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SPACECRAFT POTENTIAL

$$I_e = -A_{\text{spac}} q n_e \sqrt{\frac{k_B T_e}{2 m_e \pi}} \left(1 + \frac{q V_{sc}}{k_B T_e}\right)$$

Get from lower resolution FPI data

$$I_{\text{phot}} = I_{\text{ph0}} \exp\left(-\frac{q V_{sc}}{k_B T_{ph0}}\right) + I_{\text{ph1}} \exp\left(-\frac{q V_{sc}}{k_B T_{ph1}}\right)$$

Fit Ie to Vsc to get photoelectron parameters

- The spacecraft potential is governed by the currents to and from the spacecraft
- In the solar wind (ASPOC and EDI off) the conditions are such that only the electron thermal current to the spacecraft and the photoelectron emission from the spacecraft are dominant
- They can be assumed to be equal and having opposite signs Ie=Iph allowing the density to be derived. If ASPOC is on, we can still obtain the density but there is an additional current from ASPOC
- This allows a measurement of electron density with time resolution of 8192Hz in Burst mode 32Hz in Fast survey. This is much higher time resolution than FPI and other missions e.g. Spektr-R

$$n_{e,SC} = \frac{1}{q A_{\text{spac}}} \sqrt{\left(\frac{2\pi m_e}{k_B T_e}\right)} \left(1 + \frac{q V_{sc}}{k_B T_e}\right)^{-1} \left(I_{ph0} \exp\left(\frac{-q V_{sc}}{k_B T_{ph0}}\right) + I_{ph1} \exp\left(\frac{-q V_{sc}}{k_B T_{ph1}}\right)\right)$$

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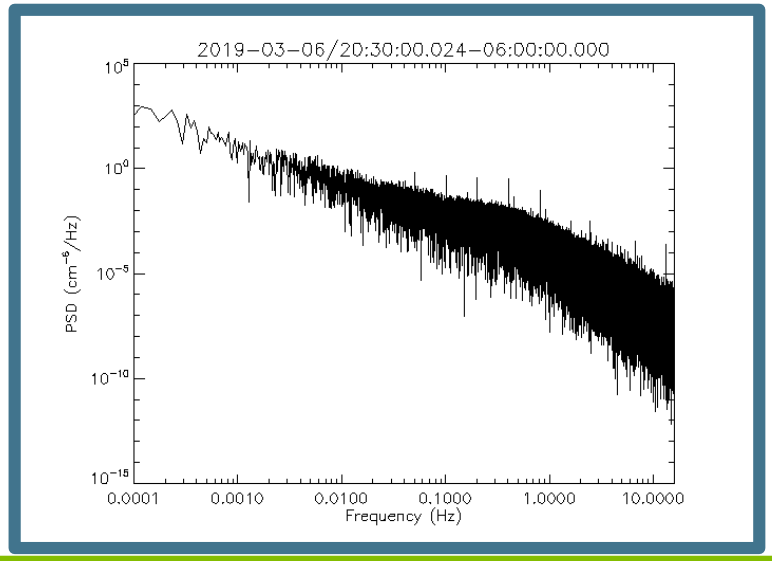
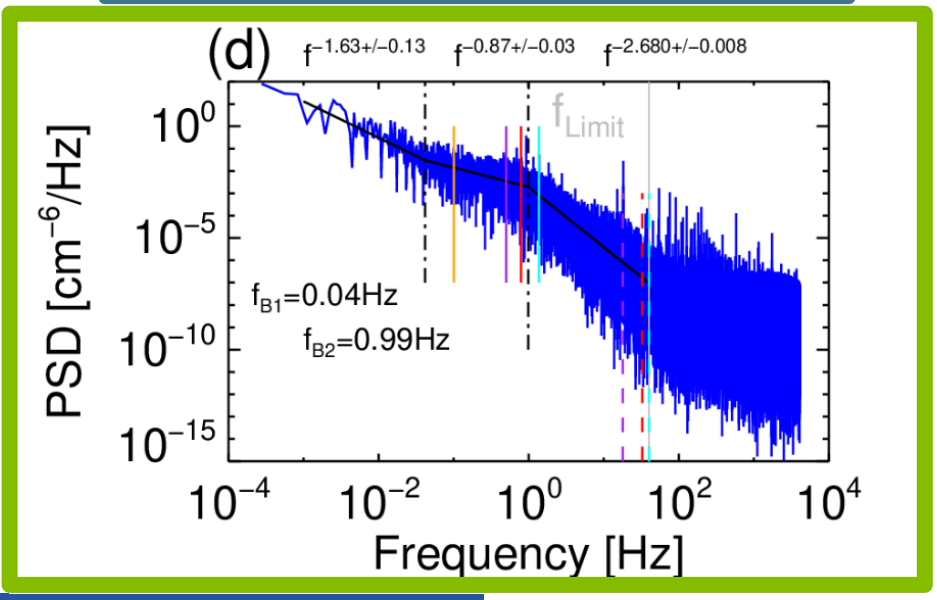
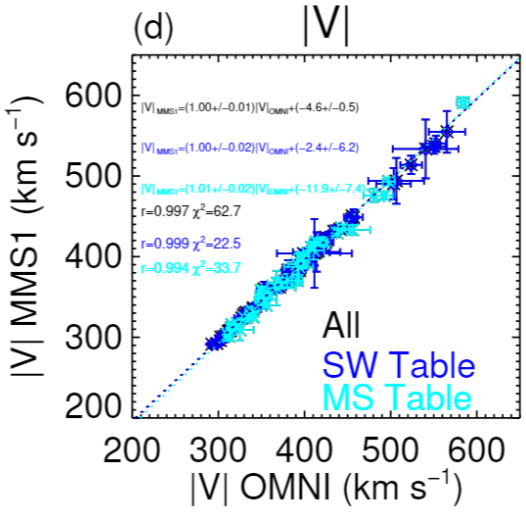
IWF DENSITY ARCHIVE

