



Quasi-parallel & Quasi-perpendicular Magnetosheath Jets Using MMS

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Swedish Space Plasma Meeting 2019

2019/02/07, Uppsala

Magnetosheath Jets

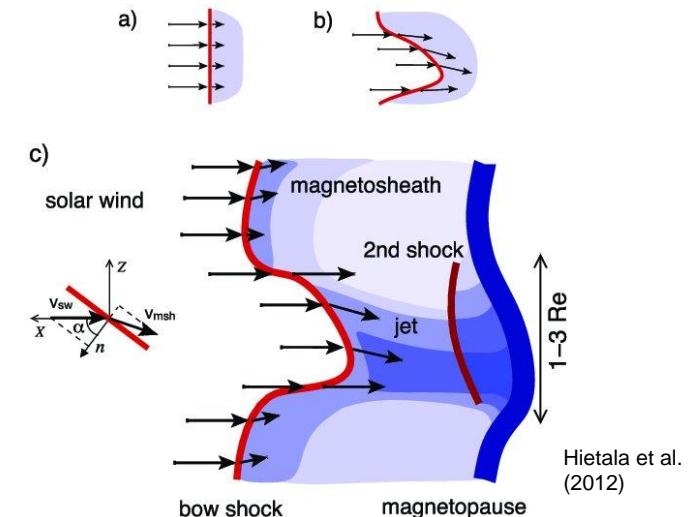
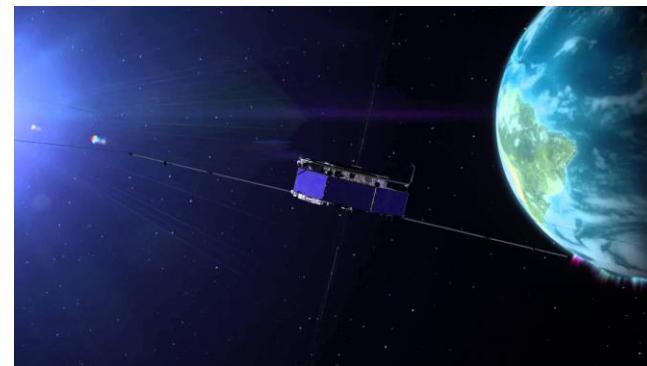
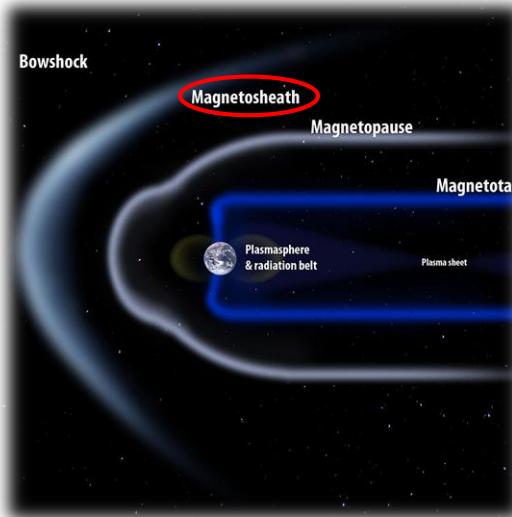
What: Enhancements of dynamic pressure above the general fluctuations level.

Where: Magnetosheath

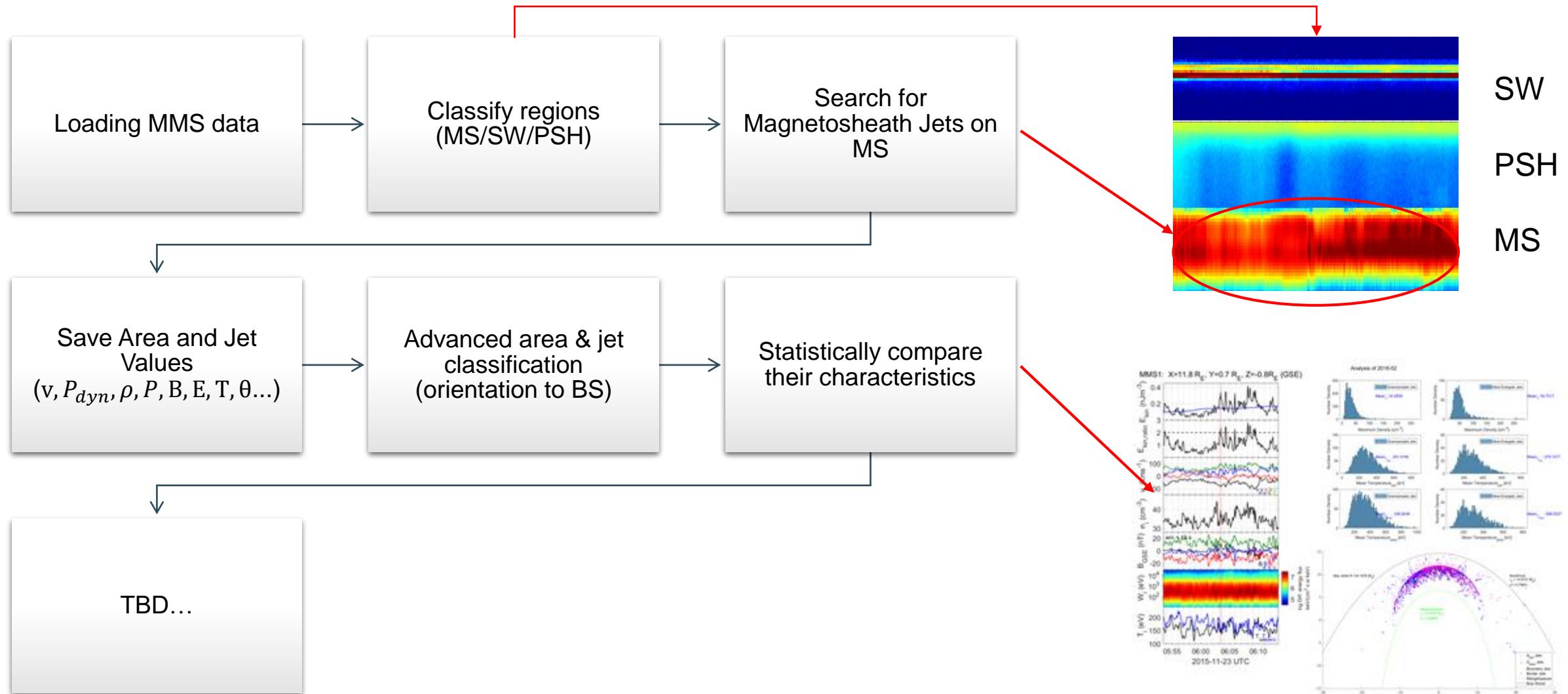
Data: MMS

How: Many possible mechanisms (Foreshock waves, SW Discontinuities, Magnetic reconnection etc.)

Why: Interaction of SW & Magnetosphere, magnetopause reconnection, radiation belts, auroral features...



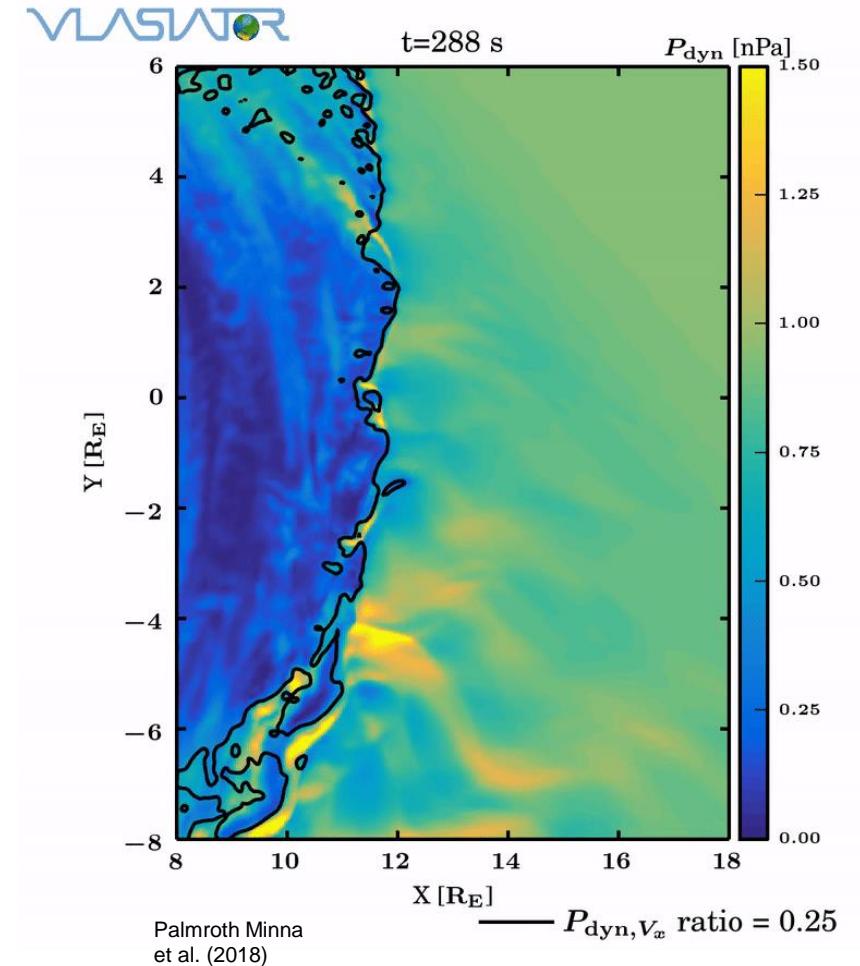
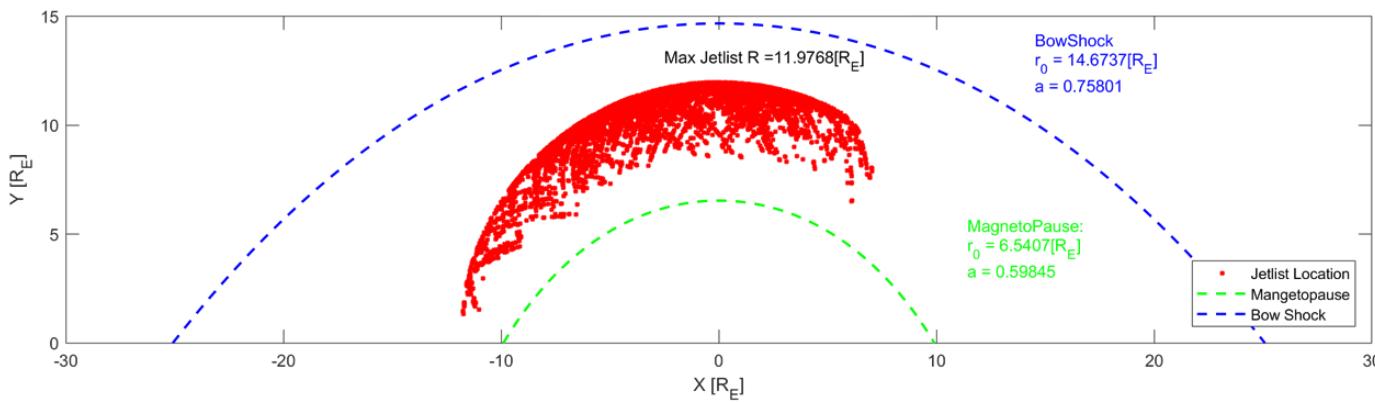
Searching for Jets



