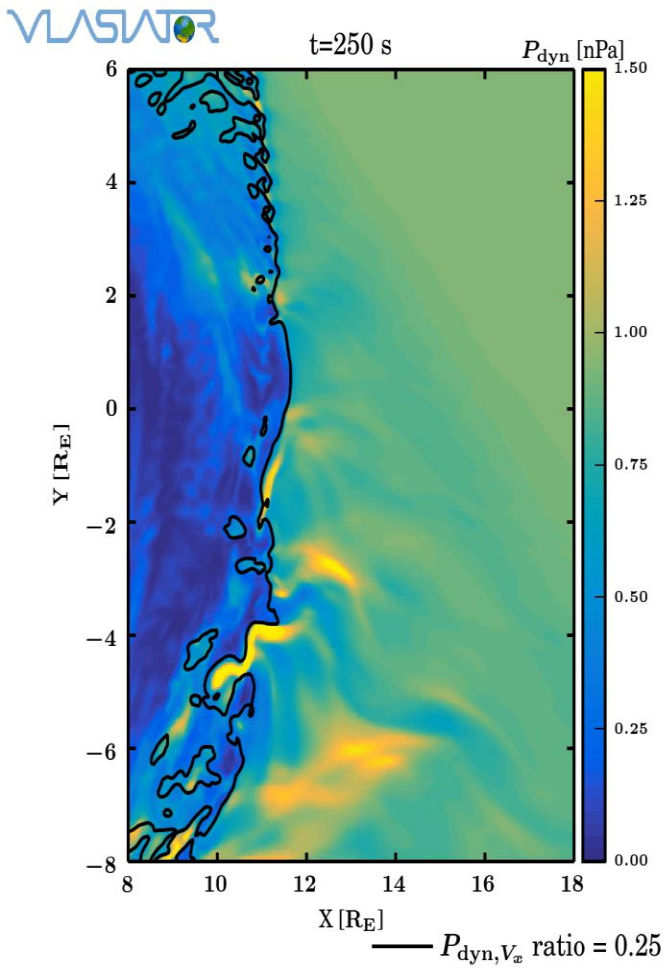
Ripples

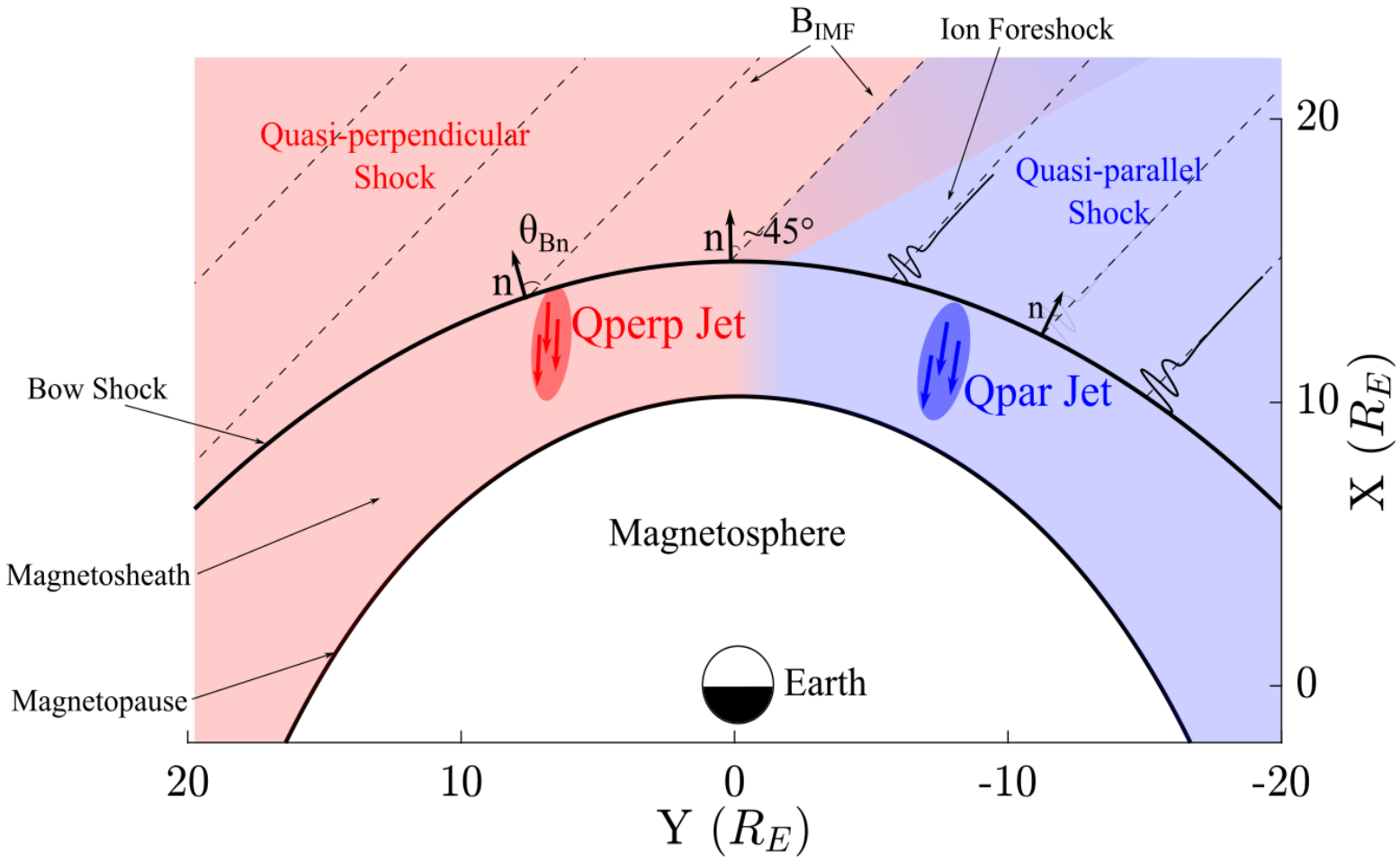


Raptis S., Karlsson T., et al. (2020) | JGR

Ongoing Work

