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Statistics of the fluctuations in Sheaths preceding Magnetic Clouds

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Magnetic clouds are among the most geoeffective solar events. They are often preceded by a shock and a sheath, and it is recognised that the sheath could play an important role in the development of geoeffectivity. However, the characteristics of sheaths remain poorly known. In this work, we focus on the fluctuations in the sheaths accompanying Magnetic clouds.

We select a list of 42 single, isolated events exhibiting a shock, a turbulent sheath, and a magnetic cloud. Every event is therefore comprised of three regions : (1) Solar Wind, (2) Sheath, (3) Magnetic Cloud. We investigate their characteristics downstream of the shock and relative to the pristine solar wind. Using data from the Advanced Composition Explorer (ACE) satellite, we characterise the fluctuations of B in every region of every event by two quantities : their energy per unit volume and frequency, and their anisotropy. We examine their dependence on the main parameters of each event, such as the shock's Alfvén Mach number M_A, the Beta in the upstream solar wind β, or the angle between the solar wind's magnetic field and the shock's normal θ_{Bn}.

It is shown that in sheaths, the turbulent energy content is significantly enhanced, while the anisotropy decreases. The main parameters playing a role on these changes are observed to be the velocity of the magnetic cloud and the usual shock parameters.

We also discuss the relative importance of the fluctuations of the magnetic field and those of the dynamic pressure, paving the way for an understanding of the evolution of fluctuations within sheaths.