Kelvin-Helmholtz waves at Earth's magnetopause during southward IMF

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Northward / southward IMF

- **KHI** has been much **more frequently observed during northward IMF** (Kavosi & Raeder, 2015)

- **Irregular and temporally intermittent** during southward IMF (Hwang et al., 2011)

- **Vortex-induced reconnection** during southward IMF leading to rapid decay of the vortices (Nakamura et. al, 2020)
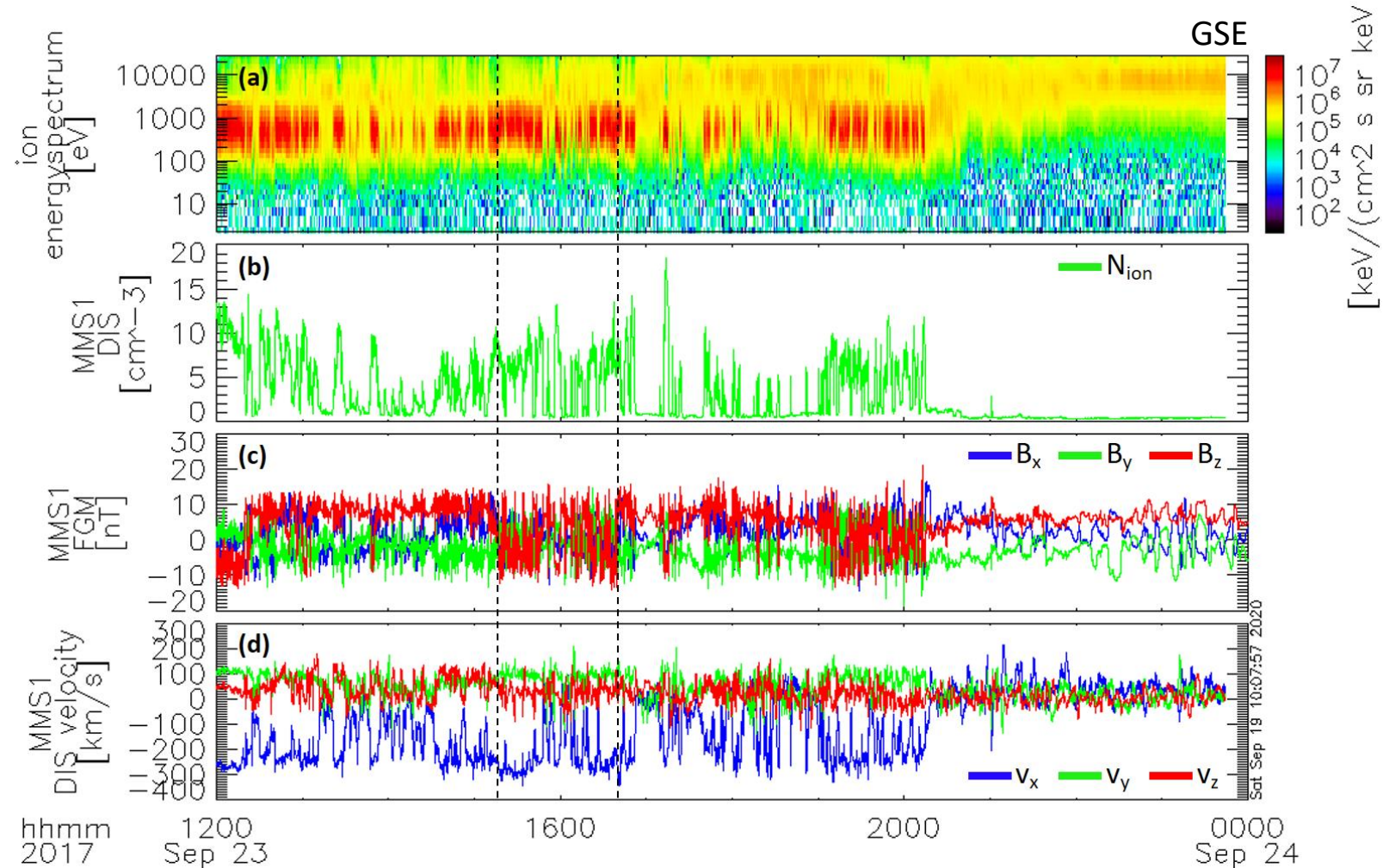
IMF clock angle
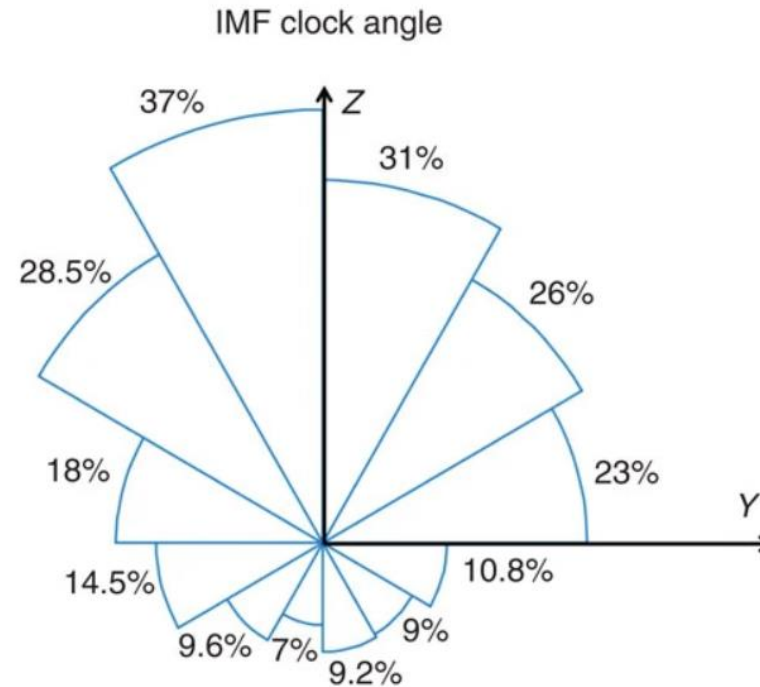
(Kavosi & Raeder, THEMIS, 2015)

