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On the Generation of Pi2 Pulsations due to Plasma Flow Patterns Around Magnetosheath Jets

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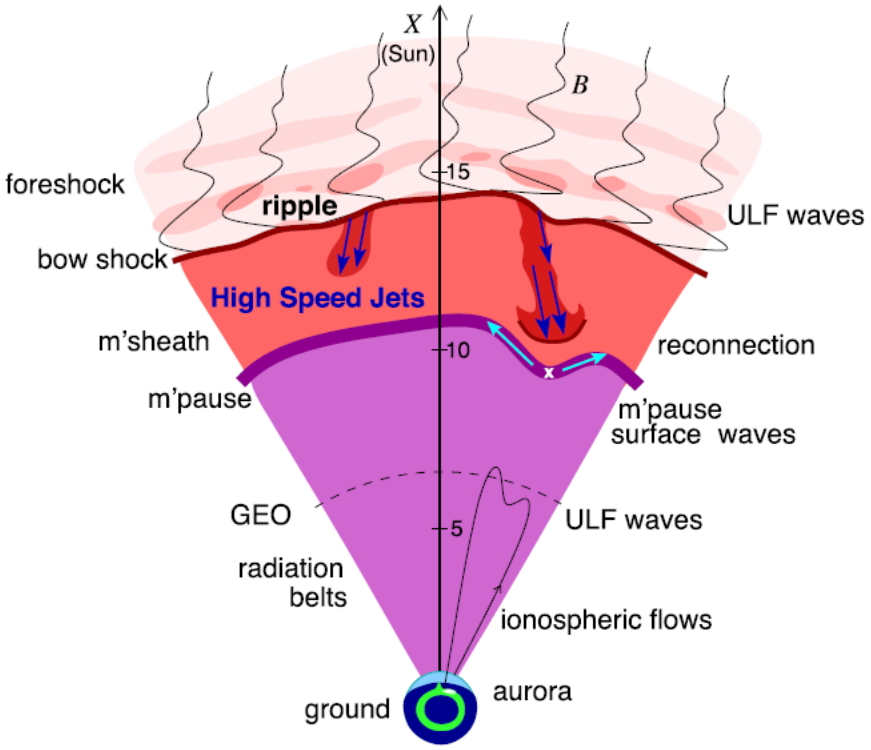
Magnetosheath jets are transient localized enhancements in dynamic pressure typically caused by increases in plasma velocity, density or both.



From Plaschke et al. *[Space Science Reviews 2018]*

In the past decade, jets have been associated with:

- driving various wave species,
- causing direct plasma penetration in the magnetosphere,
- exciting surface eigenmodes through collision with the magnetopause

Recently, jets have been associated with:

- triggering localized magnetopause reconnection (Hietala et al., 2018),
- generating substorm injections even during northward IMF (Nykyri et al. 2019)
- creating anomalous flows decelerating the plasma and make the background magnetic field more aligned with the jet's velocity (Plaschke et al. 2018)

