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First results on production of magnetosheath jets during SIRs and CMEs

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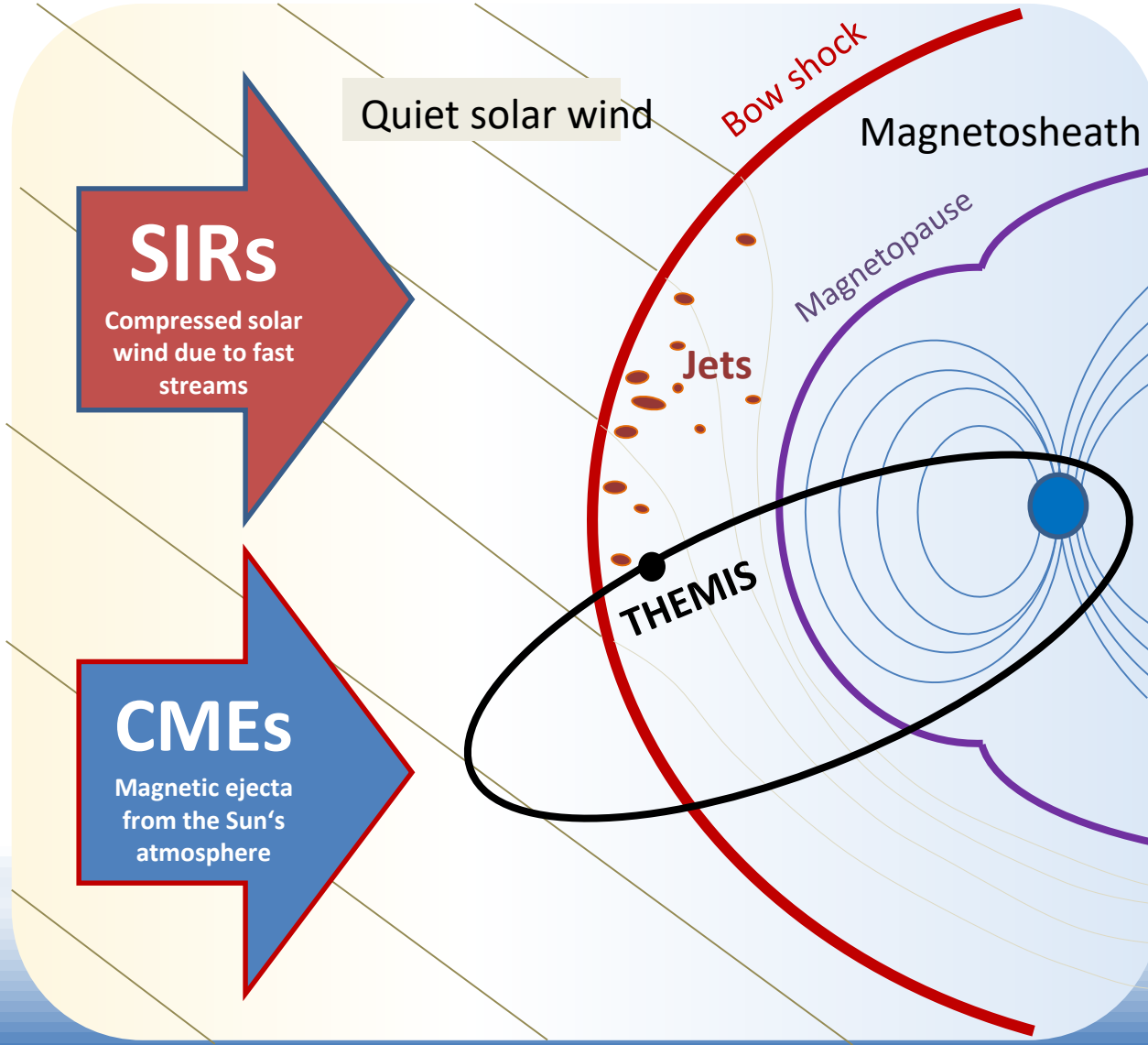
ÖAW IWF