Ongoing work – Approaching the shock

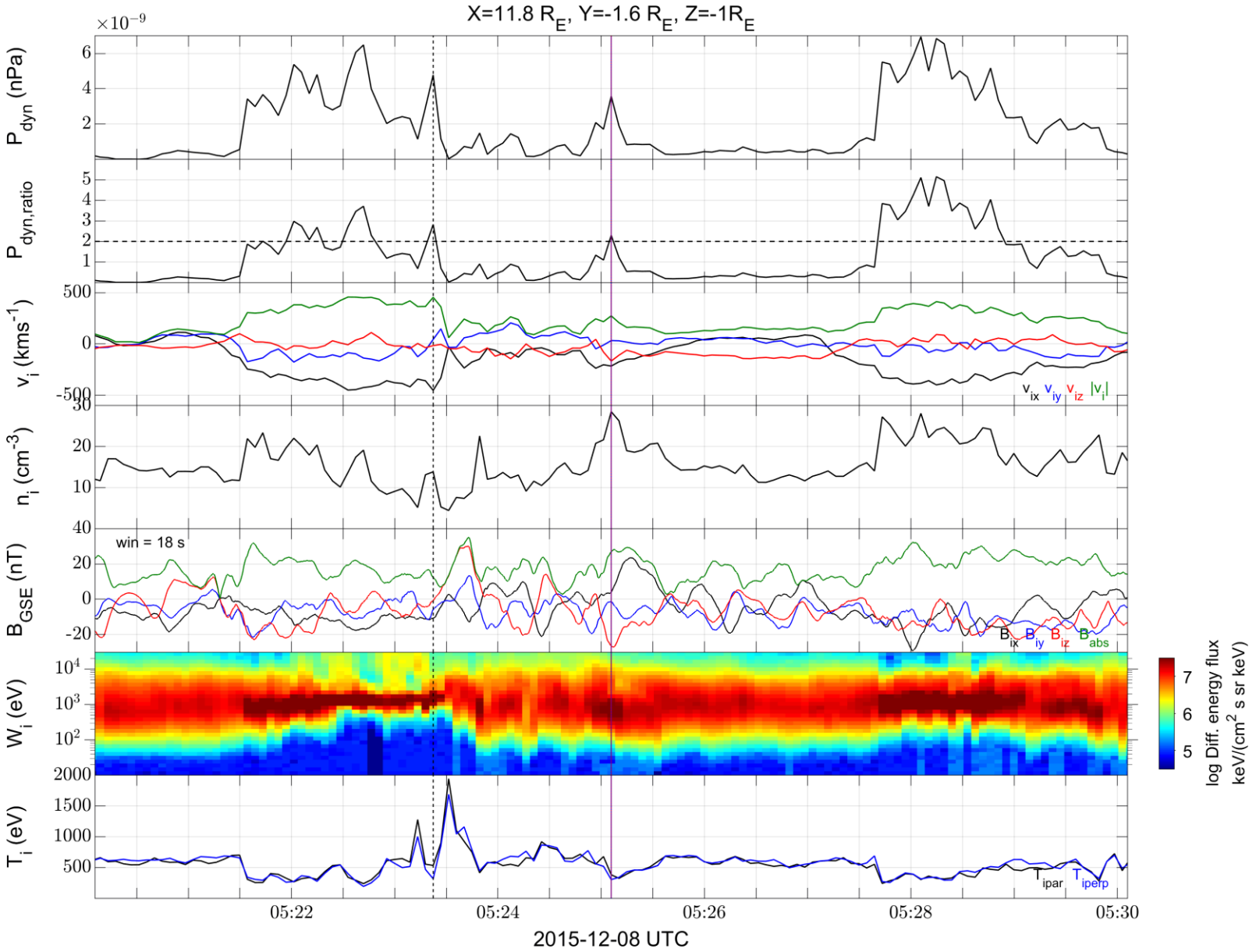




Palmroth M., **Raptis S**., et al. (2020) | Annales (under review)
Palmroth M., et al. (2018) | Annales