Derived database for Jets

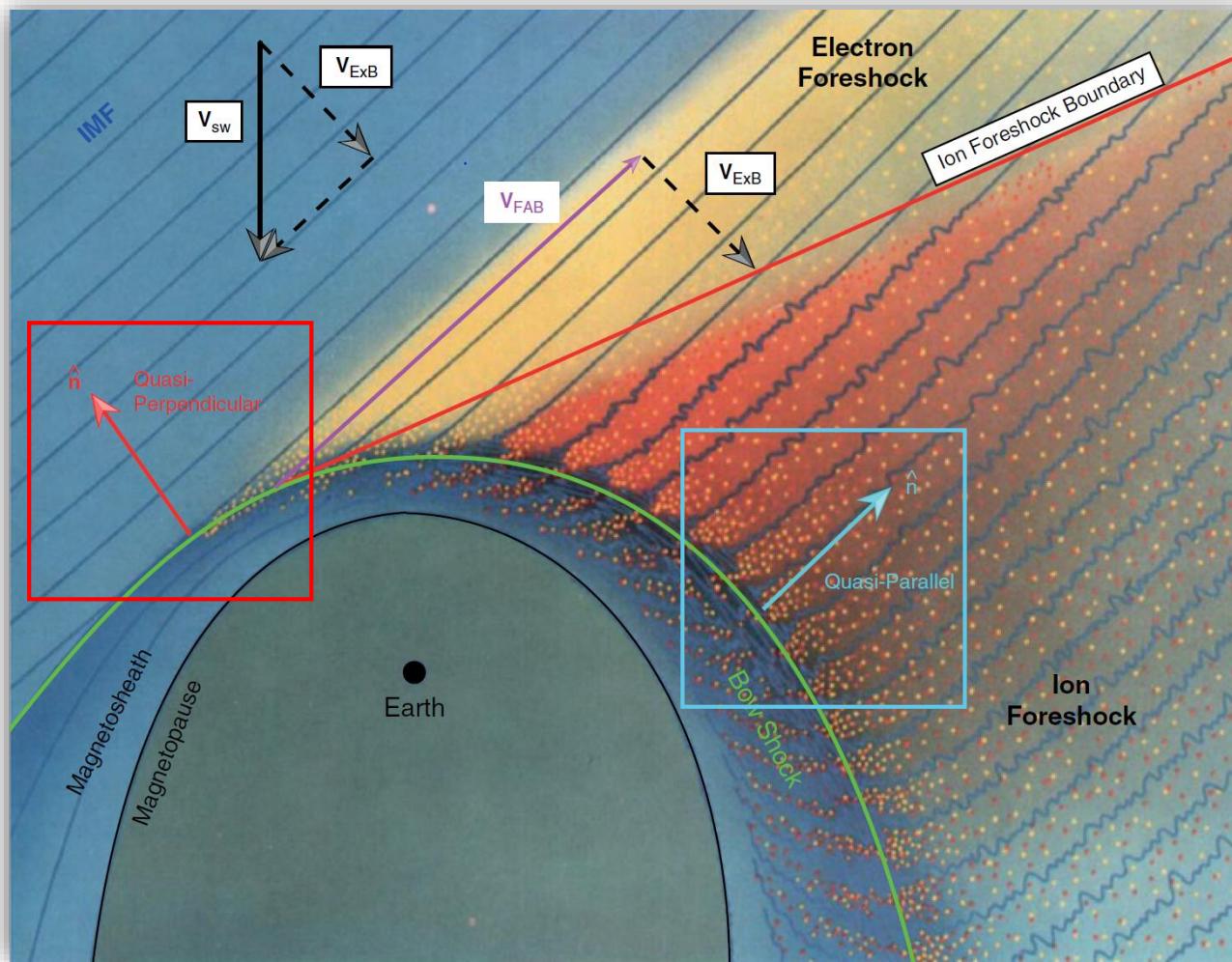
Time Period
1/9/2015 – 1/12/2018

Total	Downsampled $dt < 60$ s	High Energy $E_{kin} > 3 \text{ nJ m}^{-3}$
13050	7020	817



Palmroth Minna
et al. (2018)

Motivation – Subcategories



L. B. Wilson (2016)

Fact: Fluctuations are found mainly in Quasi-parallel shock ($\theta_n < 45^\circ$).

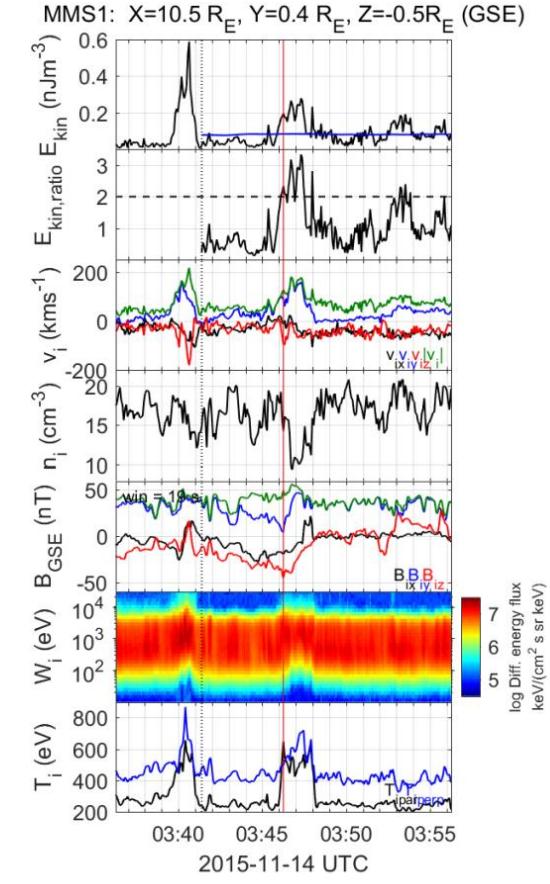
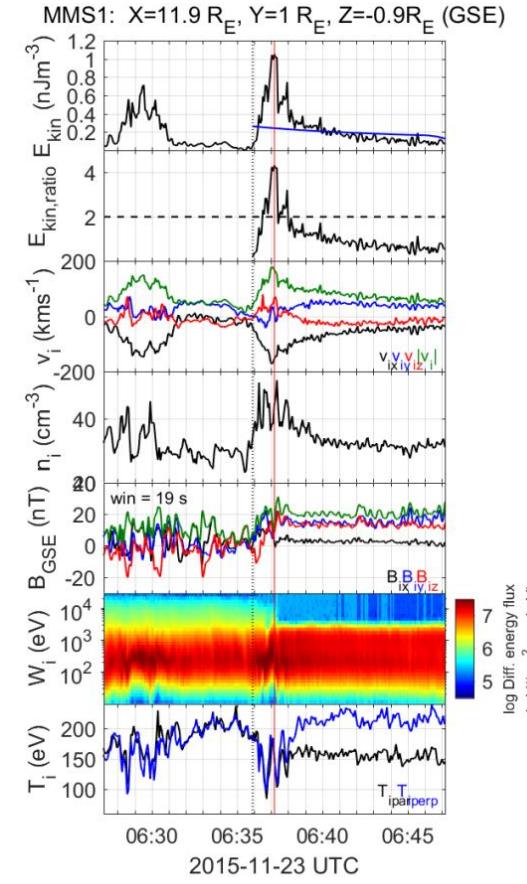
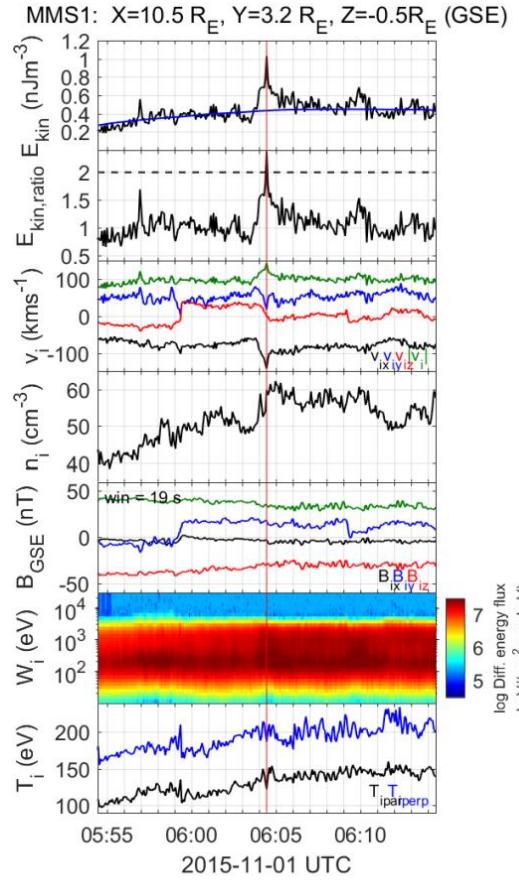
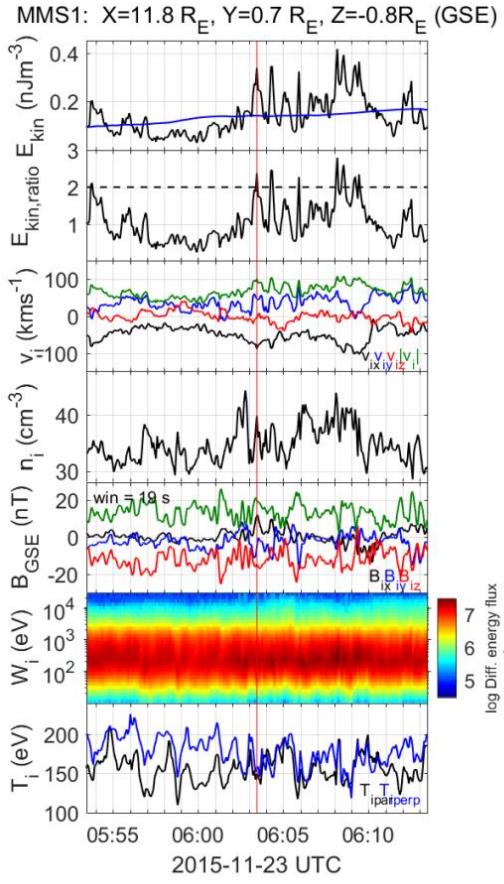
However, fluctuations also found in Quasi Perpendicular regions.

Hypothesis of different type of jets, origin, generation mechanism & characteristics.