- **Magnetopause crossings** observed by MMS on September 23, 2017

- Isolated **vortex-like event** 15:33:00 – 15:34:30 UTC

- **Linear wave event** 16:02 - 16:16 UTC

- **Instability criterion** fulfilled for both linear and nonlinear development of the KHI near the two events
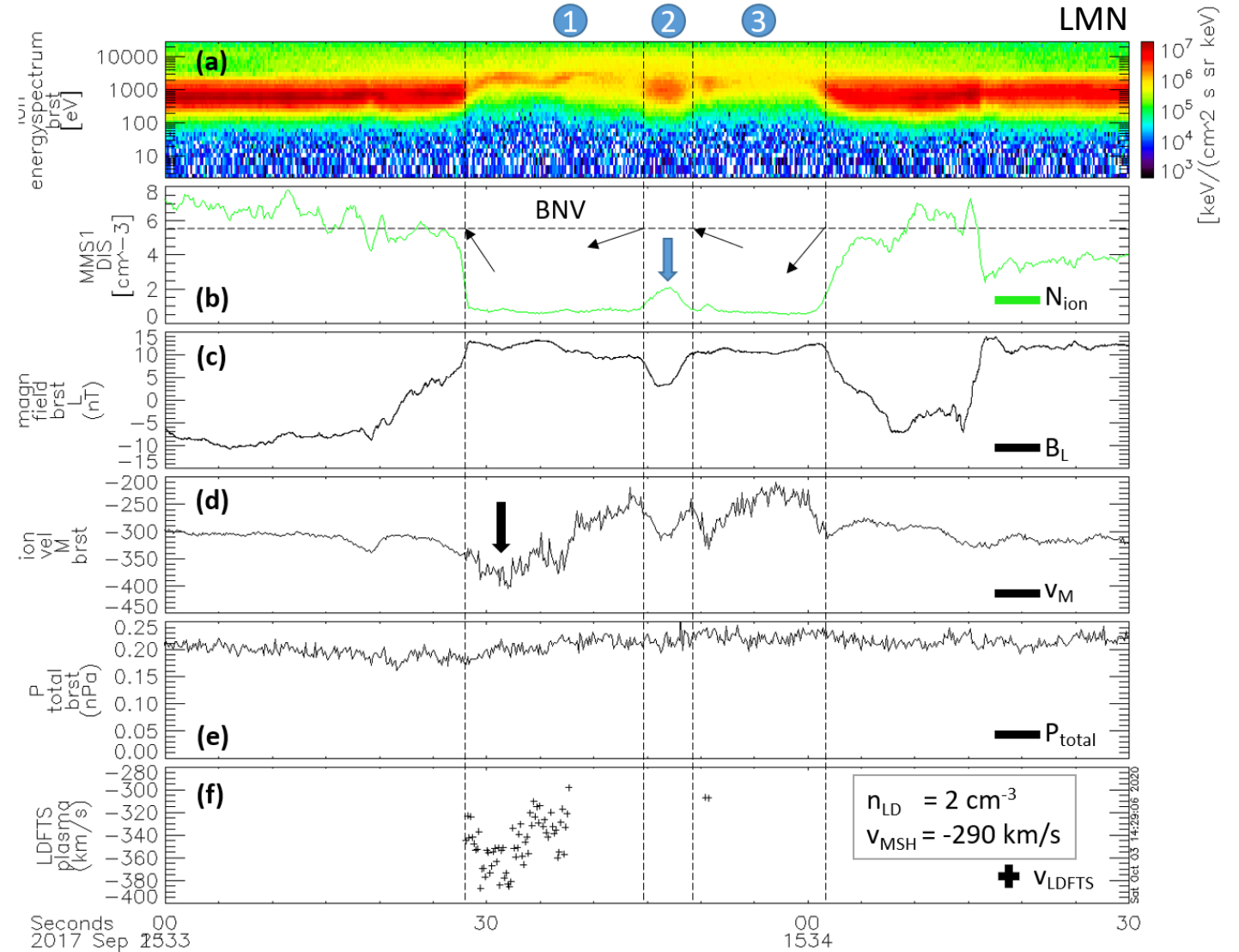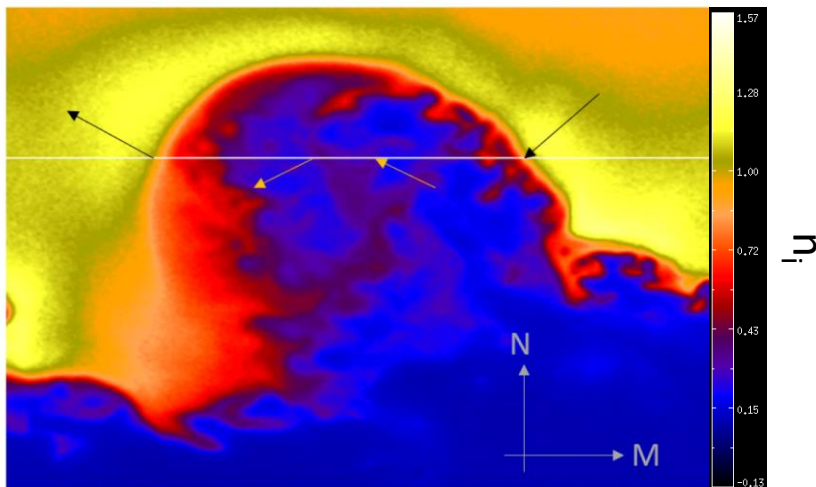
$$M_A = 3.3 \pm 2.2$$

- **Boundary normal vector** analysis using a four-spacecraft timing analysis
  → sinusoidal behaviour

