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LOFAR observations of a jet-driven piston shock in the low solar corona

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The Sun produces highly dynamic and eruptive events that can drive shocks through the corona. These shocks can accelerate electrons, which result in plasma emission in the form of a type II radio burst. Despite a large number of type II radio bursts observations, the precise origin of coronal shocks is still subject to investigation. Here we present a well-observed solar eruptive event that occurred on 16 October 2015, focusing on a jet observed in the extreme ultraviolet by the SDO Atmospheric Imaging Assembly, a streamer observed in white-light by the Large Angle and Spectrometric Coronagraph, and a metric type II radio burst observed by the LOw-Frequency Array (LOFAR) radio telescope. For the first time, LOFAR has interferometrically imaged the fundamental and harmonic sources of a type II radio burst and revealed that the sources did not appear to be co-spatial, as would be expected from the plasma emission mechanism. We correct for the separation between the fundamental and harmonic using a model which accounts for the scattering of radio waves by electron density fluctuations in a turbulent plasma. This allows us to show the type II radio sources were located $\sim 0.5 R_{\odot}$ above the jet and propagated at a speed of $\sim 1000 \text{ km s}^{-1}$, which was significantly faster than the jet speed of $\sim 200 \text{ km s}^{-1}$. This suggests that the type II burst was generated by a piston shock driven by the jet in the low corona.

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