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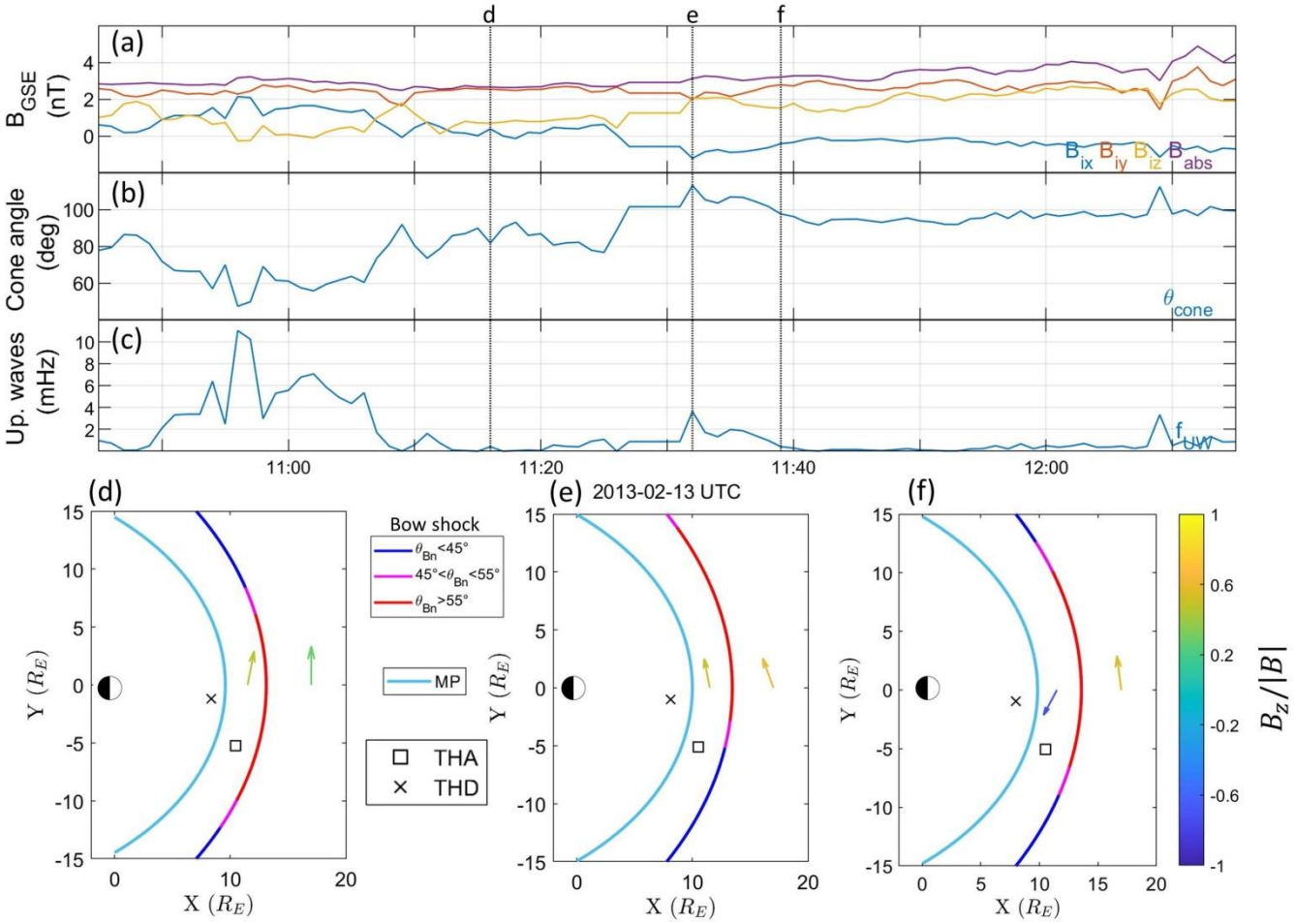
Feb 13, 2013



Solar wind speed (not shown) remained constant at **360 km/s** during the whole time-period shown

Estimation of the upstream wave frequency following the model of Takahashi et al. (1984)

Modelling of the MP and the bow shock following the model of Chao et al. (2002)