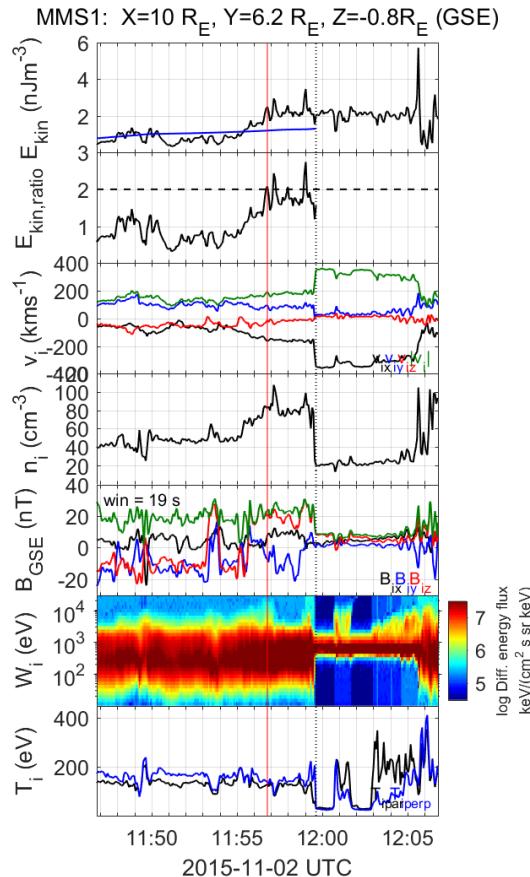
Q_{par}	Q_{per}	Boundary
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Preliminary Results

