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Solar Orbiter reveals that reconnection jets cluster in the solar wind

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Magnetic reconnection is a fundamental process in astrophysical plasma, as it enables the dissipation of energy at kinetic scales. Detecting it in-situ is therefore key to further our understanding of energy conversion in space plasma. However, ion reconnection jets usually scale from seconds to minutes in-situ, and as such they can be quite tedious to find in the months or years of data provided by Wind, ACE, Helios, PSP and Solar Orbiter.

In this work, we use a new approach to identify automatically reconnection exhausts in-situ. The method strongly relies on the Walén relation and uses Bayesian inference as well as physical considerations to detect reconnection jets in-situ. Applying the detection algorithm to one month of Solar Orbiter data at 0.7 ~AU, we find an occurrence rate of 6.4~jets/day, which is significantly higher than in previous studies performed at 1~AU. We repeat the analysis over the Solar Orbiter perihelion at 0.3 AU and show that the occurrence rate of magnetic reconnection tends to increase with radial distance.

We show that magnetic reconnection exhausts clearly cluster in the solar wind. We perform a statistical analysis, distinguishing between the exhausts associated with the heliospheric current sheet and turbulent reconnection. We find that the source and the degree of Alfvénicity of the solar wind might have an impact on magnetic reconnection occurrence.