



Cross helicity of coronal mass ejections

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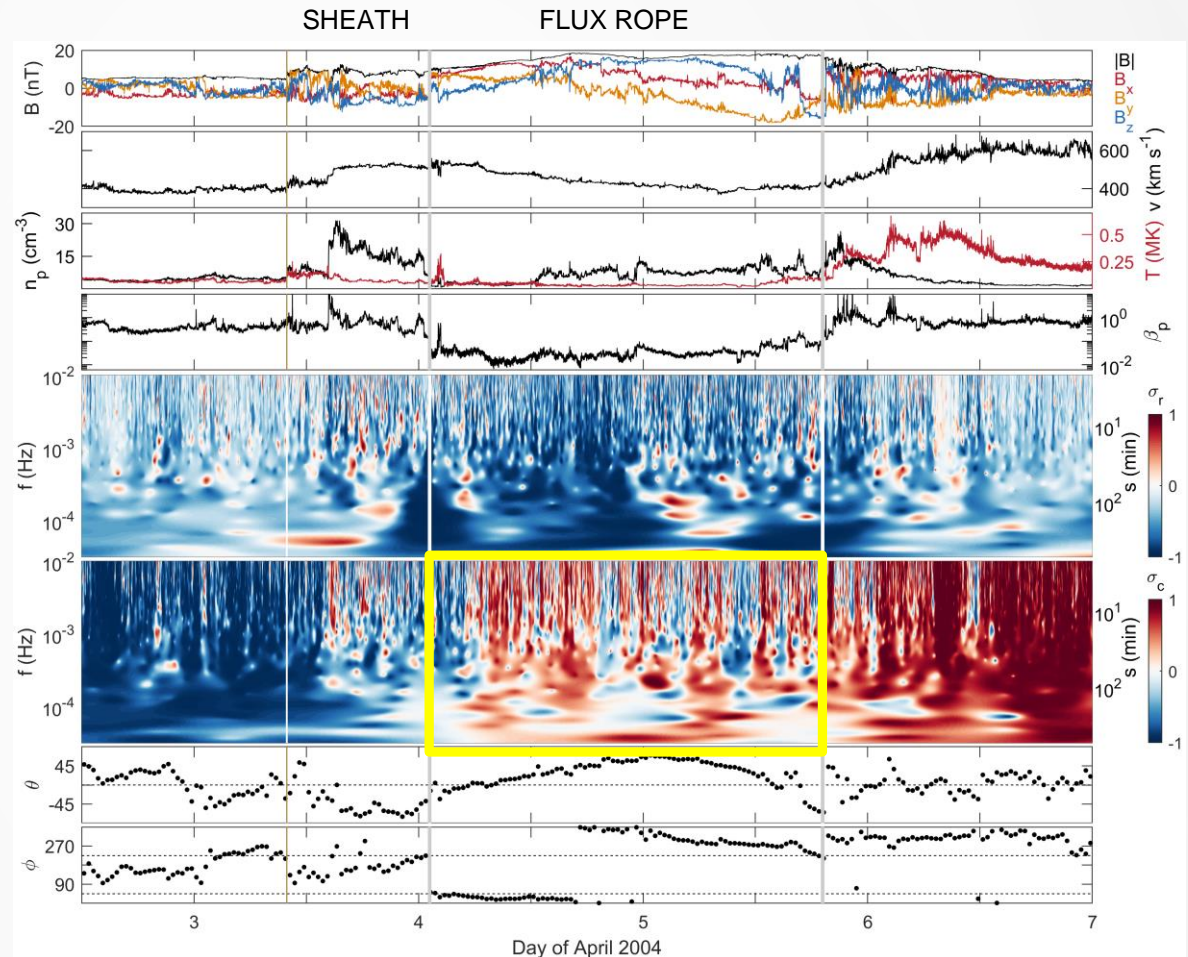