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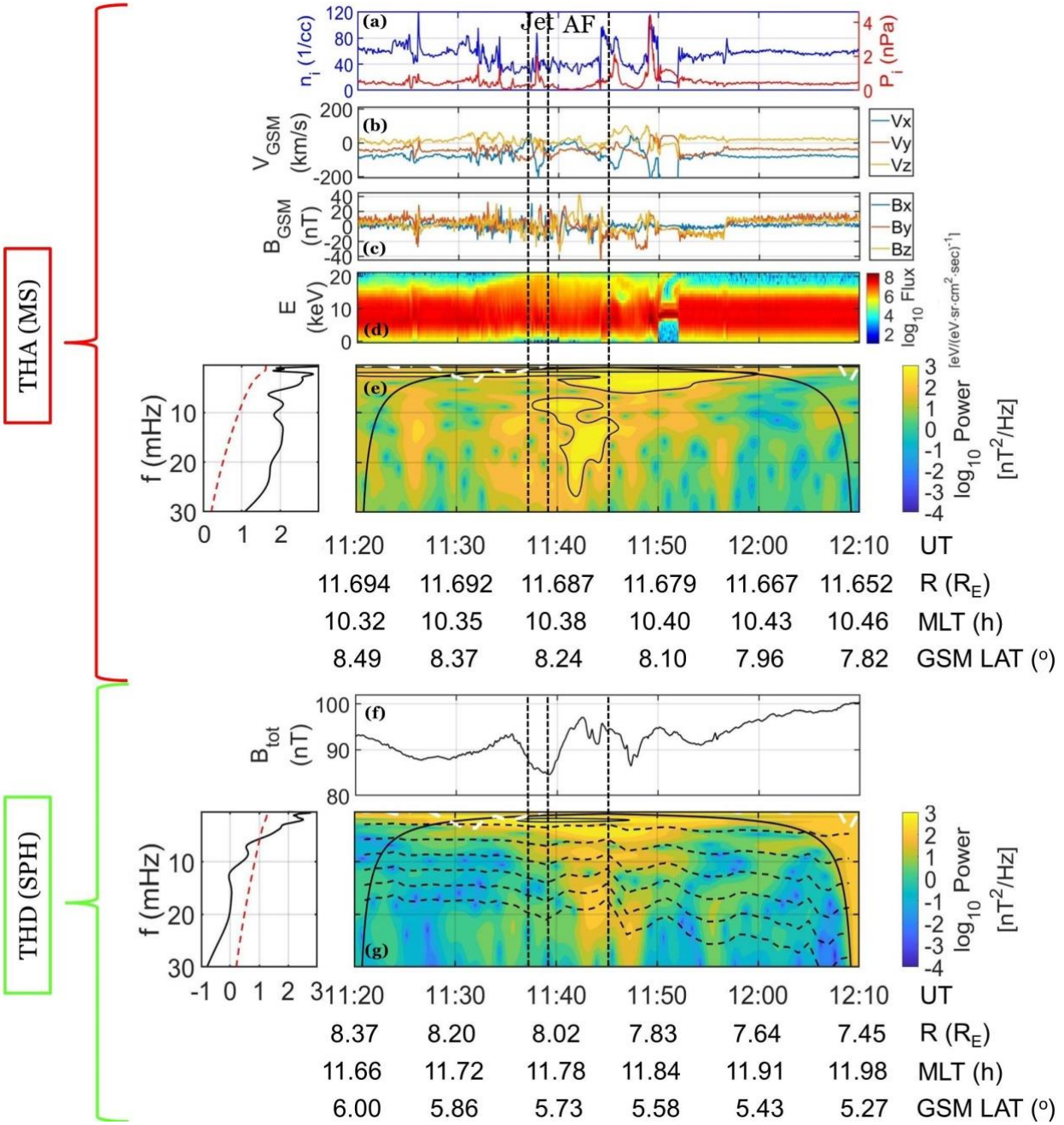
Moderate magnetosheath jet at 11:37 - 11:39 UT with maximum speed of -213 km/s

Right after the jet, the Vx component of speed dropped to a zero average, with occasionally sunward direction, until 11:46 UT.

After-Flow (AF)