Basics of Magnetosheath Jets

- Dynamic Pressure enhancements in the Earth's Magnetosheath
  Plaschke et al. 2018
- Can impact Magnetopause and be geoeffective
  Hietala et al. 2018, Wang et al. 2018, Nykyri et al. 2019
- Origin in the bow shock
  Plaschke et al. 2018
- Relationship to large scale solar wind structures unknown



Research question and motivation

How does the appearance of large-scale disturbances in the solar wind (CMEs, SIRs, HSS) influence the generation of magnetosheath jets?

- Effects of large scale SW structures on jets were unknown
- As of now, nothing is known about the effects of the solar cycle on the properties and amount of jets
- Jet origins are still part of active research
- Magnetosheath jets constitute a key linking effect between the solar wind – magnetosphere interaction and are very frequent Plaschke et al. 2018
- They should appear at all bow shocks with high Alfven Mach numbers – future prospect of analysis on different magnetospheres

Data and methods

Jet Data: Jets detected by THEMIS from 2008-2020 using two different criteria

(one based on upstream SW conditions (Plaschke et al. 2013), one on local magnetosheath conditions)

CME data: list by Richardson & Cane (2010) for CME-magnetic ejecta and CME-sheaths

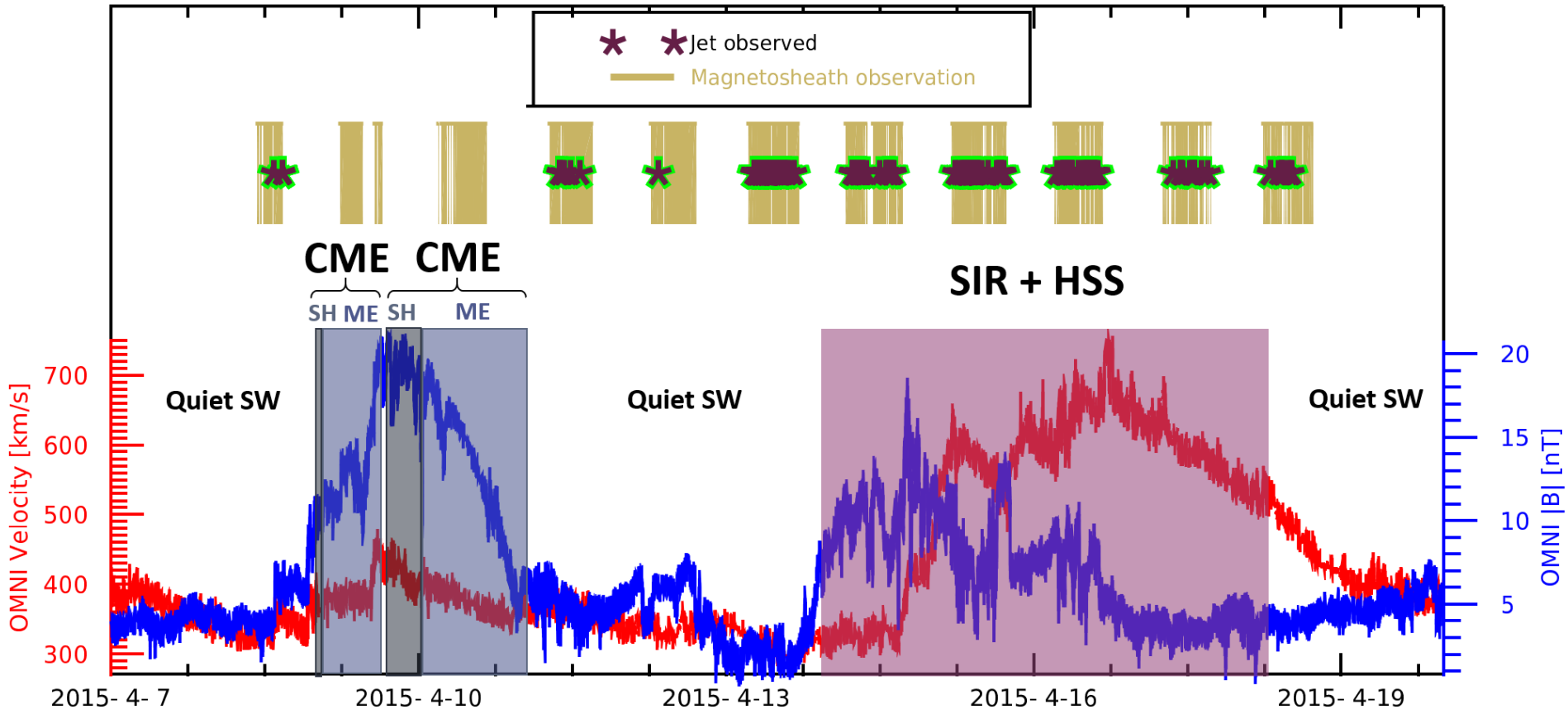
SIR and HSS data: Combined list of Grandin et al. (2019), Jian et al. (2011), Geyer et al. (2021), and self expanded