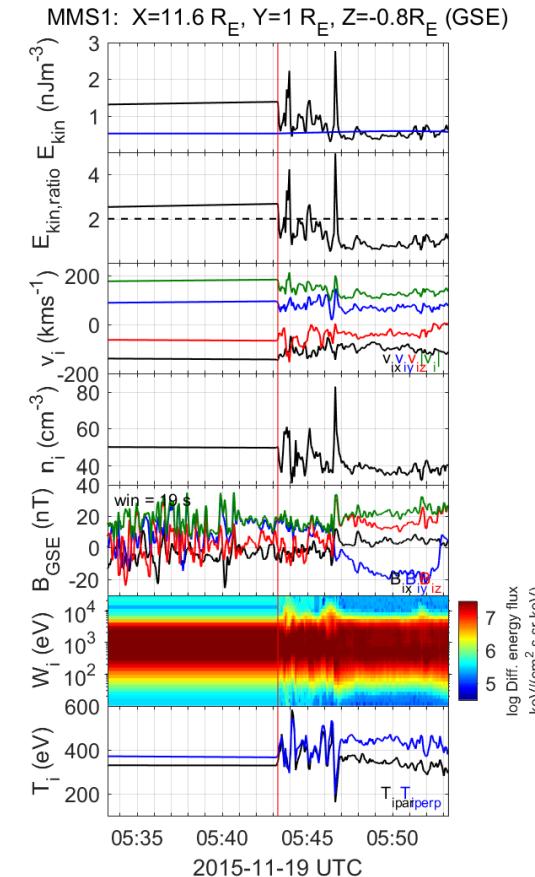
Main Categories



“Necessary Evil” Categories

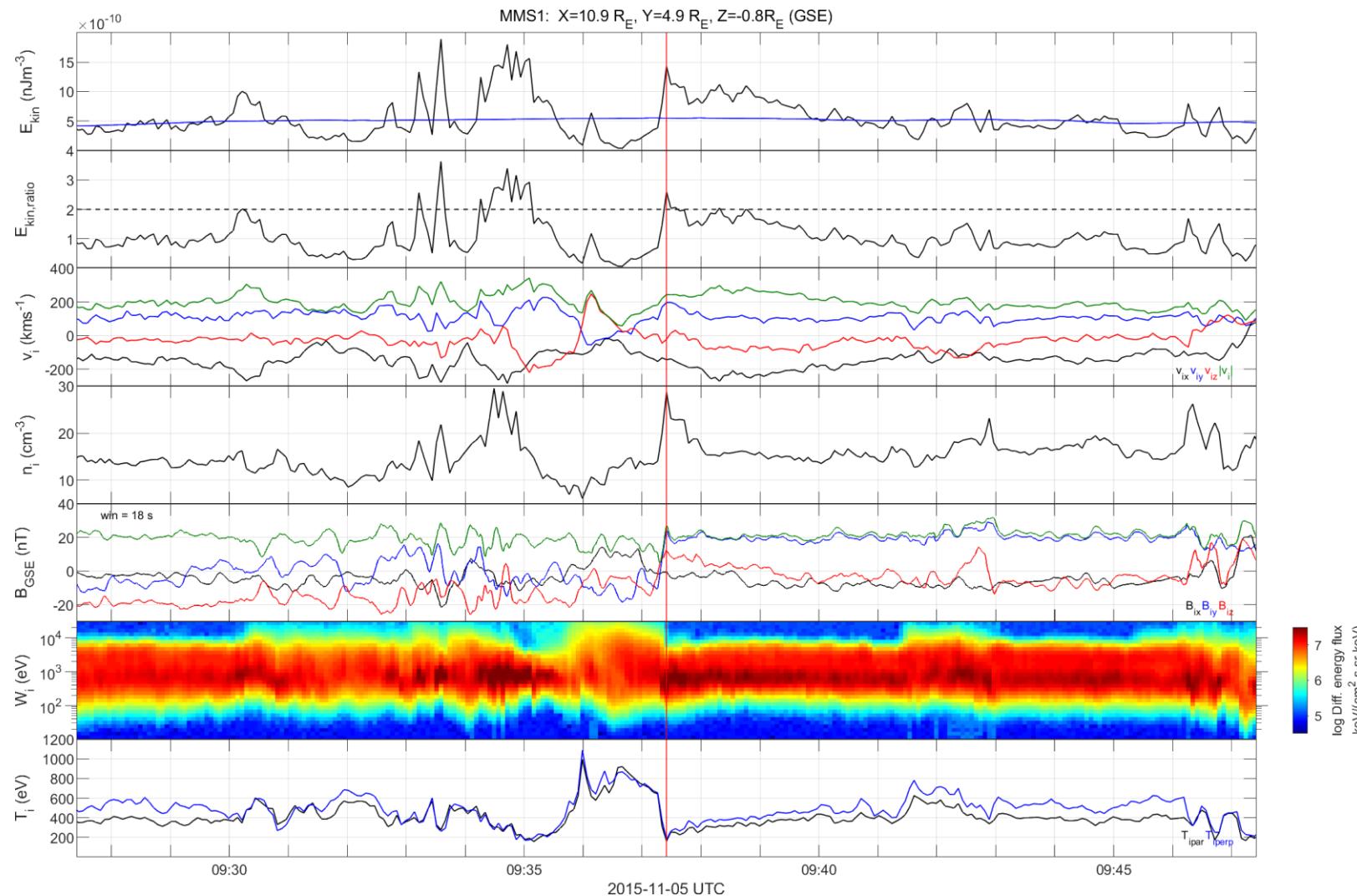


Border Jets

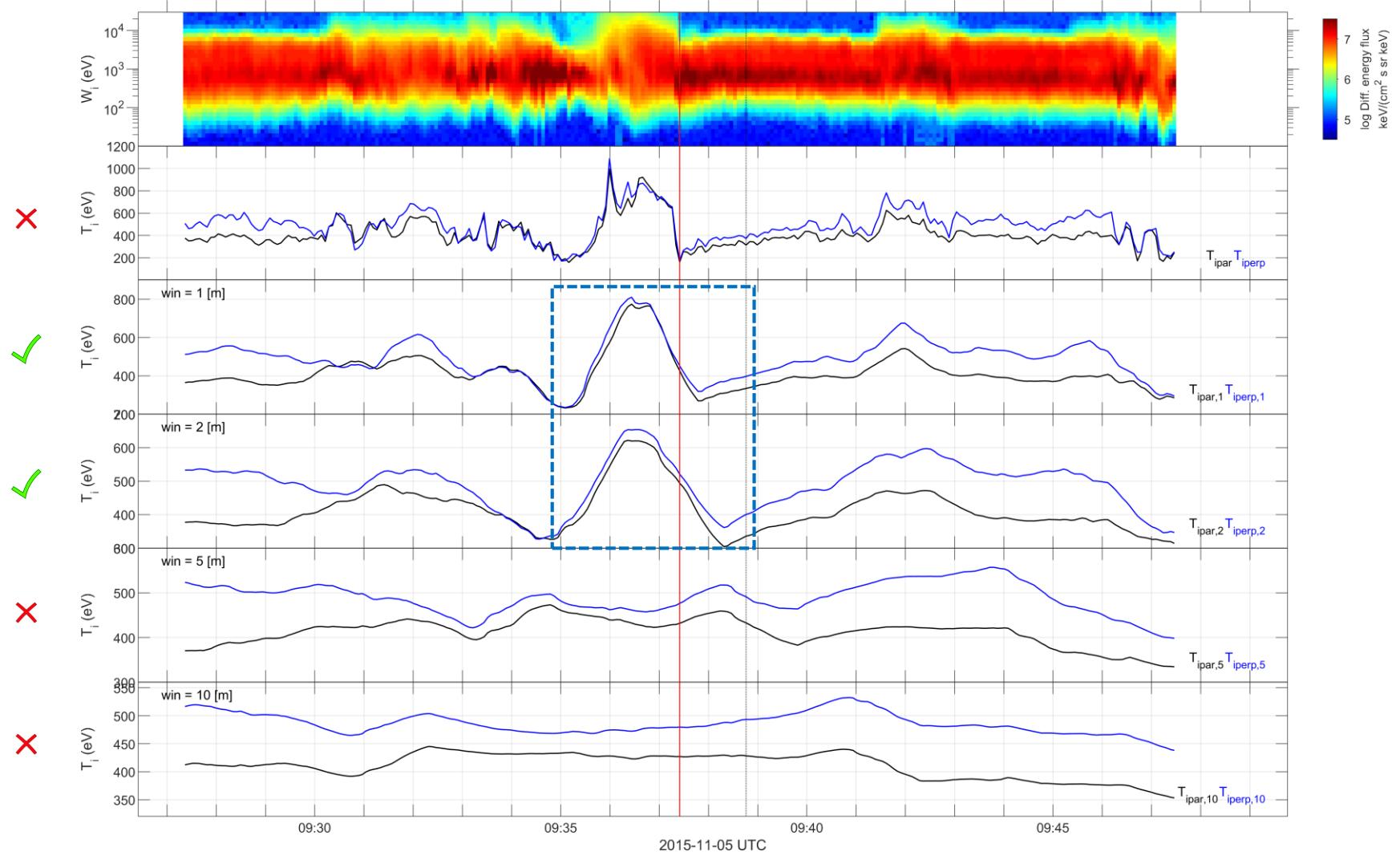


Unclassified Jets

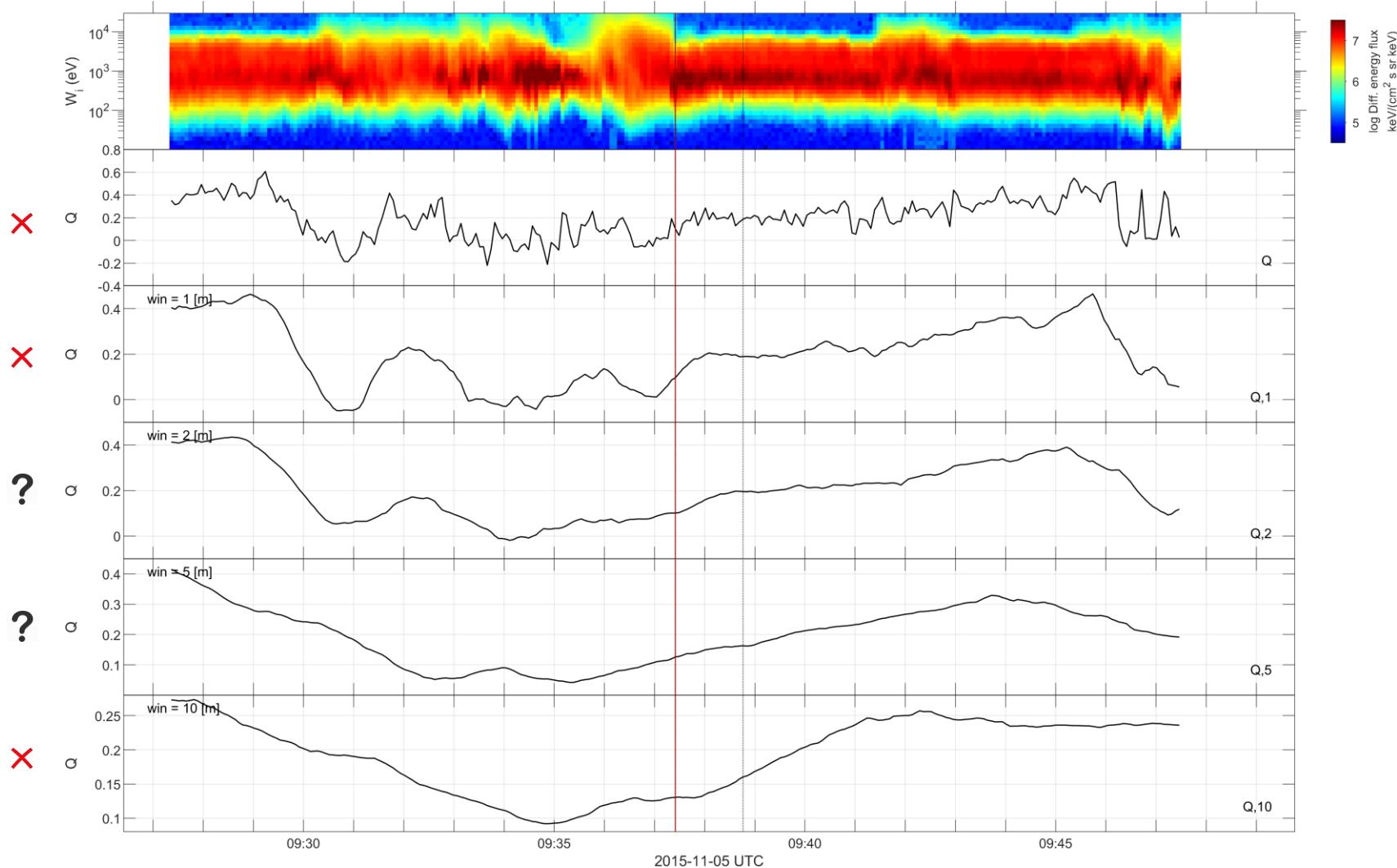
Boundary Example



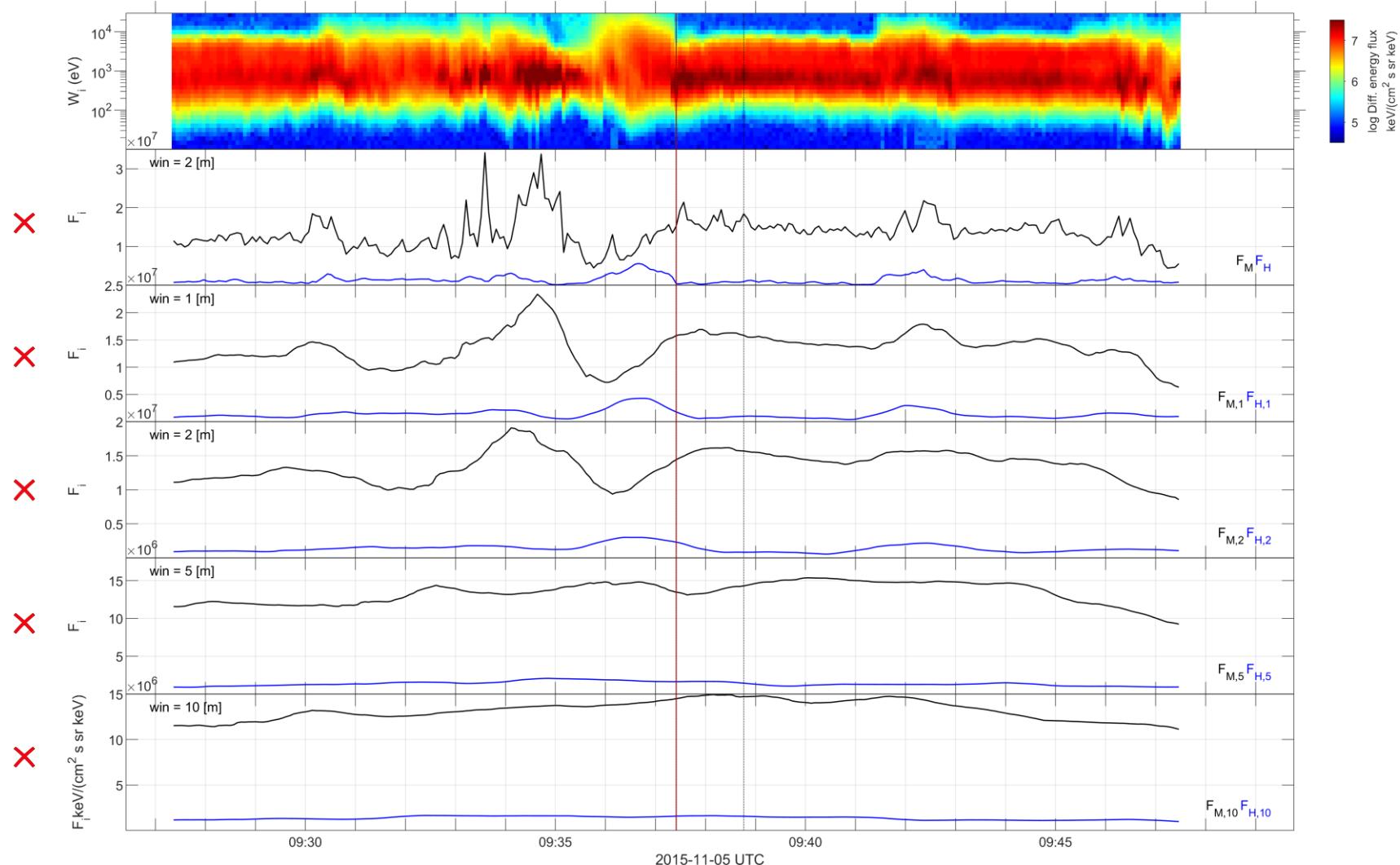
Classifying Jets – Boundary Example – Temperature



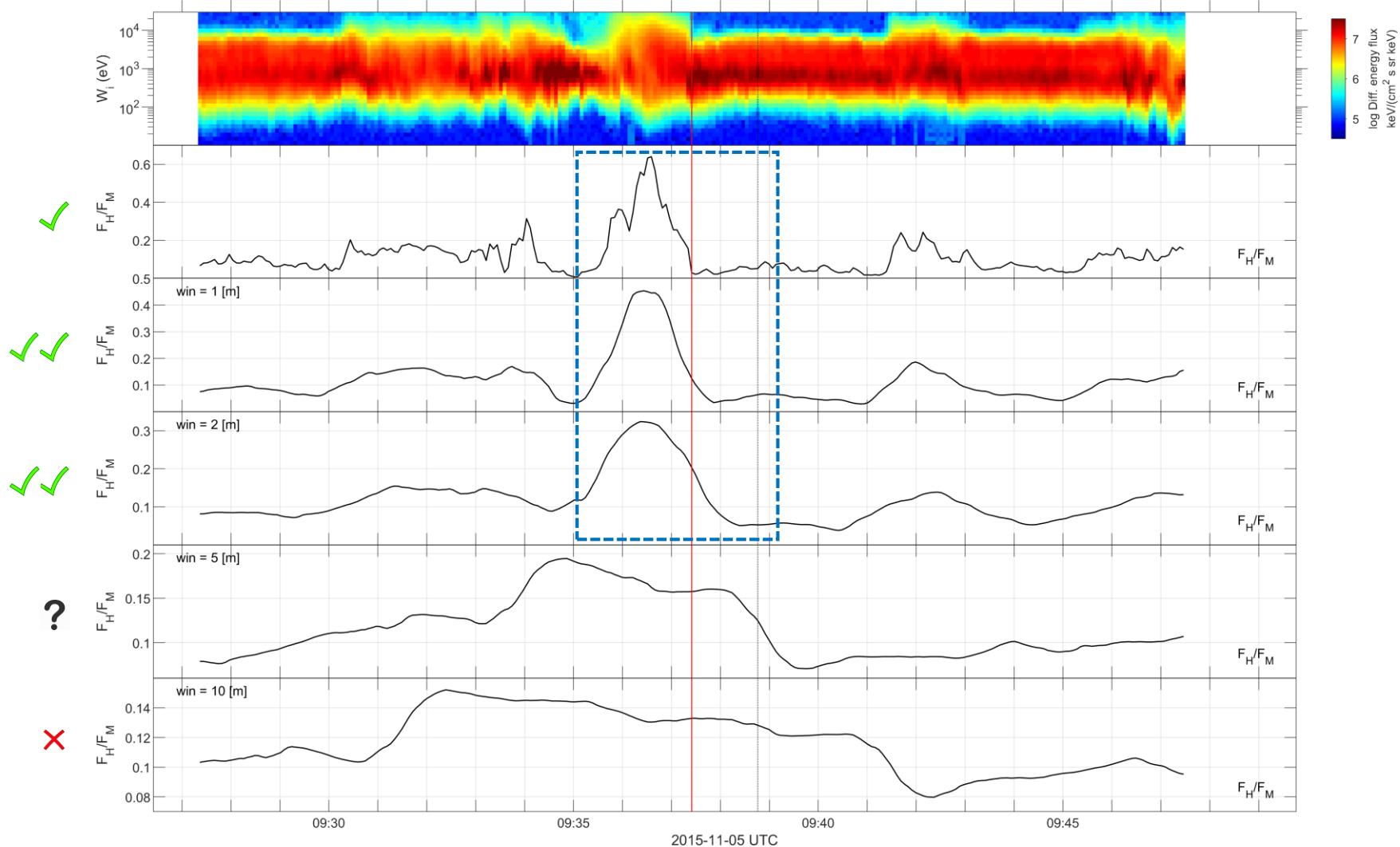
Classifying Jets – Boundary Example – Anisotropy