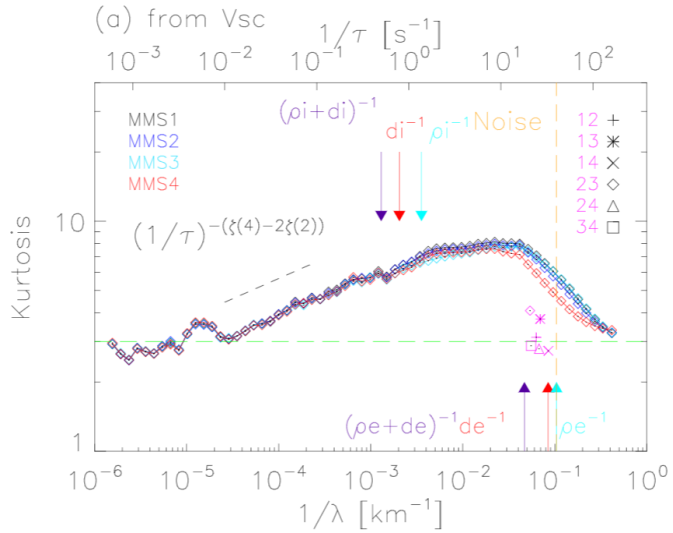


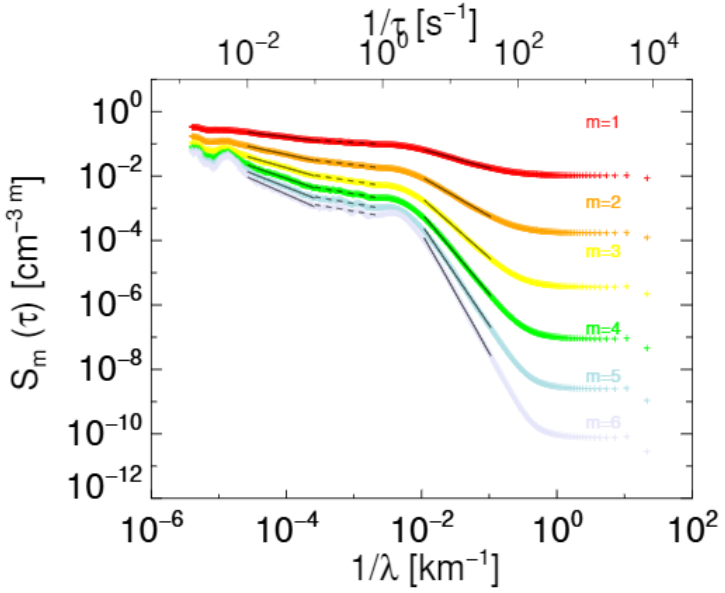


- 16 intervals of burst mode data 96 intervals of **fast survey** mode data over the period 2016-2020
- Spin effect has been removed
- So far we have only considered ASPOC off, but we will try to obtain densities with ASPOC on (Another term in the current balance equation makes it more difficult)
- Variety of solar wind speeds (mostly slow wind)