- v_N indicates a wave structure in magnetospheric intervals

- Maxima of P_{total} near trailing edges
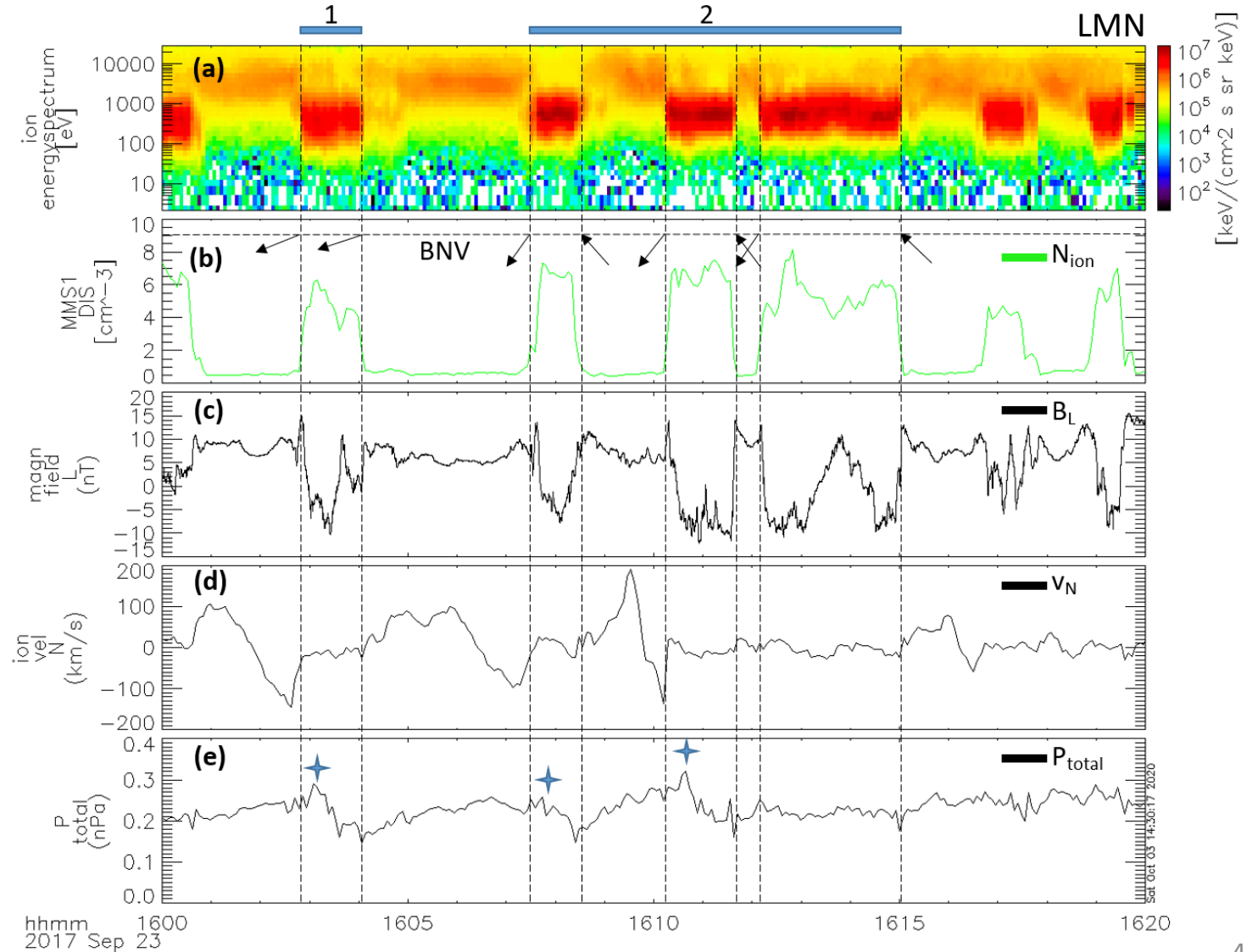
- **Boundary normal vectors** confirmed from simulation results