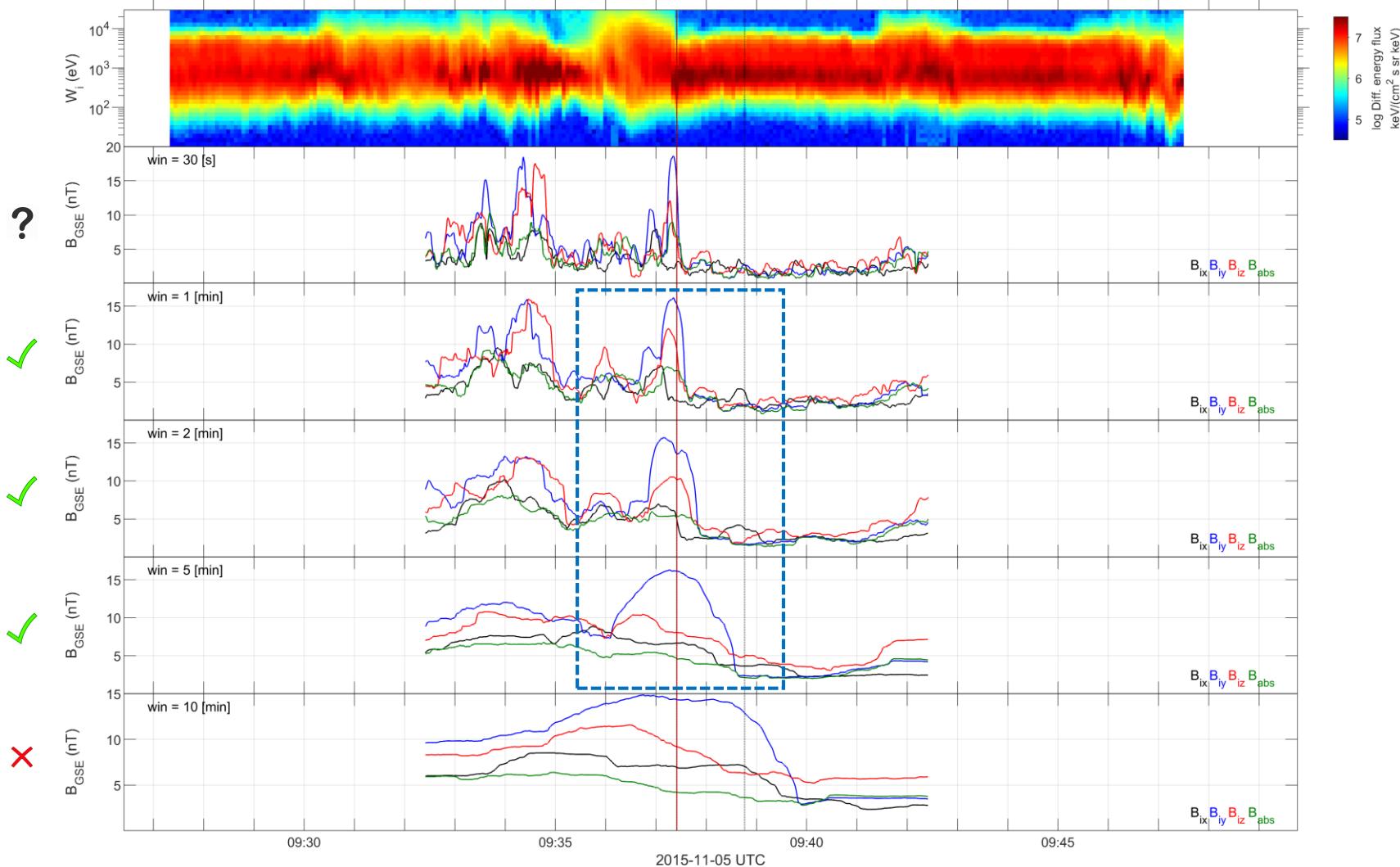
Classifying Jets – Boundary Example – Flux



Classifying Jets – Boundary Example – Flux Ratios



Classifying Jets – Boundary Example – $\text{STD}(\vec{B})$



Updated database for Jets (Example)

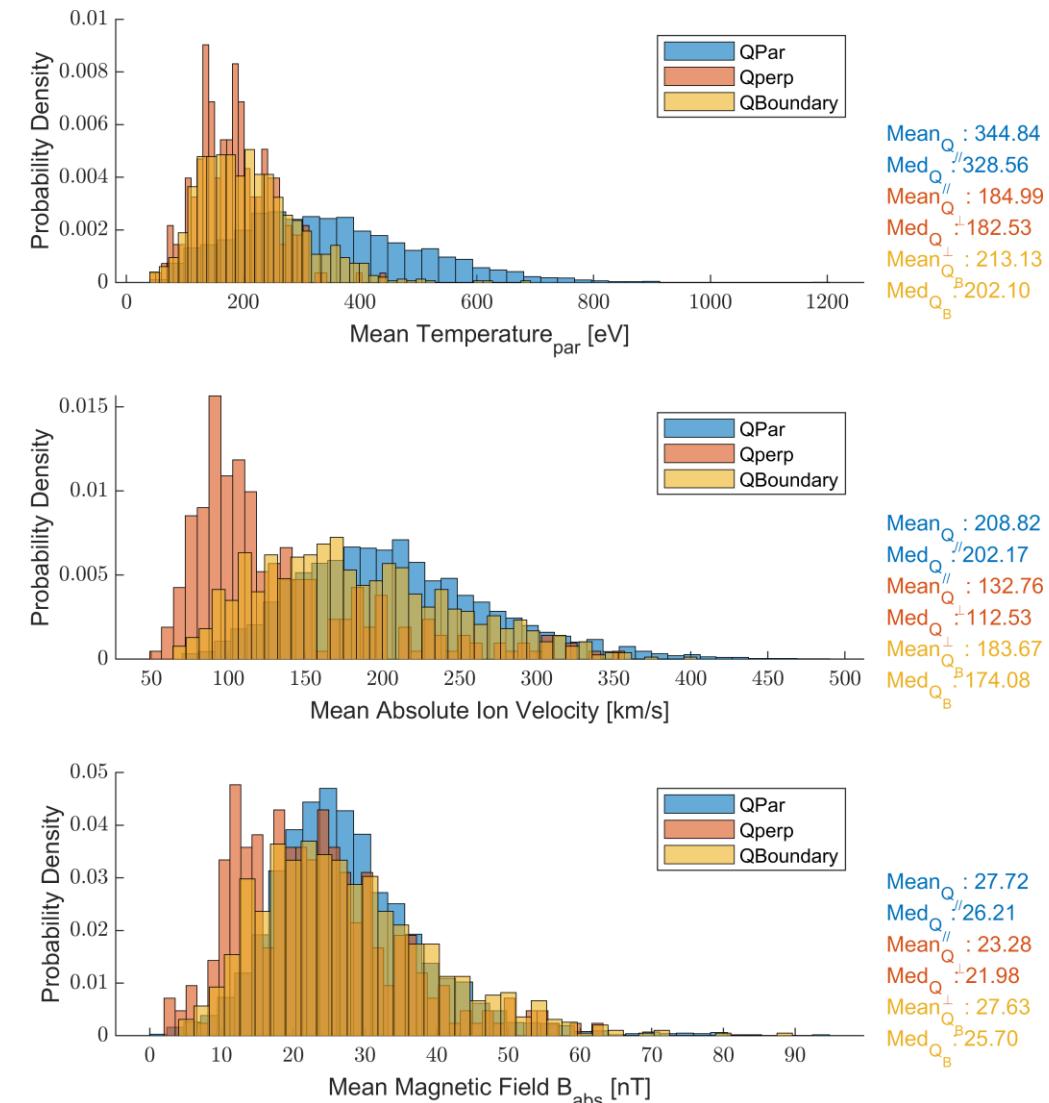
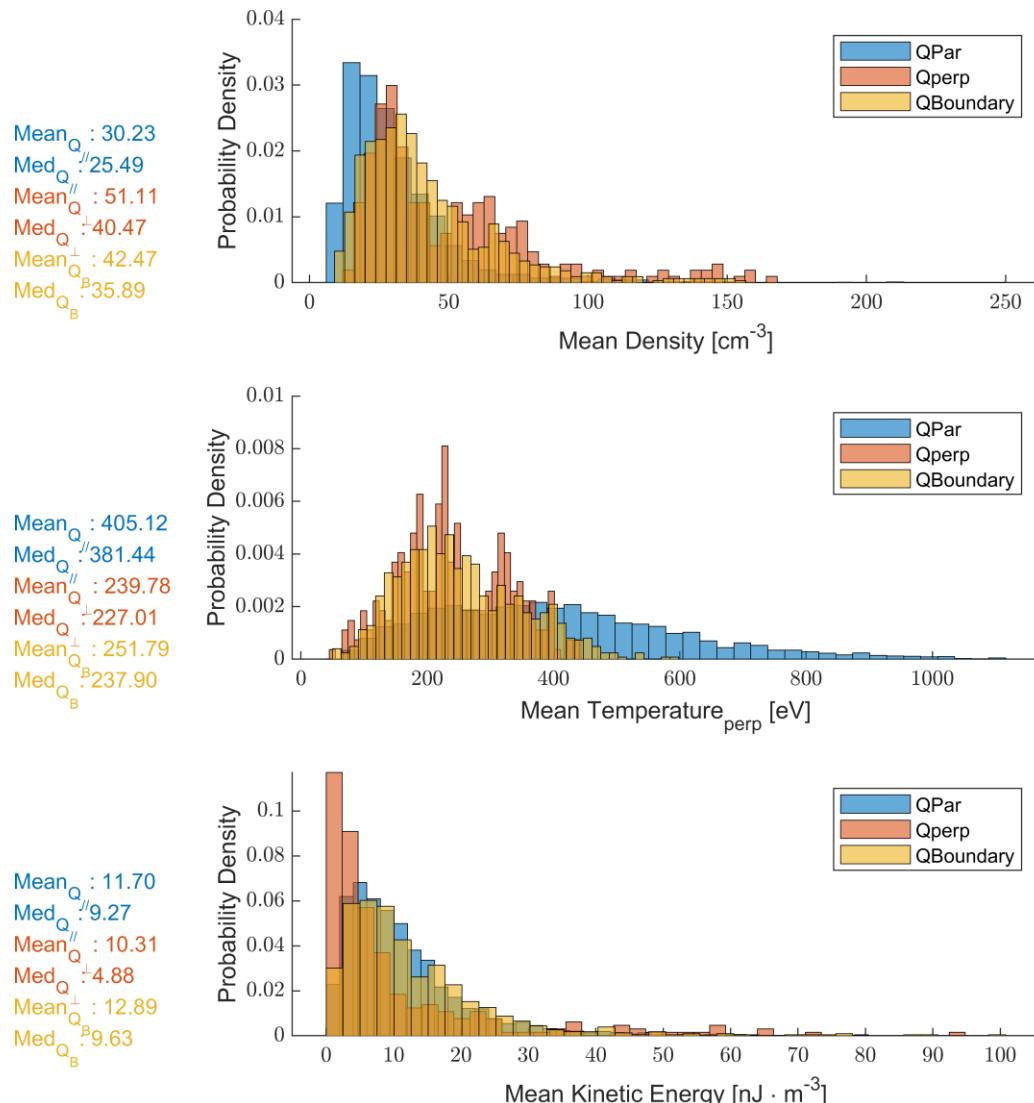
Time Period
1/9/2015 – 1/12/2018

