Strongly structured radio emission observed by LOFAR on August 25, 2014

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On August 25, 2014, NOAA AR 2146 produced the M2.0 class flare (peaked at 15:11 UT). The flare was associated with a halo CME and a radio event observed by LOFAR (the LOw-Frequency Array). The radio event consisted of a type II, type III and type IV radio emissions. In this study, we present LOFAR observations of the type II (radio signatures of shock waves) and type III bursts (radio signatures of fast electron beams propagating along open or quasi open field lines). Both, the type II burst and type III bursts show strong fragmentation of the radio emission. Although fine structures of type II bursts were already reported, the richness of the fine structures observed in the studied event is unprecedented. We found type II fine structures morphologically very similar to the ones sometimes seen superposed on type IV continuum emission, and similar to simple narrowband super short structures (Magdalenic et al., 2006). The group of type III bursts was as usually, observed during the impulsive phase of the flare. The high frequency/time resolution LOFAR observations reveal that only few of the observed type III bursts have a smooth emission profile, and the majority of bursts is strongly fragmented. Surprisingly, fine structures of some type III bursts show similarities to the fine structures observed in the type II burst, but on a smaller frequency scale. Some of the type III bursts show a non-organized patchy structure which gives an indication on the possibly related turbulence processes. We show that these LOFAR observations bring completely new insight and pose a new challenge for the physics of the acceleration of electron beams and associated emission processes.