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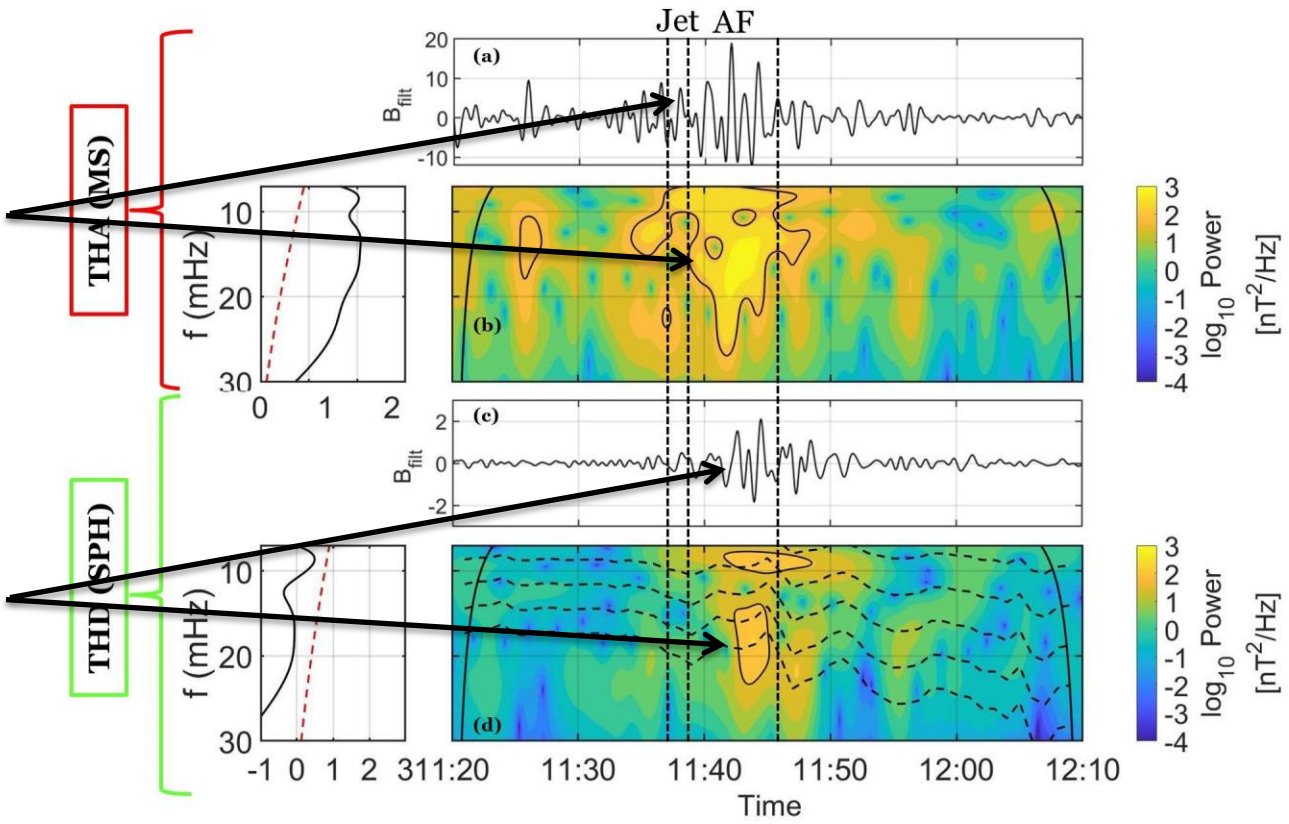
Strong Pi2 pulsations in two frequency bands (7.6-9.2 and 12-17 mHz) beginning simultaneously with the AF.

Prominent pulsations in two frequency bands (7-9.7 and 14-20 mHz) corresponding to the second and fifth harmonics of the FLR.