Downsampled $dt < 60$ [s]	Quasi – Parallel jets	Quasi – Perpendicular jets	Boundary Jets	Border Jets	Unclassified/ Unknown
7020	4174	274	910*	690	962

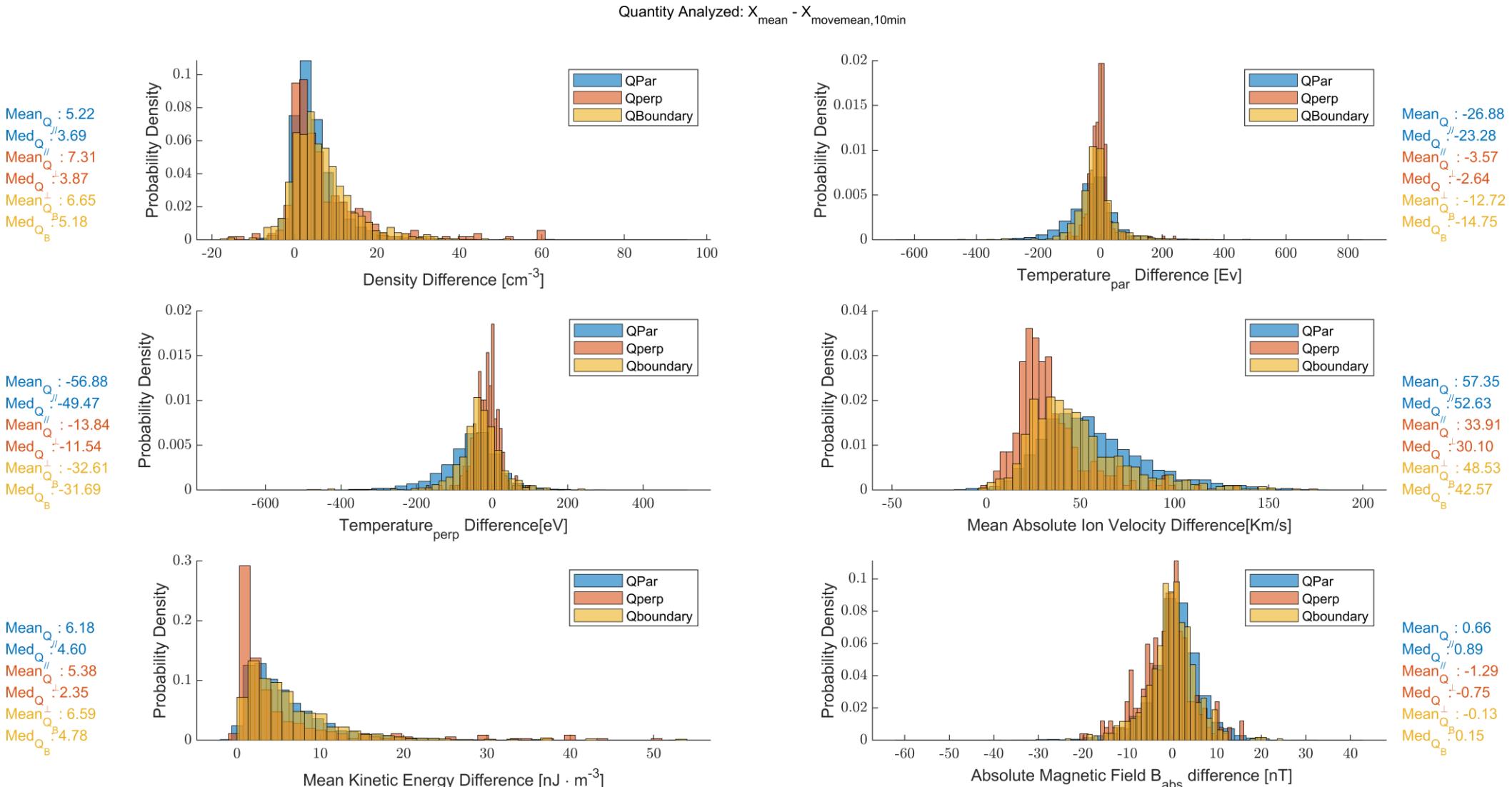
$$Q_{\text{par}} > 0.05 \left(\frac{F_H}{F_m} \right)_5$$

$$Q_{\text{perp}} < 0.02 \left(\frac{F_H}{F_M} \right)_5$$

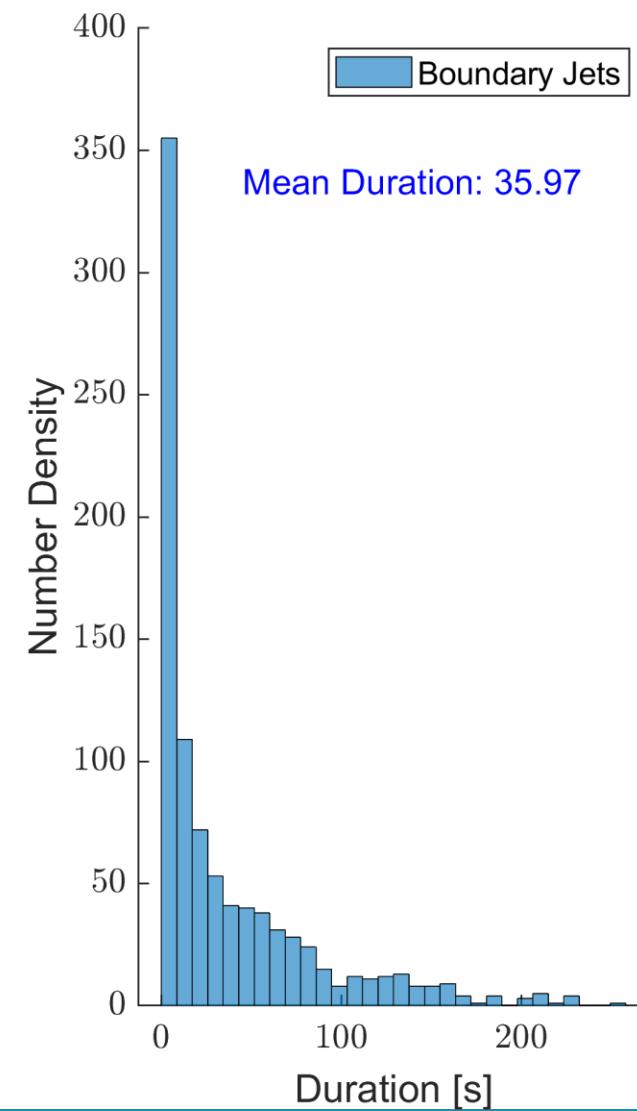
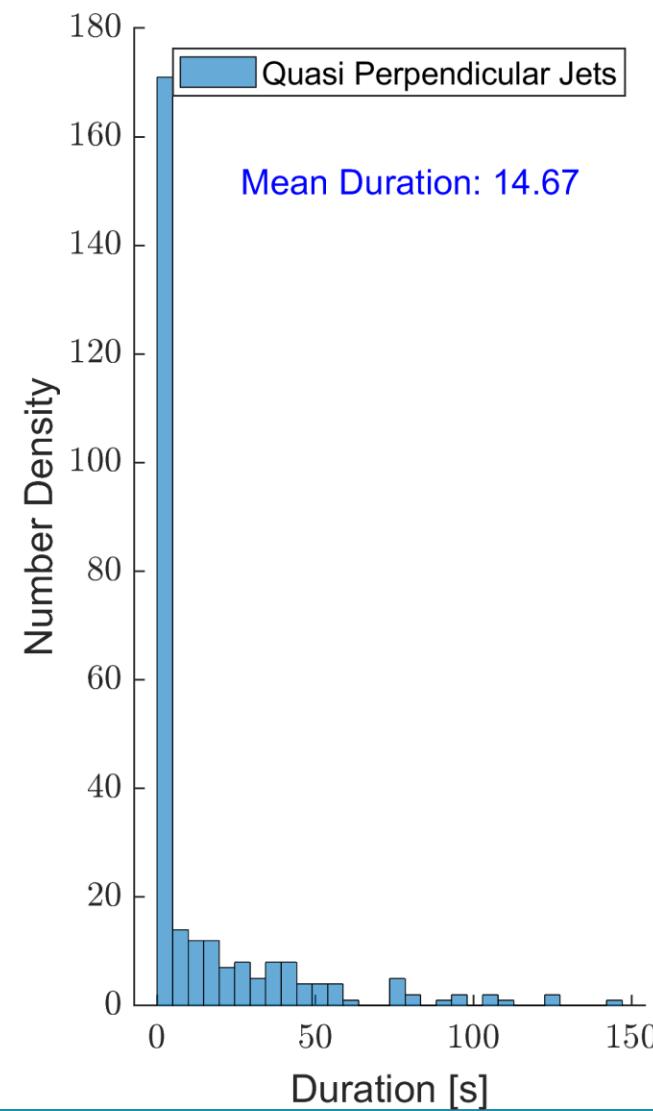
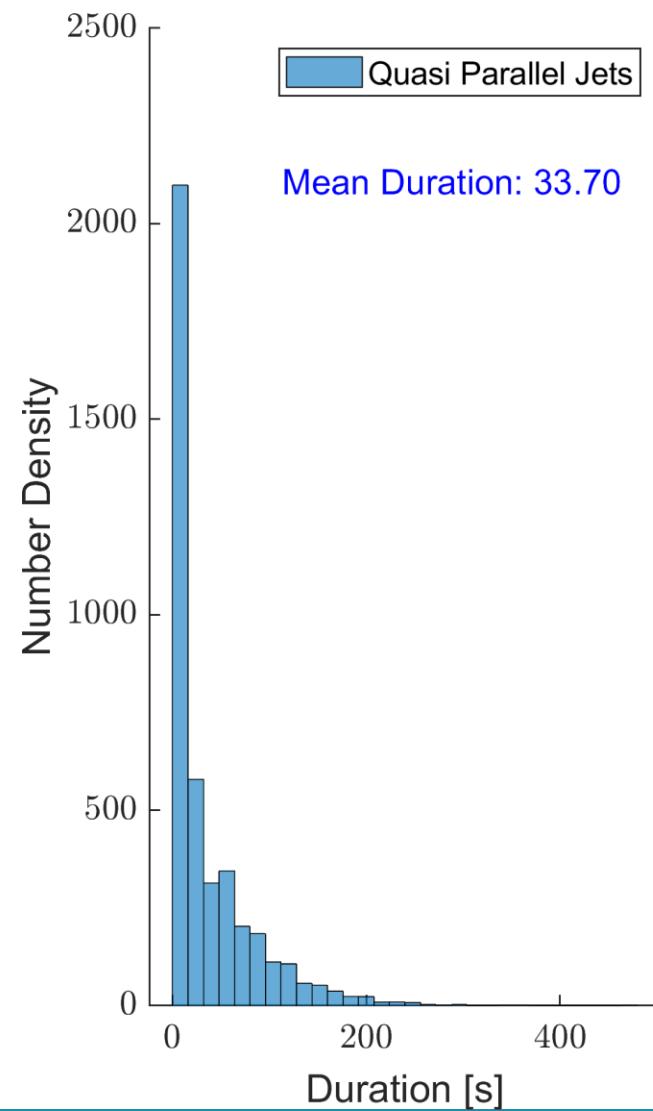
Characteristics of each category