- https://www.iwf.oeaw.ac.at/en/research/research-groups/space-plasma-physics/sc-plasma-interaction/solarwinddensityproduct/

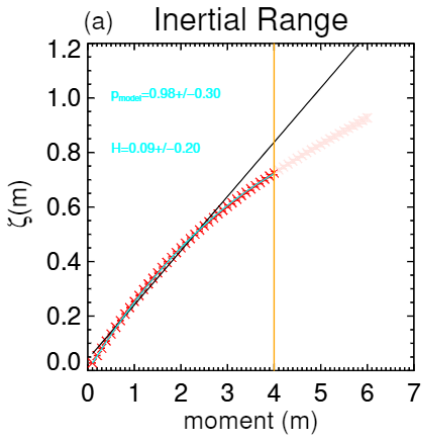


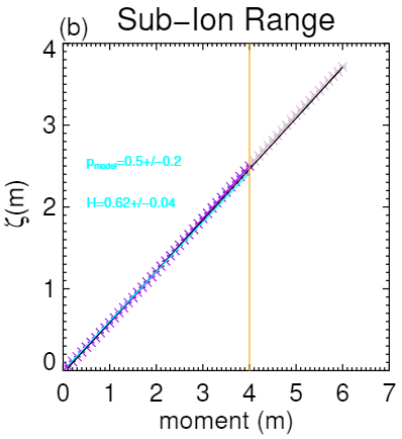
EXAMPLES OF SCIENCE WE CAN DO- INTERMITTENCY





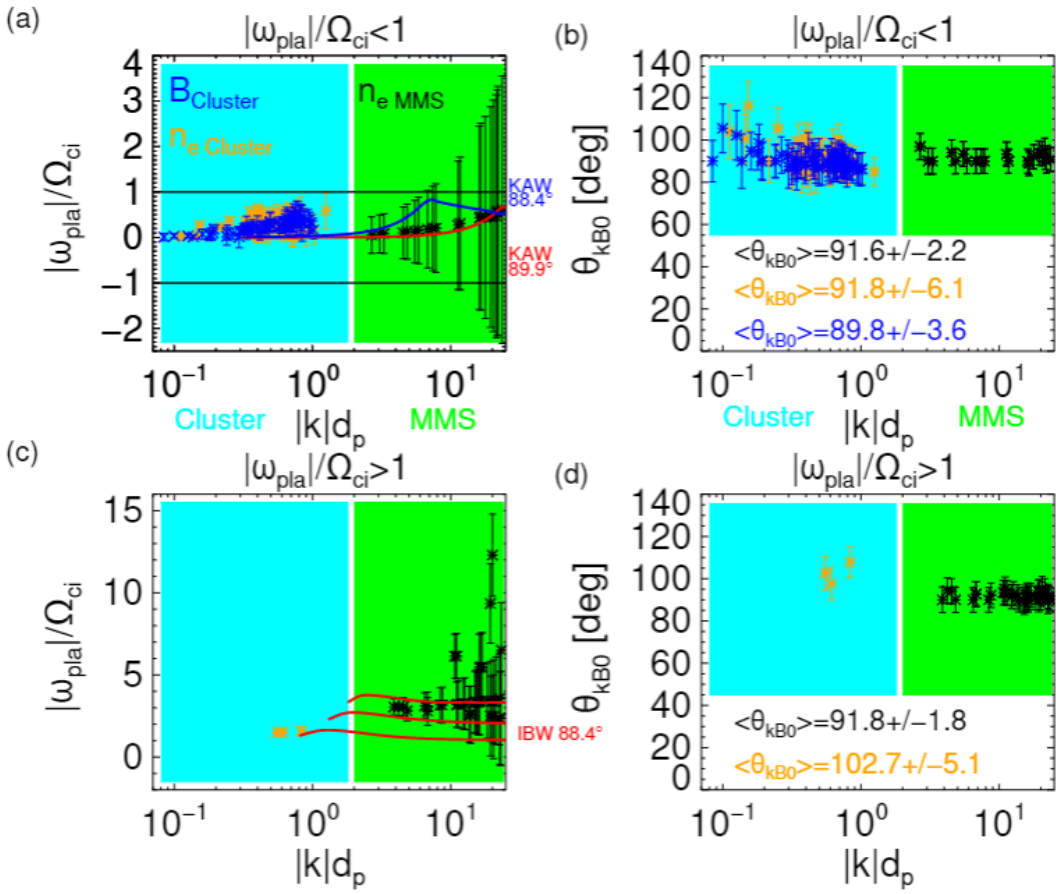
Scale-dependent kurtosis plateaus between ion and electron scales. Sub-ion range characterized by monofractal scaling. Inertial range is in contrast multi-fractal. Directional differences? Come to see my poster in the SWT Afternoon Posters #1 Thursday