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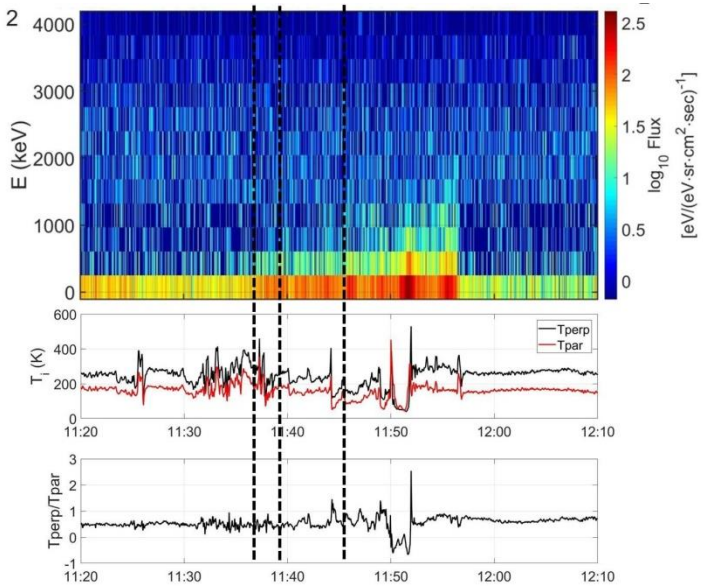
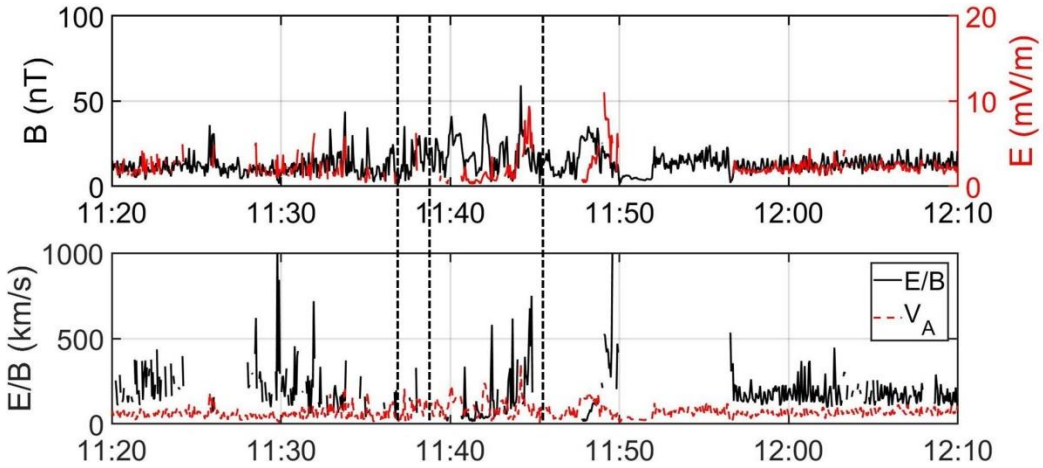
Magnetosheath Pulsations

E/B ratio is systematically higher than the estimated local Alfven speed, which indicates that the observed Pi2 pulsations are **fast mode waves.**





Could these pulsations be foreshock generated rather than locally generated?

- Upstream wave frequency does not match.
- There are no ion beams.

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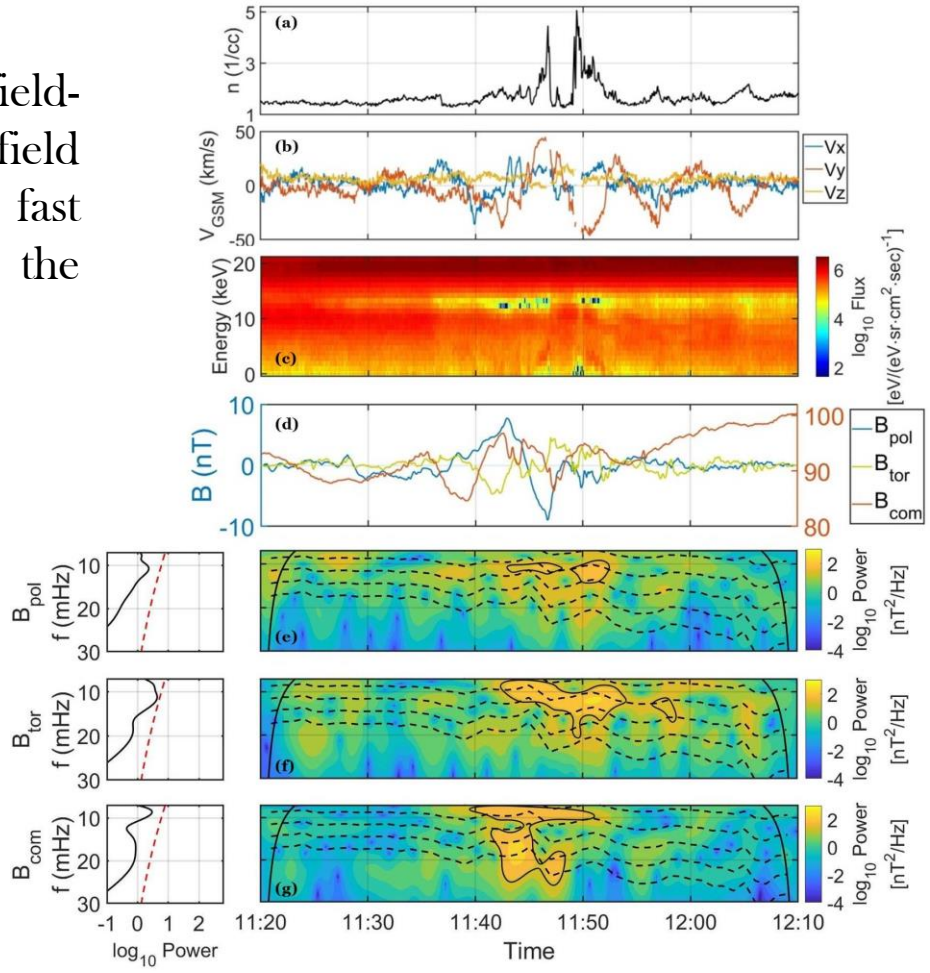
Magnetosphere Pulsations

