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Solar Orbiter observations of magnetic Kelvin-Helmholtz waves in the solar wind

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The Kelvin-Helmholtz instability (KHI) is a nonlinear shear-driven instability that develops at the interfaces between shear flows in plasmas. KHI is ubiquitous in plasmas and has been observed in situ at planetary interfaces and at the boundaries of coronal mass ejections in remote-sensing observations. KHI is also expected to develop at flow shear interfaces in the solar wind, but while it was hypothesized to play an important role in the mixing of plasmas and exciting solar wind fluctuations, its direct observation in the solar wind was still lacking. We report first in-situ observations of ongoing KHI in the solar wind using Solar Orbiter during its cruise phase. The KHI is found in a shear layer in the slow solar wind near the Heliospheric Current Sheet. We find that the observed conditions satisfy the KHI onset criterion from linear theory and the steepening of the shear boundary layer is consistent with the development of KH vortices. We further investigate the solar wind source of this event to understand the conditions that support KH growth. In addition, we set up a local MHD simulation using the empirical values to reproduce the observed KHI. This observed KHI in the solar wind provides robust evidence that shear instability develops in the solar wind, with obvious implications in the driving of solar wind fluctuations and turbulence. The reasons for the lack of previous such measurements are also discussed.