- Constant **total pressure** over the whole vortex interval
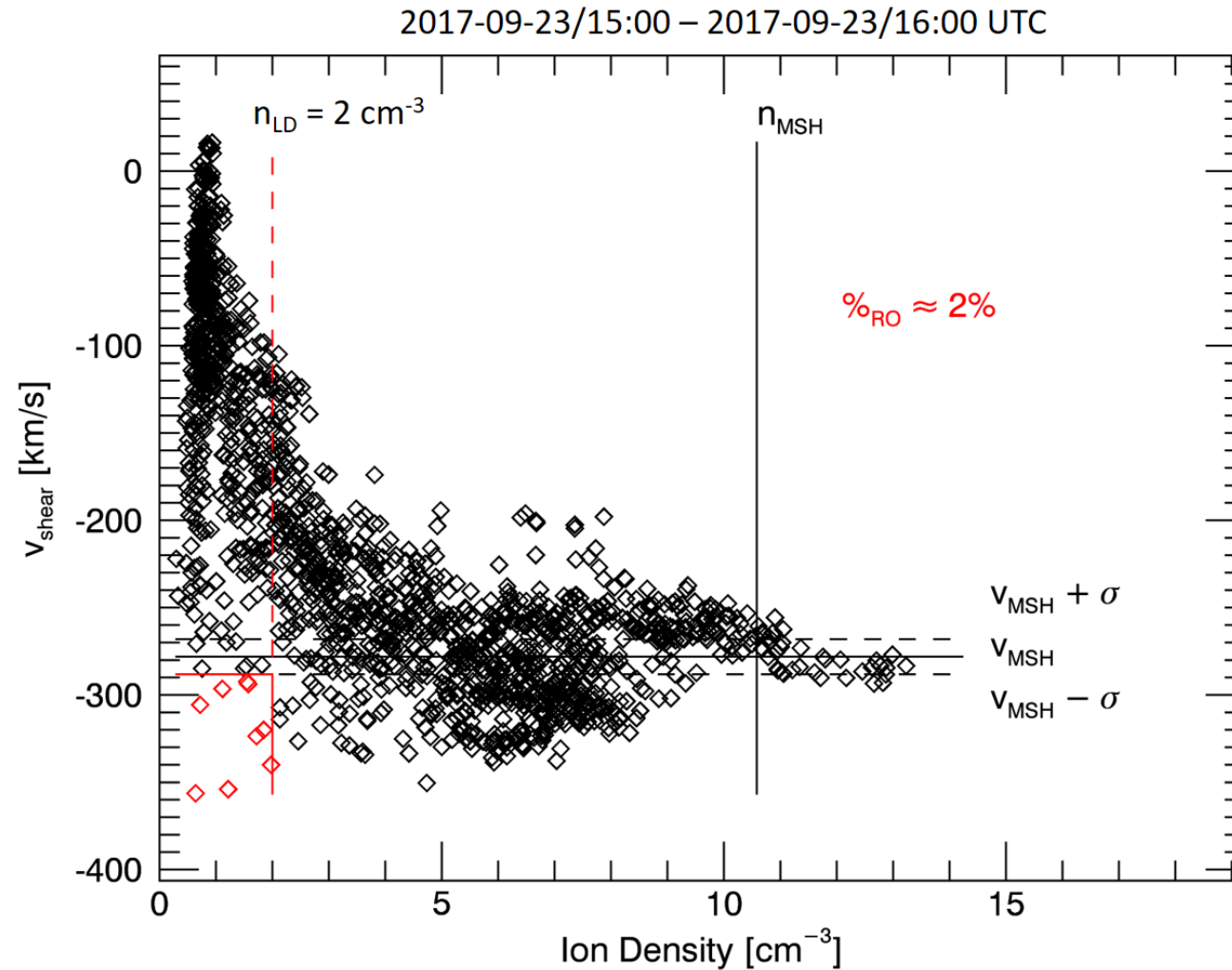
- **LDFTS** plasma at leading edge

- **2D fully kinetic PIC simulation** using VPIC (Bowers et al., 2008, 2009)

- Performed by **Takuma Nakamura** for the plasma parameters around the MMS events

- **Nearly constant total pressure** for crossing on magnetosheath side of the vortex