Method: Analysis of overlapping times of magnetosheath measurements with times of CME and SIR+HSS passing

Defined „Jet percentage“: total duration of jets / total time of magnetosheath data within a given time range

We used superposed epoch analysis to get an idea on jet percentage development within CMEs and SIRs

Timeline with overlapping events



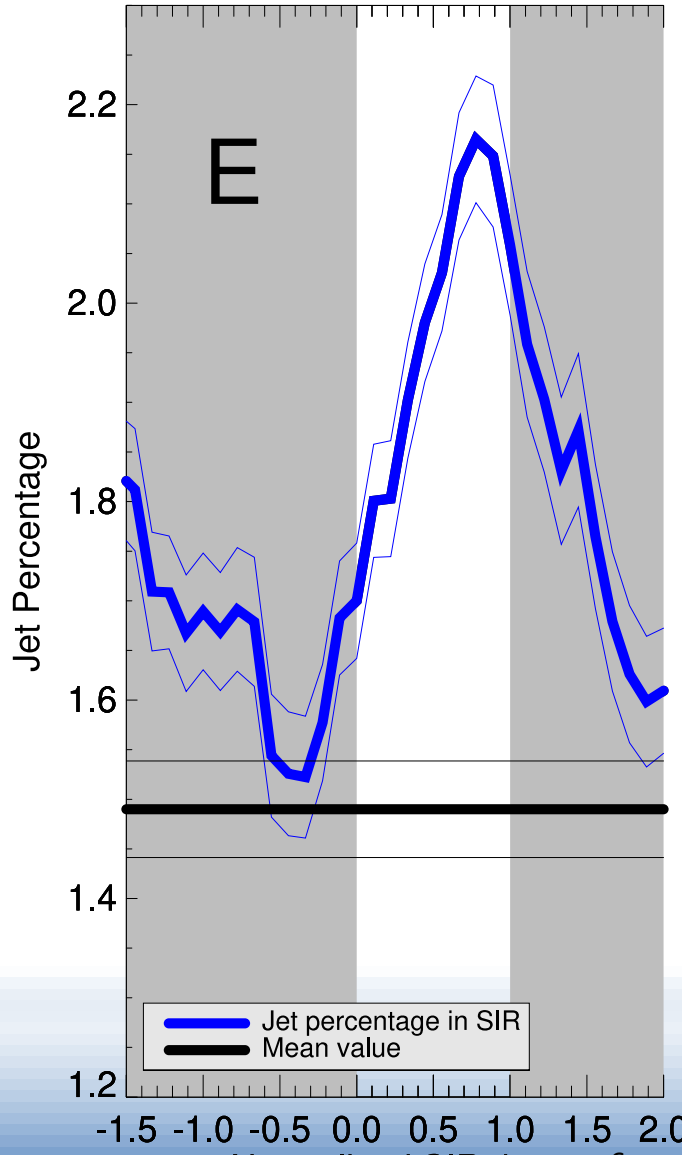
SH … Sheath
ME … Magnetic ejecta

Koller et al. 2021 (in preparation)