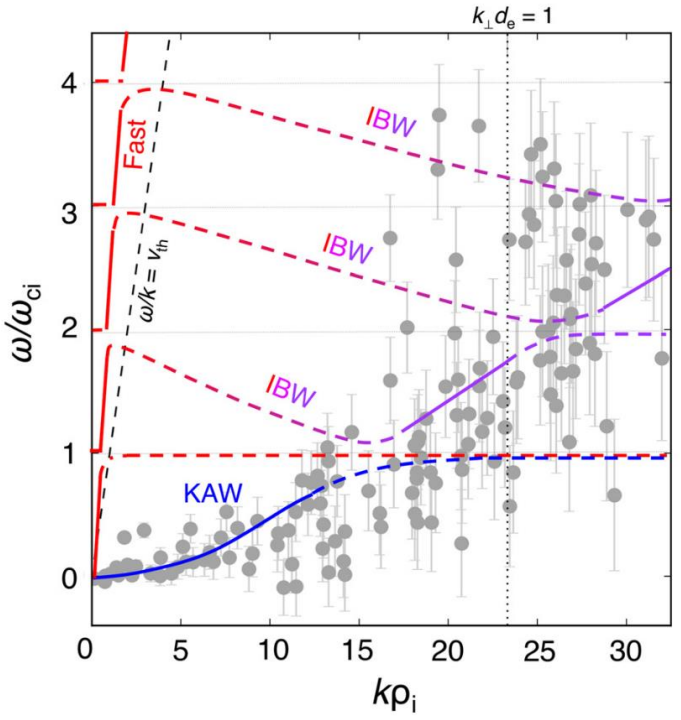


Roberts et al. 2020 Frontiers in Physics in Press
doi: 10.3389/fphy.2020.584063

EXAMPLES OF WHAT WE CAN DO- COMPRESSIVE WAVE ANALYSIS



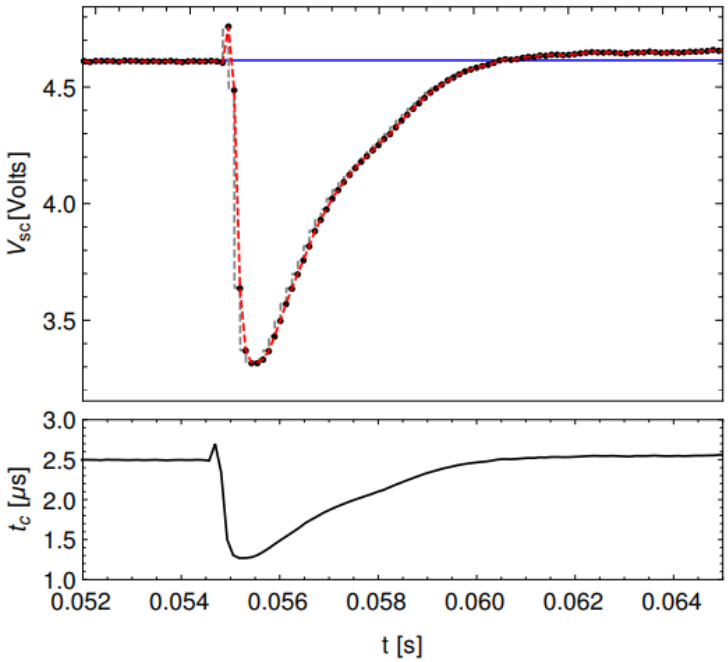
Solar wind density fluctuations in the solar wind