ICME cross helicity: an example event

- σ_c measures the balance of power between Alfvénic wave packets propagating parallel and anti-parallel to the background \mathbf{B} field:

$$\sigma_c = \frac{E_+ - E_-}{E_+ + E_-}$$

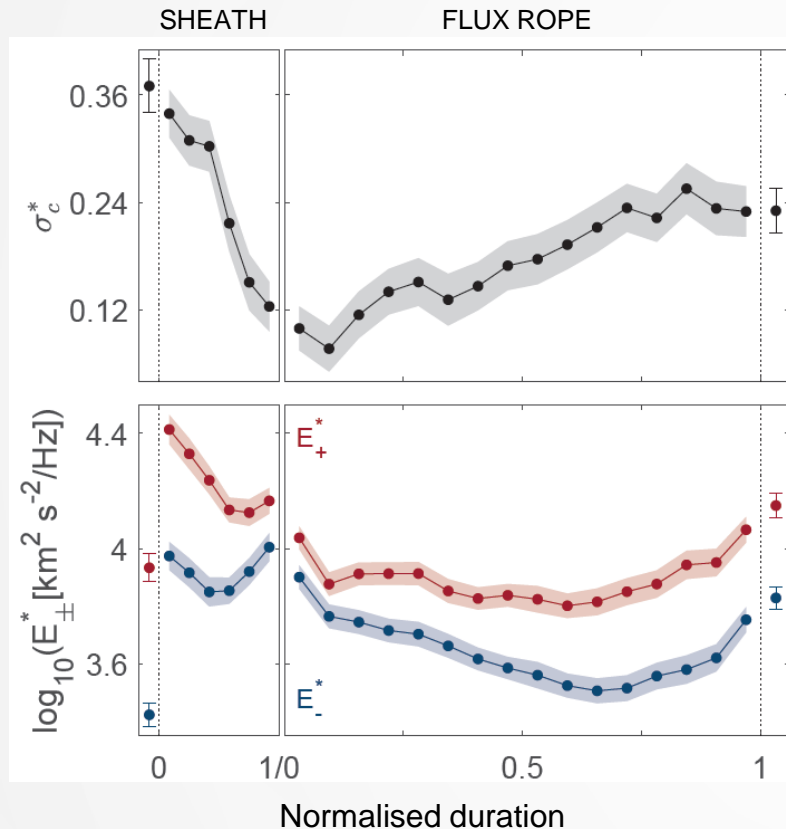
- Solar wind is well known to be imbalanced ($|\sigma_c| \rightarrow 1$) in the anti-sunward direction. What about ICME plasma?
- Morlet wavelet analysis used to find σ_c at $10^{-3} - 10^{-2}$ Hz in 226 ICMEs observed by the *Wind* spacecraft, 1995-2015
- ICME flux ropes tend to have patchy σ_c with a low globally averaged value





