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Observations of shock propagation through turbulent plasma in the solar corona

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Eruptive activity in the solar corona can often lead to the propagation of shockwaves. In the radio domain the primary signature of such shocks are type II radio bursts, observed in dynamic spectra as bands of emission slowly drifting towards lower frequencies over time. These radio bursts can sometimes have inhomogeneous and fragmented fine structure, but the cause of this fine structure is currently unclear. Here we observe several type II radio bursts on 2019-March-20th using the New Extension in Nancay Upgrading LOFAR (NenuFAR), a radio interferometer observing between 10-85 MHz. We show that the distribution of size-scales of density perturbations associated with the fine structure of one type II follows a power law with a spectral index of -1.71, which closely matches the value of -5/3 expected of fully developed turbulence. We determine this turbulence to be upstream of the shock, in background coronal plasma at a heliocentric distance of ~2 R_{sun}. The observed inertial size-scales of the turbulent density inhomogeneities range from ~62 Mm to ~209 km. This shows that type II fine structure and fragmentation can be due to shock propagation through an inhomogeneous and turbulent coronal plasma, and we discuss the implications of this on electron acceleration in the coronal shock.