- Consistent with expectations for location of **LDFTS** region
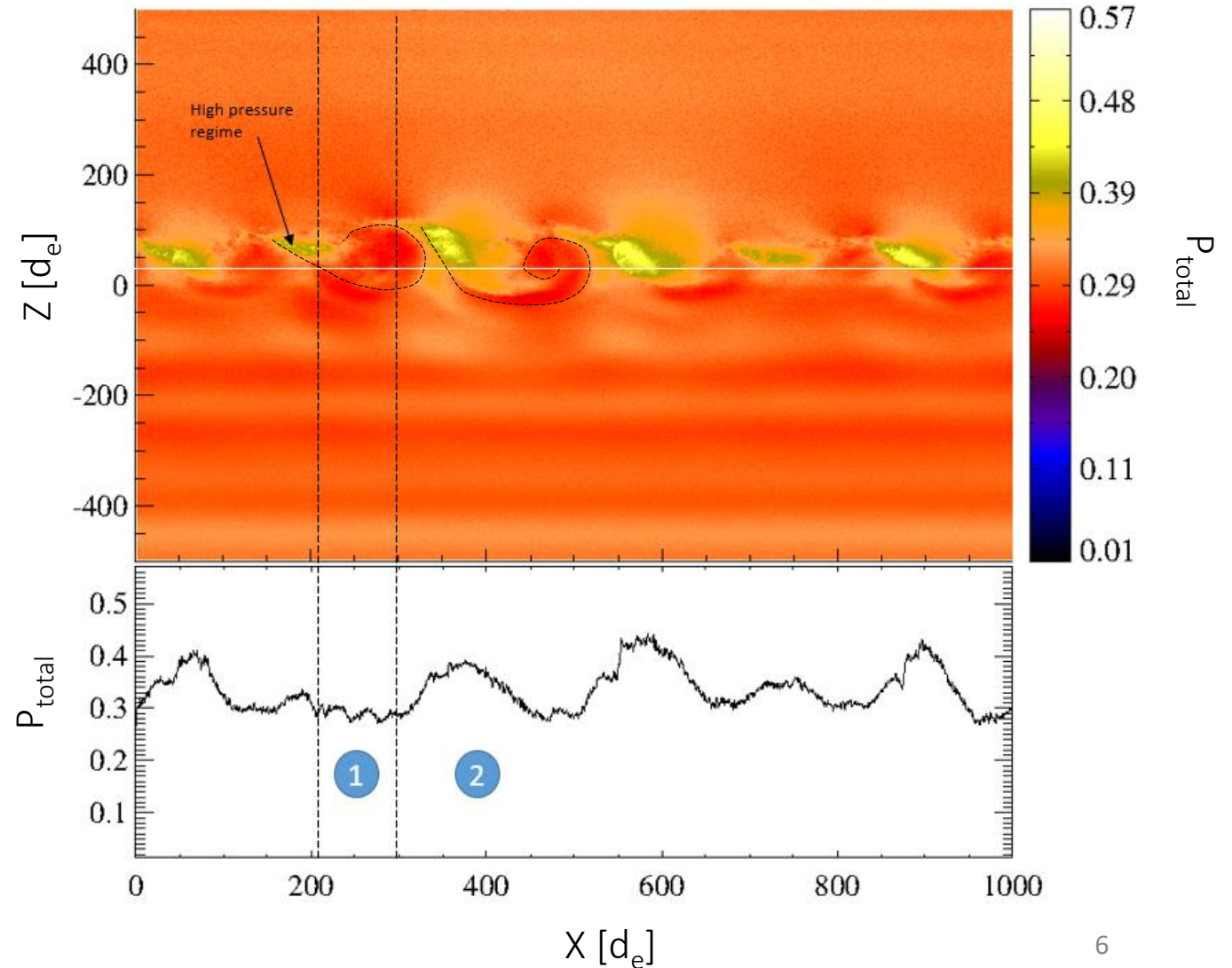
- **LDFTS plasma signatures** originating from isolated vortex event during one hour of MMS data

- Analysis method adapted from Taylor et. al (2012) → stricter boundaries

2017-09-23/15:00 − 2017-09-23/16:00 UTC

Thank you