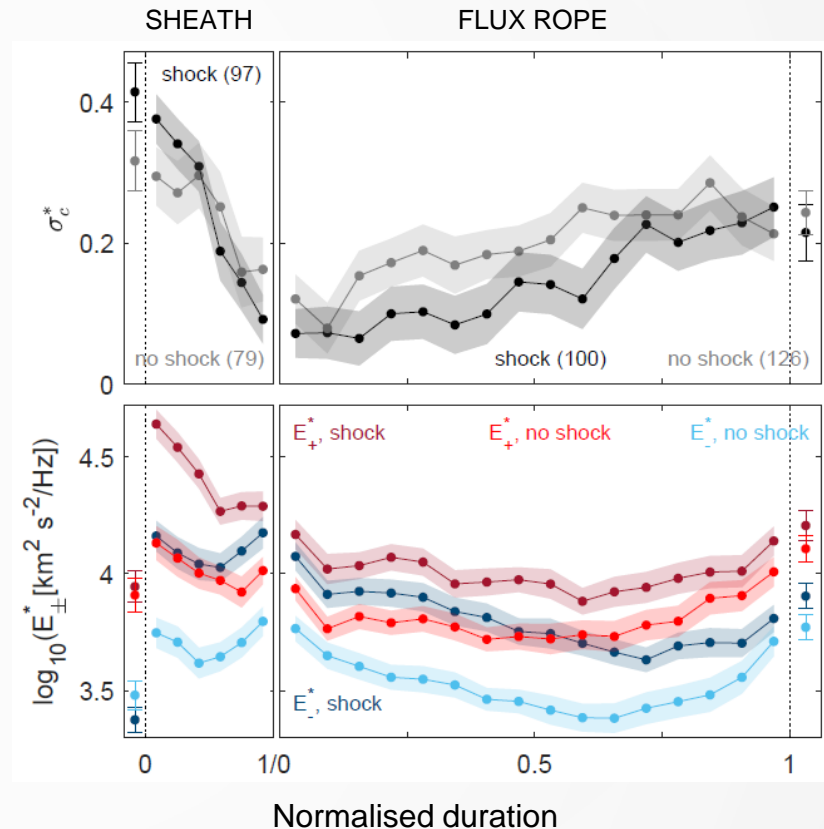
Superposed epoch analysis

All events



- ICMs represent a local depression in σ_c
- σ_c low in value but still everywhere positive (anti-sunward)

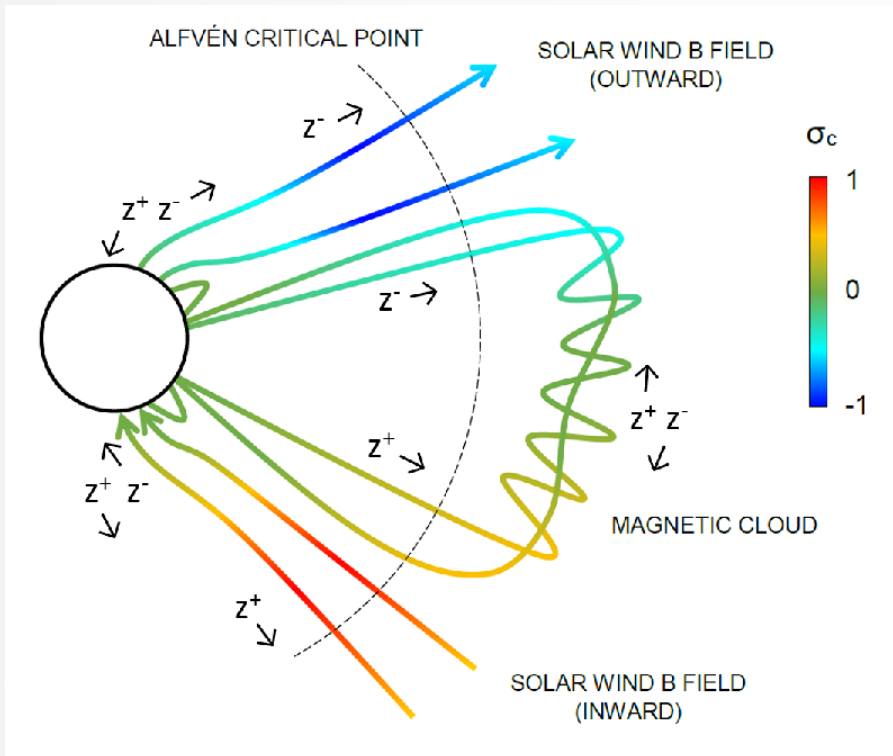
Shock / no shock



- E_{\pm} amplified then falls; **greater relative rise and fall of E_- causes the σ_c trend**
- Greater E_{\pm} amplification in shock-associated events, but σ_c similar



Balanced σ_c in ICMEs: possible origins



The result of a closed field structure in the corona?
(Adapted from [Good et al. 2020](#))

1. **Closed global field structure** in the corona, which carries a balanced population of fluctuations across the Alfvén critical point? (*cf.* open solar wind field lines)
2. **Radial evolution in the turbulence** as seen in the solar wind, but more pronounced in ICMEs?
3. **Velocity shear** locally adding equal power to z^+ and z^- fluctuations, lowering $|\sigma_c|$? (perhaps more likely in sheaths than flux ropes) → **please see talk by Juska Soljento on Friday ([EGU22-11945](#)) for more details!**

This study accepted by MNRAS, now available at: <http://arxiv.org/abs/2205.07751>