Raptis S., Aminalragia-Giamini S., et al. (2020) | Frontiers

Close to the bow shock jet



Raptis, Karlsson, et al. | Ongoing

Updated database of jets

Initial: N = 8499

Subset	Number	Percentage (%)
Quasi-parallel	2284	26.9
Final cases	**860**	10.1
Quasi-perpendicular	504	5.9
Final cases	**211**	2.5
Boundary	744	8.8
Final cases	**154**	1.8
Encapsulated	77	0.9
Final cases	**57**	0.7
Other	4890	57.5
Unclassified/Uncertain	3499	41.2
Border	1346	15.8
Data Gap	45	0.5

09/2015 - 04/2019

Raptis S., Karlsson T., et al. (2020) | JGR
Raptis S., Aminalragia-Giamini S., et al. (2020) | Frontiers
Palmroth M., **Raptis S**., et al. (2020) | Annales (under review)

Updated: N = 9196

Subset	Number	Percentage (%)
Quasi-parallel	2458	26.7
Final cases	**901**	10.1
Quasi-perpendicular	542	5.9
Final cases	**214**	2.3
Boundary	781	8.5
Final cases	**191**	2.1
Encapsulated	80	0.9
Final cases	**60**	0.7
Other	5335	58.0
Unclassified/Uncertain	3789	41.2
Border	1500	16.3
Data Gap	46	0.5