“Background Difference” Statistics



Duration of Jets



Conclusion

Summary

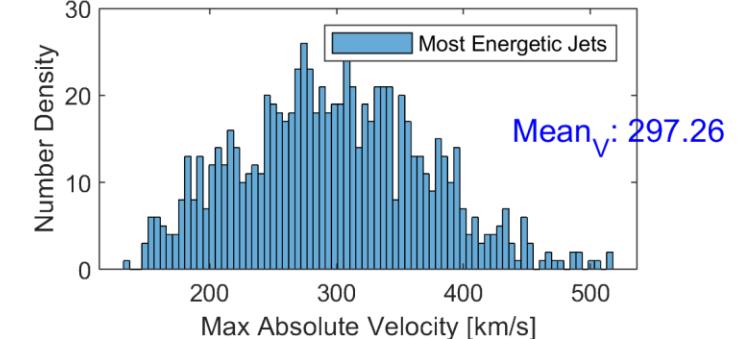
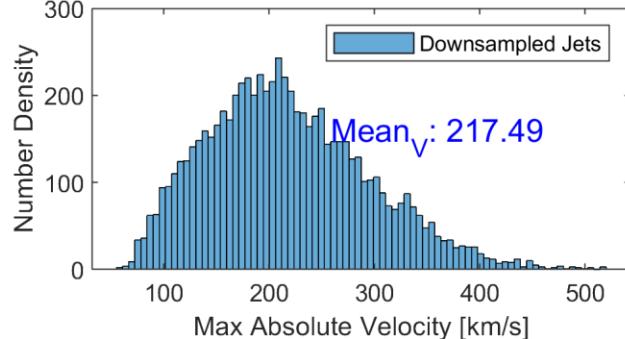
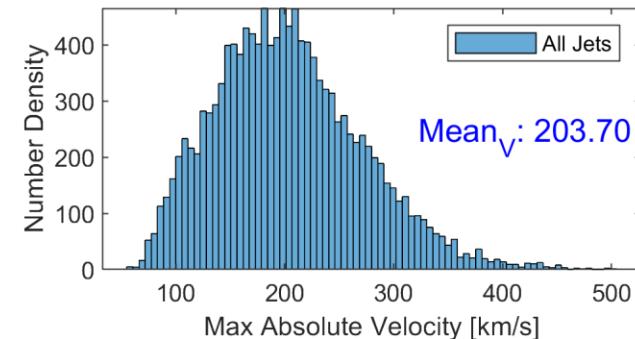
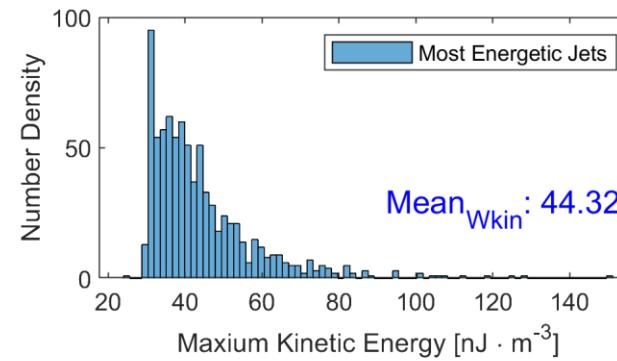
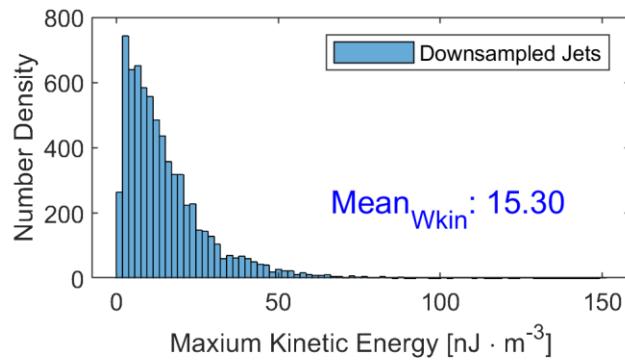
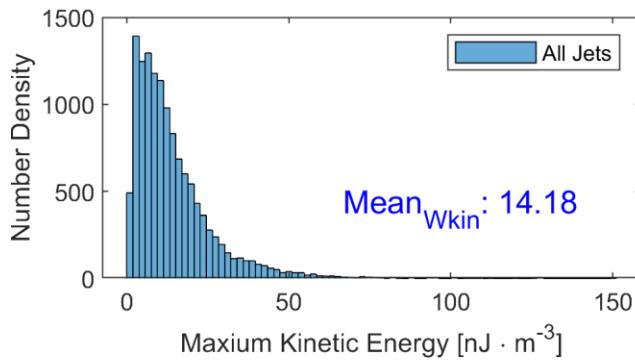
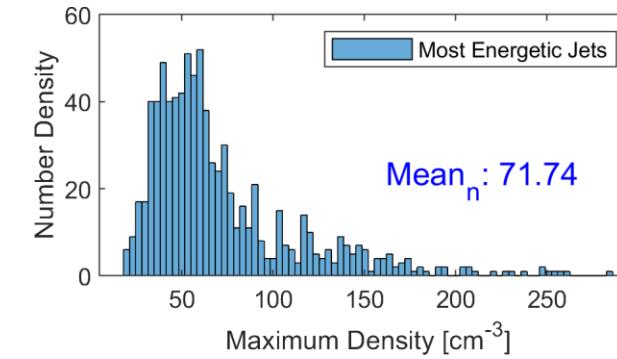
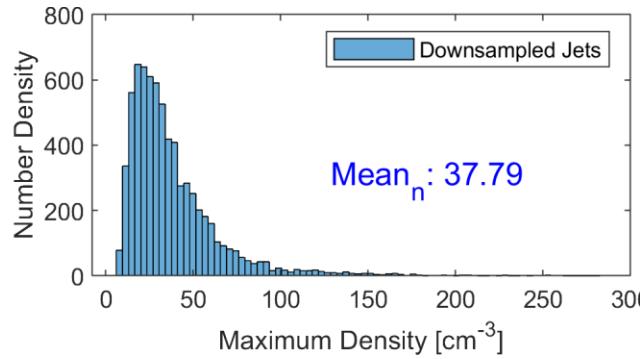
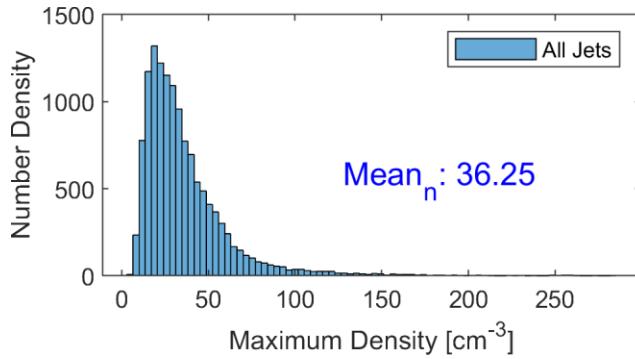
- Obtained a large **database of Magnetosheath Jets** using all available MMS data.
- Analyzed their **statistical characteristics** and found **interesting similarities and differences** compared with earlier results.
- Successfully **classified them into different categories** showing different characteristics.

Future Work

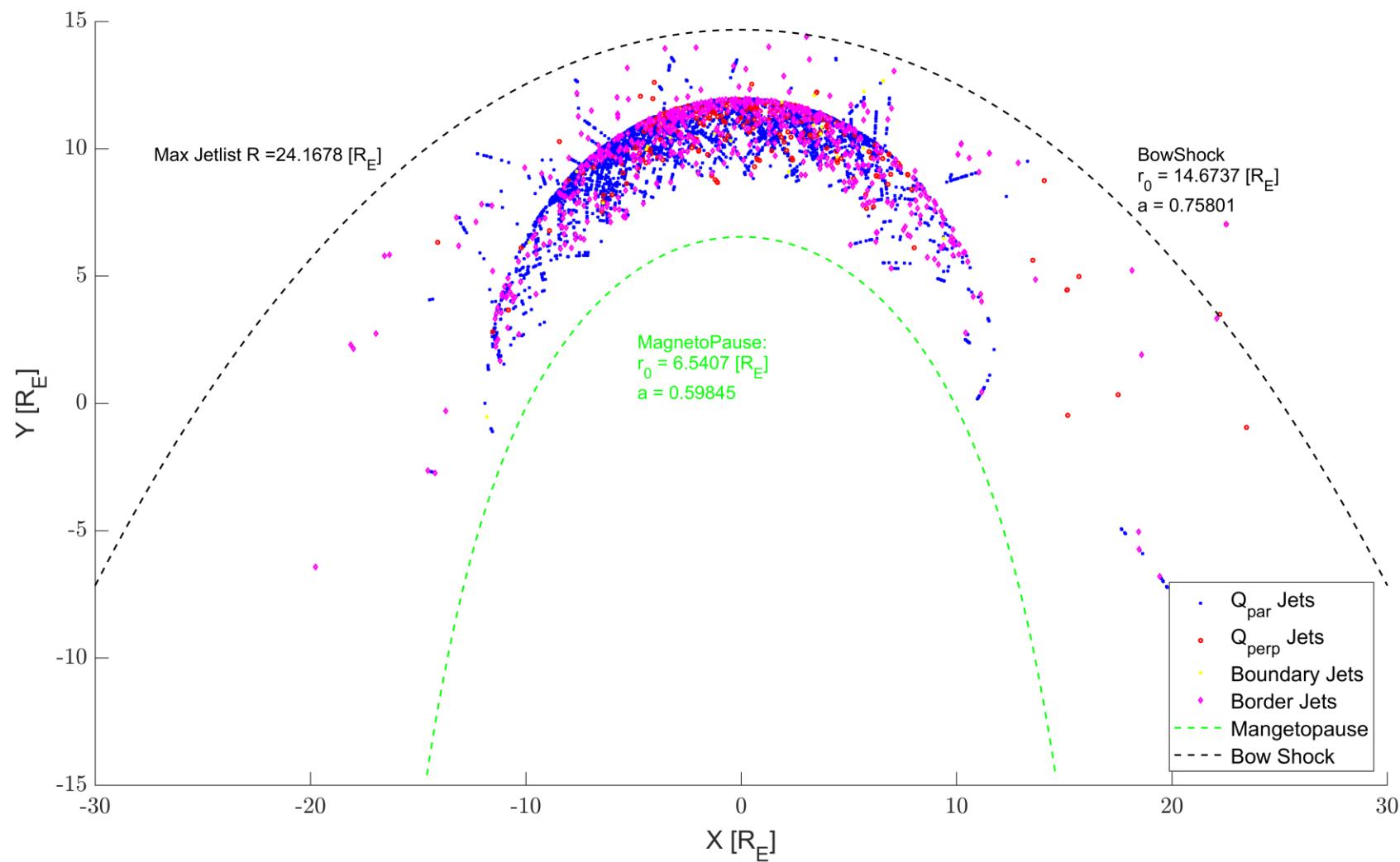
- Quantify **true negative** and **false positive** situations from classification.
- Verify **classification algorithms** via **Machine Learning** (Hierarchical, k-means, SOM etc.)
- Investigate **pre-jet** and **post-jet plasma properties** in comparison to each category.
- Connect each category to **a generation mechanism and origin candidate**.