Results: Jet percentage during SIRs

- **Significant INCREASE** of jet numbers during SIRs and HSS
- Roughly coincides with the velocity increase of the solar wind
- The percentage slowly drops down to usual levels after the passing of the high speed stream
- Confirmed expected results

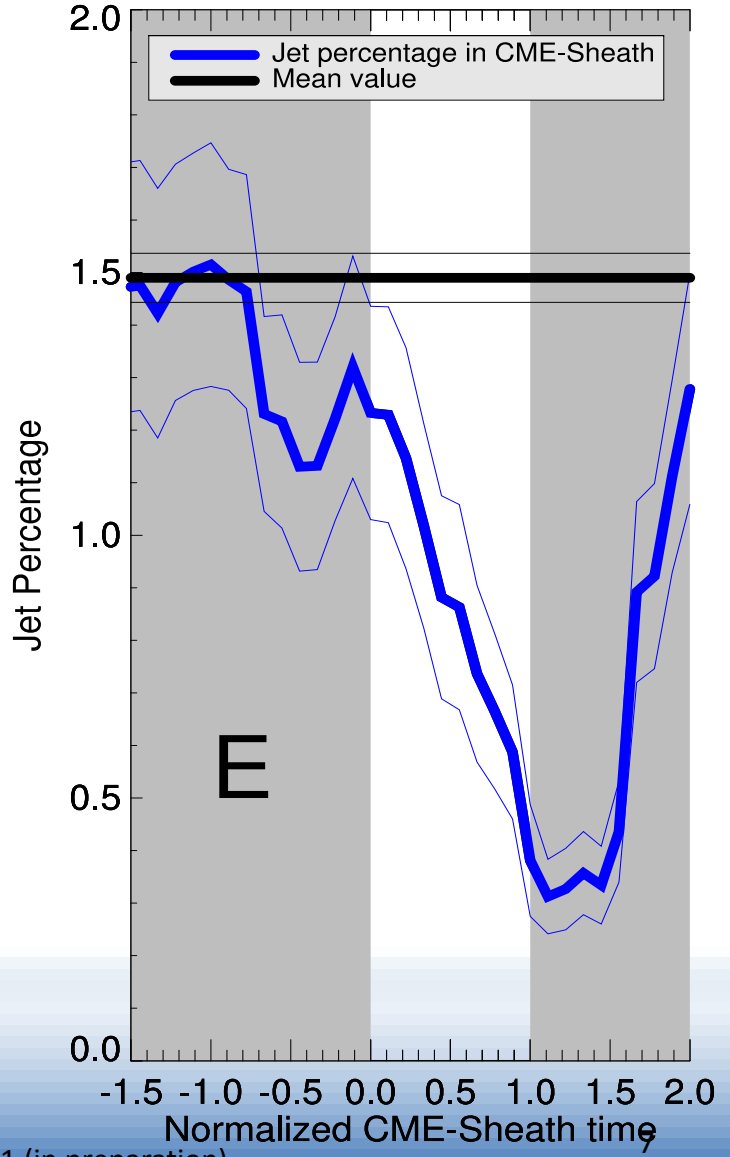
"jets […] approximately 5 times more likely to reach and potentially impact the magnetopause during fast solar wind", LaMoury et al. 2021



Koller et al. 2021 (in preparation)