9/2015 - 9/2020

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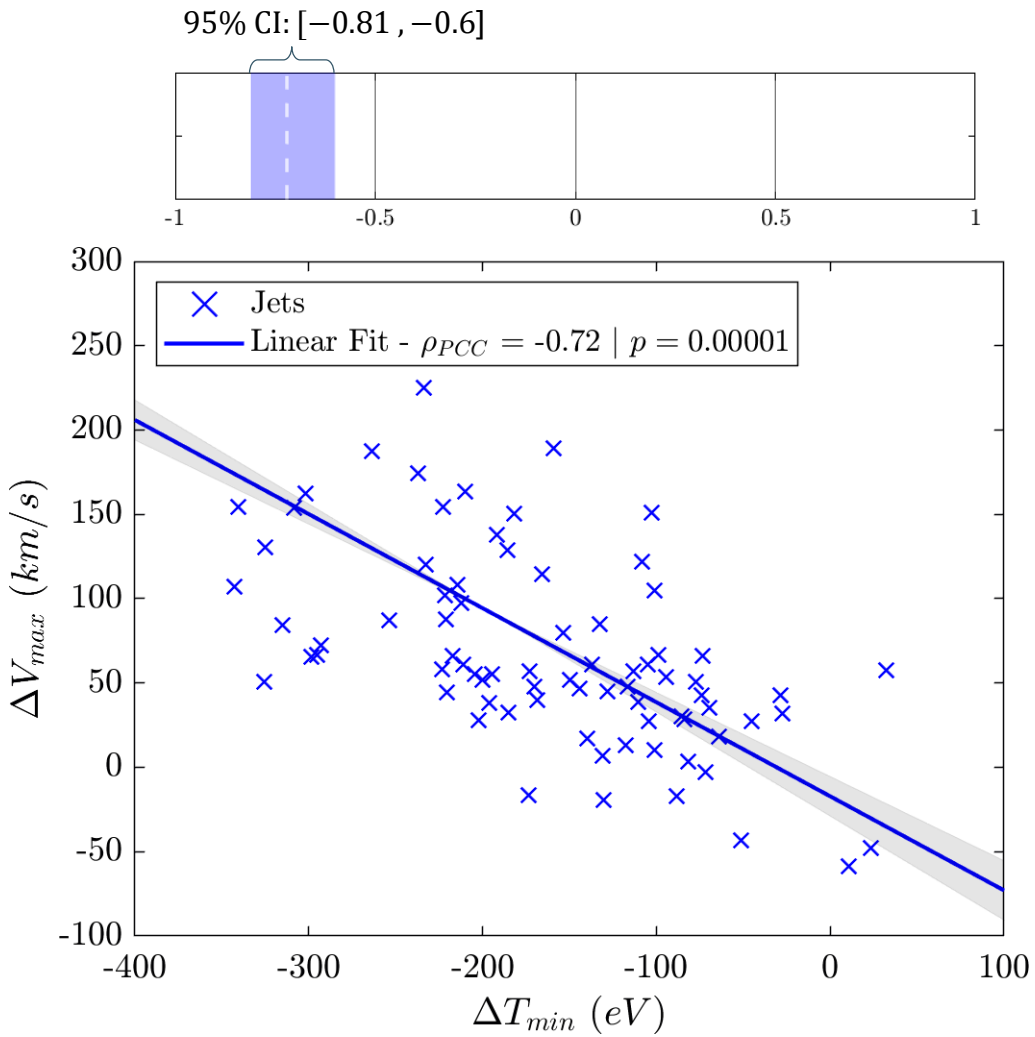
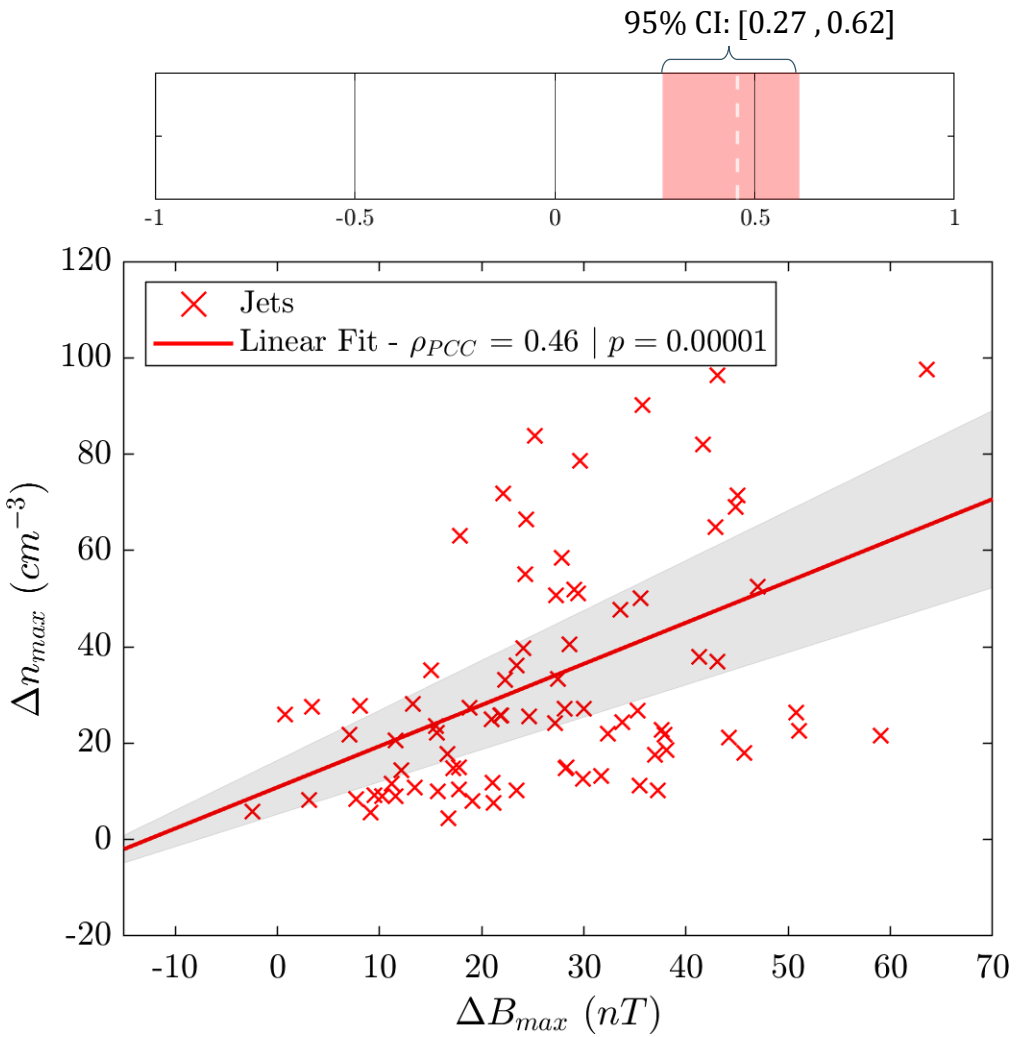
Ongoing Results

$n = 90$

Ripples



SLAMS



Raptis, Karlsson, et al. | Ongoing

Summary & Conclusion

Good indication that existent mechanism are at least partially responsible for what we see.

Quite a few things to be done:

- See class specific correlations close to the bow shock.
- Check other tools of connecting mechanisms (time series analysis, mutual information, prediction power scores, machine learning etc.)
- Search for other generation mechanisms (e.g. reconnection Preisser et. al. 2020 | ApJL).
- Inspect for statistical artifacts (e.g. partial shock crossings)

Excited results in the upcoming months!