Extras

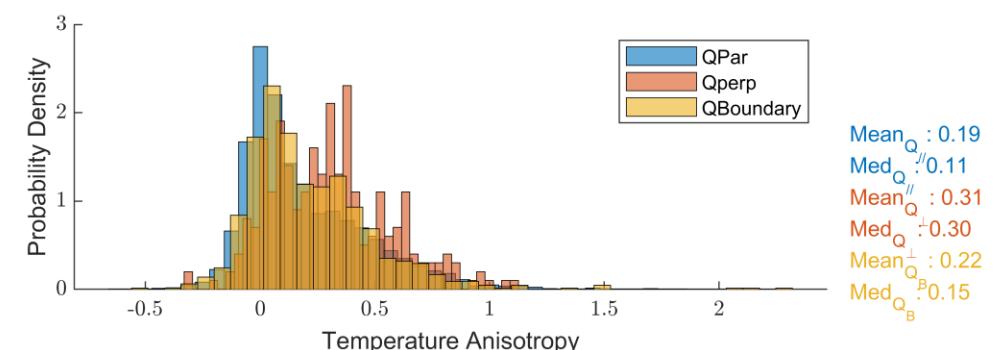
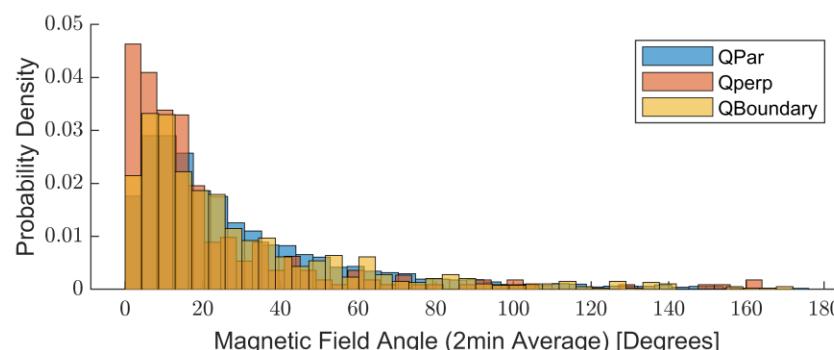
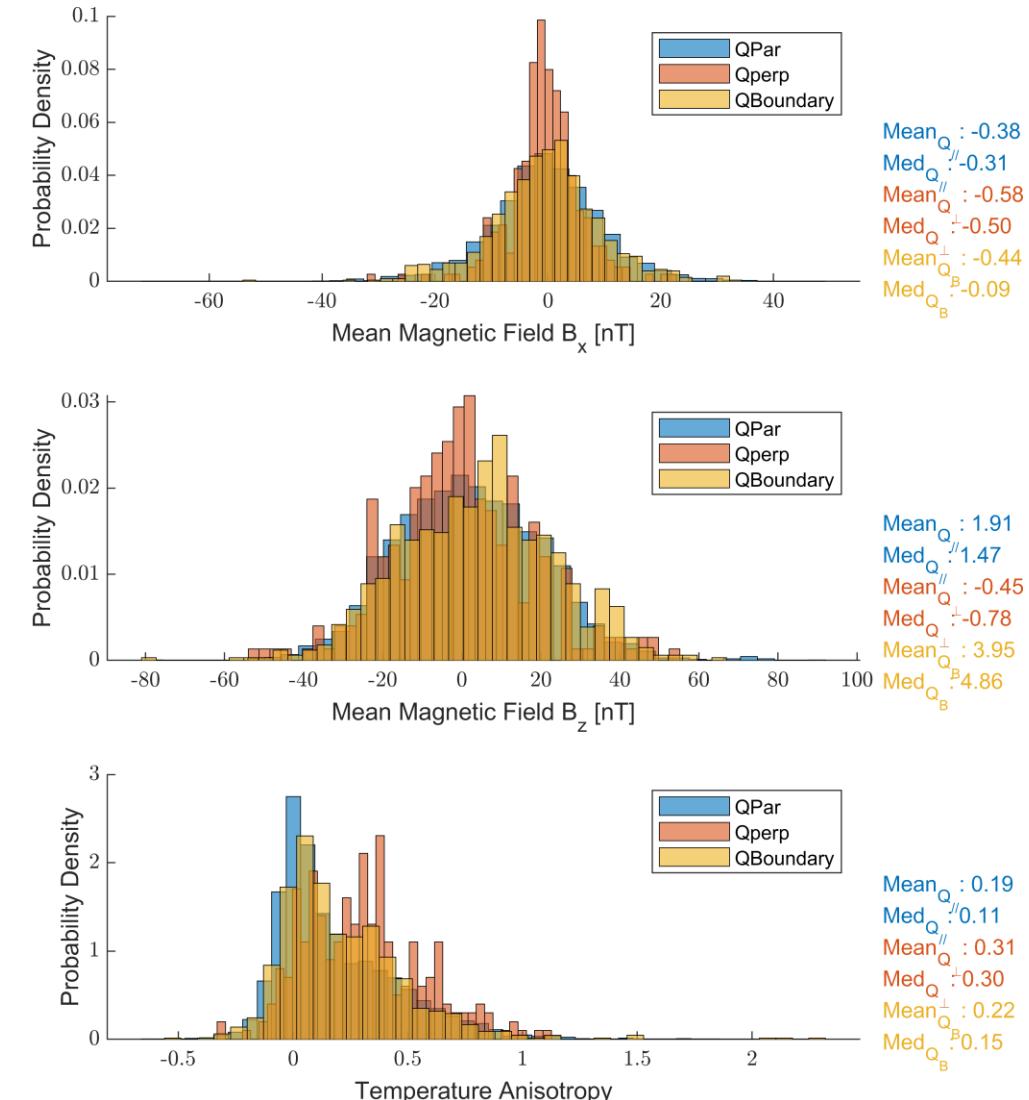
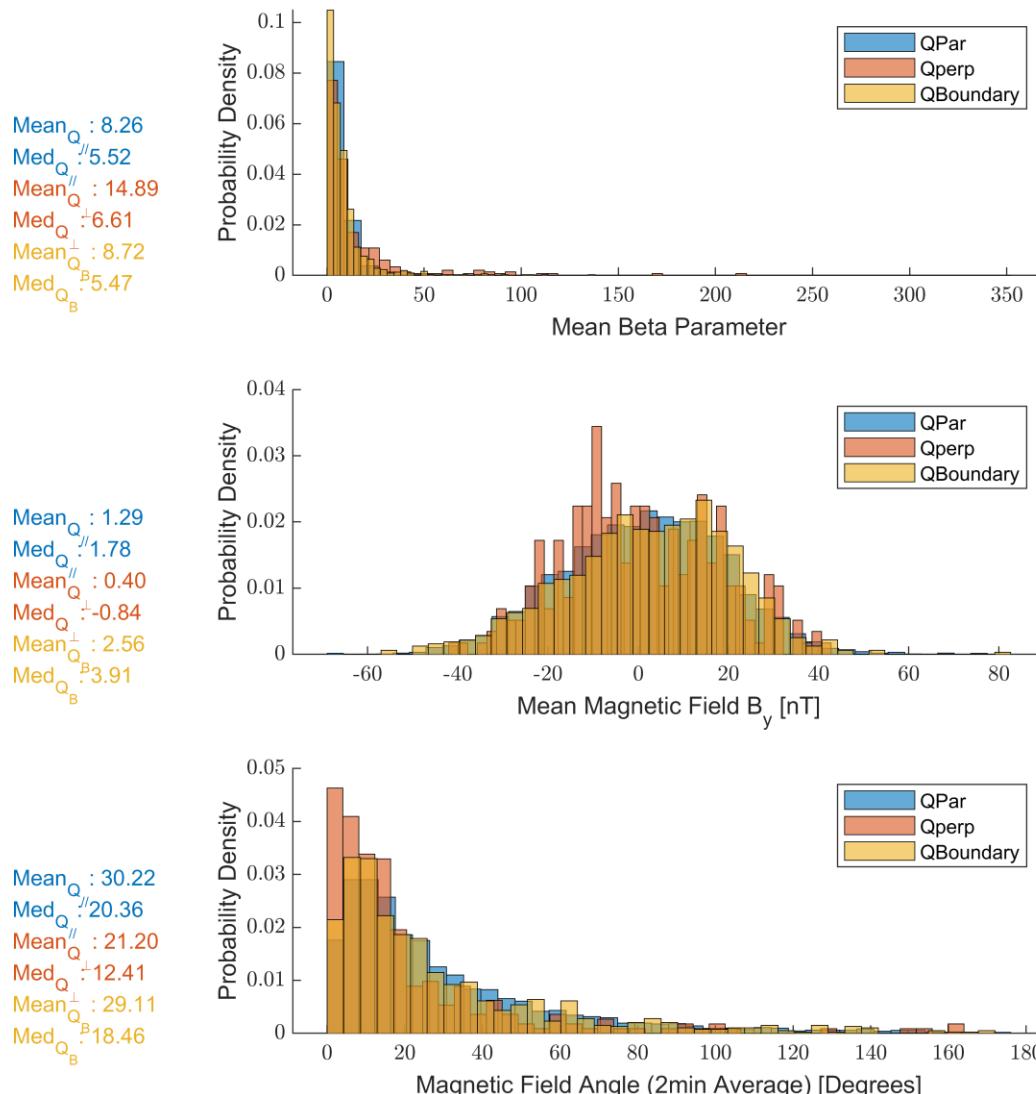
Some General Properties of Jets



Where are they?



Characteristics of each category



How Jets look like from MMS?

Can see many different characteristics (Density/Energy/Velocity/Magnetic Field etc.)