Results: Jet percentage during CME-Sheath

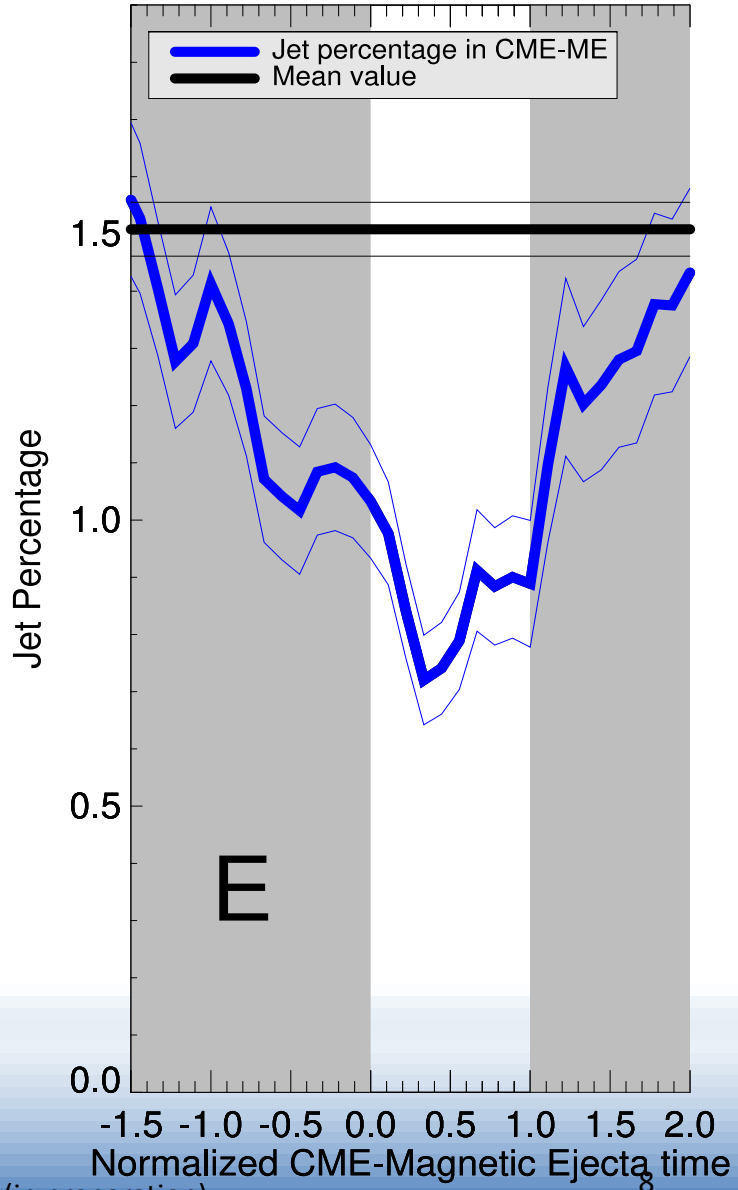
- **Significant DECREASE** of jet numbers during the CME-Sheath
- Jet percentage drops monotonically
- Seemingly anti-correlated with the magnetic field strength
- Not expected



Koller et al. 2021 (in preparation)

Results: Jet percentage during CME-Magnetic Ejecta

- **Significant DECREASE** of jet numbers during the CME-Ejecta
- The percentage reaches its minimum within the magnetic ejecta
- Seemingly anti-correlated with the magnetic field
- Number of jets recover quickly after the event
- Not expected



Koller et al. 2021 (in preparation)

Discussion, Summary, and Outlook

Jets can happen all the time, **BUT**:

Number of jets **higher during SIRs + HSS**

Number of jets **lower during CMEs**

- Anti-correlation of CMEs peculiar
  - CME-sheaths and SIRs show both increased SW velocity and chaotic magnetic field, but opposite jet occurrence
- Jet definitions based on upstream SW conditions difficult for analyzing influences of disturbances
  - We used upstream and local conditions to mitigate observational biases

- Work in progress: Detailed analysis of jet plasma parameter during SIRs and CMEs for bigger picture + case studies for understanding individual events

Question: Are the jets different during CMEs compared to SIRs?

Thank you for your attention!

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