EGU21-1013
https://doi.org/10.5194/egusphere-egu21-1013
EGU General Assembly 2021

Formation of solar coronal loops through magnetic reconnection in an emerging active region

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Coronal loops are building blocks of solar active regions (ARs). However, their formation is not well understood. Here we present direct observational evidence for the formation of coronal loops through magnetic reconnection as new magnetic fluxes emerge to the solar atmosphere. Observations in the EUV passbands of SDO/AIA clearly show the newly formed loops following magnetic reconnection within a vertical current sheet. Formation of the loops is also seen in the Hα images taken by NVST. The SDO/HMI observations show that a positive-polarity flux concentration moves toward a negative-polarity one with a speed of ~0.5 km s^{-1} before the apparent formation of coronal loops. During the formation of coronal loops, we found signatures of flux cancellation and subsequent enhancement of the transverse field between the two polarities. We have reconstructed the three-dimensional magnetic field structure through a magnetohydrostatic model, which shows field lines consistent with the loops in AIA images. Numerous bright blobs with a width of ~1.5 Mm appear intermittently in the current sheet and move upward with apparent velocities of ~80 km s^{-1}. We have also identified plasma blobs moving to the footpoints of the newly formed large loops, with apparent velocities ranging from 30 to 50 km s^{-1}. A differential emission measure analysis shows that the temperature, emission measure and density of the bright blobs are 2.5-3.5 MK, 1.1-2.3×10^{28} cm^{-5} and 8.9-12.9×10^{9} cm^{-3}, respectively. Power spectral analysis of these blobs indicates that the magnetic reconnection is inconsistent with the turbulent reconnection scenario.