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Examining the relationship between electron magnetic reconnection and magnetosheath turbulence with MMS observations

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Turbulent plasmas are known to generate intense small-scale current sheets and it has long been suggested that these current sheets can be sites for magnetic reconnection. However, the role of this fundamental process within the turbulence is still not fully understood. Using Magnetospheric Multiscale (MMS) observations in the Earth's magnetosheath, Phan et al. [Nature, 577, 202-206, (2018)] recently reported a novel form of magnetic reconnection where the dynamics only couple to electrons without any ion involvement. It was suggested that such dynamics may be driven by turbulence in the magnetosheath. In this study, the properties of the fluctuations within the interval studied by Phan et al. are examined using MMS data in order to determine whether the plasma is turbulent, what the properties of the turbulence are, and if there is a signature of the reconnection in the statistics of the turbulence. The study reveals statistical properties consistent with a turbulent plasma. Potential signatures are present in the magnetic spectrum at length scales associated with the reconnecting current sheets within subintervals where magnetic reconnection is more prevalent and the statistics of intense current structures appear to influence the prevalence of magnetic reconnection. The results support the hypothesis that electron reconnection is driven by the turbulent environment and highlight diagnostics that may provide insight into the presence of reconnection in other turbulent plasmas.