Wave activity occurred primarily in the field-aligned component of the magnetic field suggesting that these Pi2 pulsations are fast Alfven waves which propagated across the magnetic field.

A mode conversion from fast to shear Alfven waves is also present.

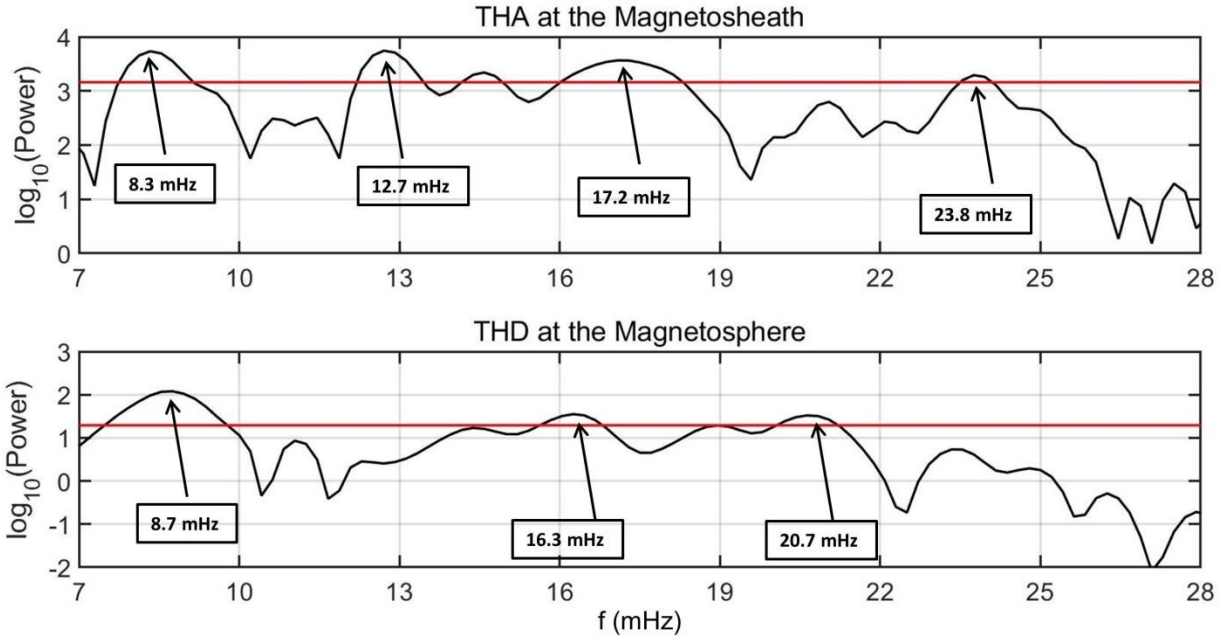
These standing waves accompanied by a 90° phase relationship between the electric and magnetic field (not shown) are present in the spectrum of the toroidal component at the second harmonic of the FLR in the 9.5-11.5 mHz frequency range.