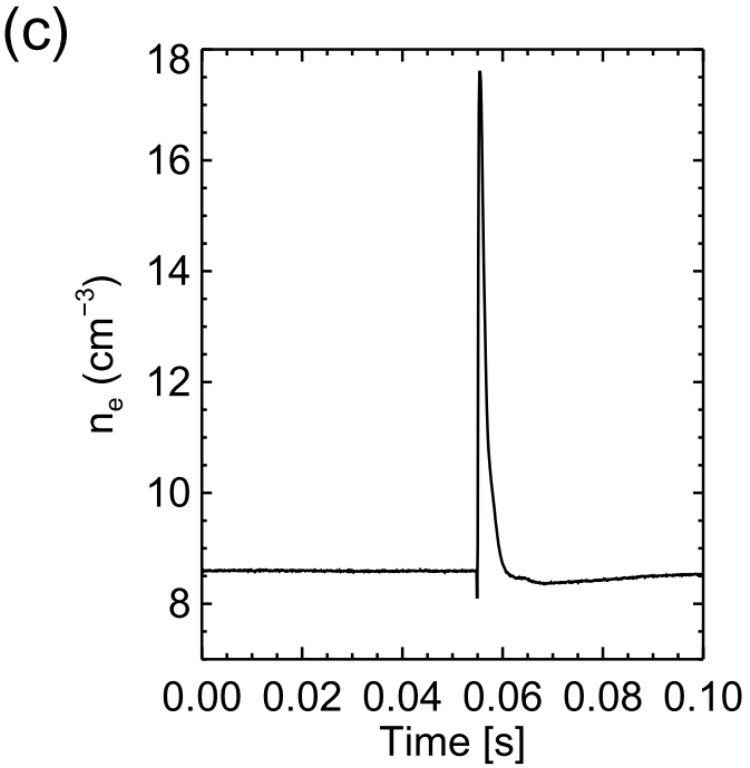
Gershman et al. POP (2018)
Magnetosheath Magnetic field fluctuations

DUST STRIKES/SPACECRAFT CHARGING ANALYSIS

- When a dust particle strikes the spacecraft if vaporizes causing an increase in the density
- Timescale varies with potential



Lhotka et al. POP in Press (2020)



Roberts et al. APJS in Press (2020)

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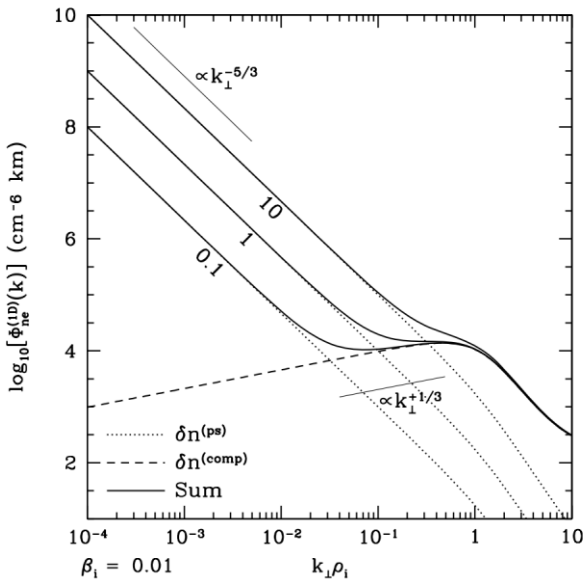
YOUR IDEAS?

- Do you have any ideas of what to do with this data set?
- Bear in mind the magnetic field measurements/particle measurements are limited in the solar wind? Magnetic field available to 5Hz. Ion velocity available to ~1Hz (Bandyopadhyay et al. 2018)
- Comparison of spectra with Models (e.g. Chandran et al. 2009)
- SW campaign data (ASPOC On)
- Your ideas?



Chandran et al. APJ (2009)