Is there a link between the magnetosheath and magnetosphere pulsations?

The two periodograms:

- exhibit a remarkable similarity and, furthermore,
- are in good agreement with the corresponding wavelet spectra.



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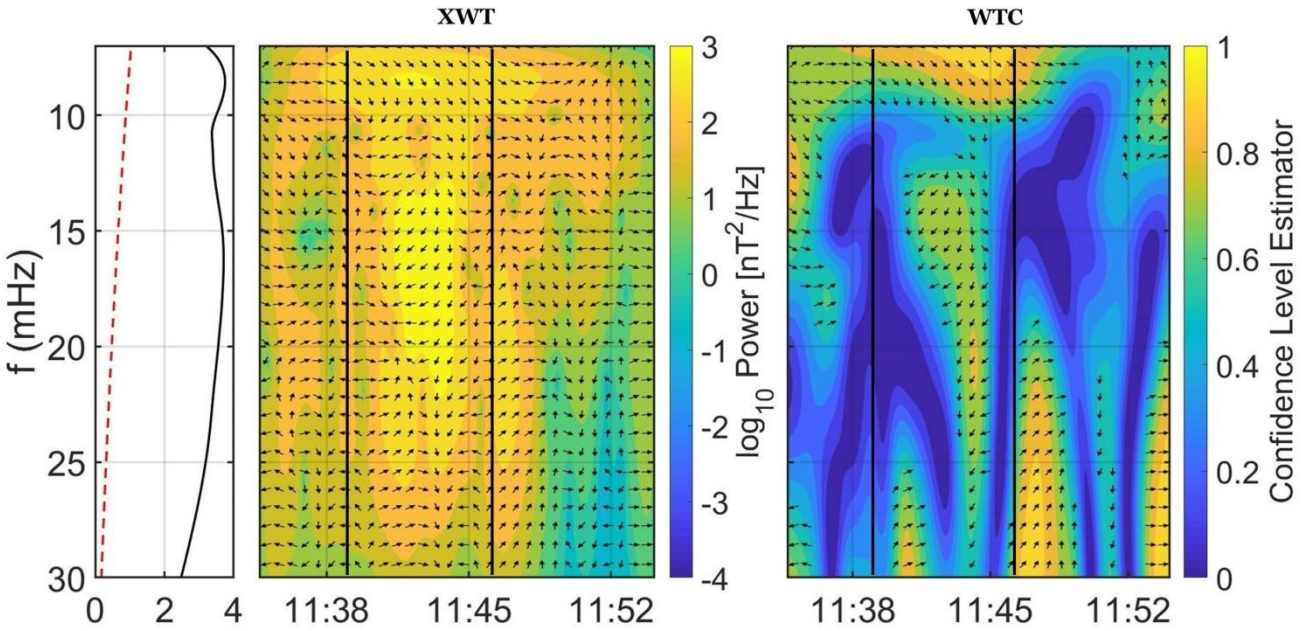

Same frequency bands with ≈60 and 120° phase difference for the 8.7 and 16.3 mHz, respectively.

This phase difference corresponds to a time-lag of ≈140 seconds which is in good agreement with the estimated propagation time of a disturbance travelling with Alfvenic speed

Conclusions

We report – for the first time – Pi2 pulsations generated locally at the magnetosheath at the wake (After-Flow) of a jet.

- These pulsations are detected in two frequency bands (7.6-9.2 and 12-17 mHz) and are associated with fast mode Alfven waves.
- These pulsations were also detected inside the magnetosphere with a 140 seconds time-lag, which raises the question of how exactly these pulsations are propagated through the magnetopause.
- Our results are consistent with a dynamic influence of magnetosheath jets on the magnetosphere.

Katsavrias, C., Raptis, S., Daglis, I. A., Karlsson, T., Georgiou, M., & Balasis, G. (2021). On the generation of Pi2 pulsations due to plasma flow patterns around magnetosheath jets. Geophysical Research Letters, 48, e2021GL093611. https://doi.org/10.1029/2021GL093611

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