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Properties of sub-arcsecond transition-region structures at the footpoints of coronal loops in the active-region plage

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The energy release above the photosphere of 5,800 K produces the chromosphere of ten thousand degrees and the corona of a million degrees. The building block of the corona is a coronal loop that connects two magnetic polarities with opposite signs on the photosphere. The width of coronal loops that are observed with the most X-ray and EUV telescopes is broader than an arcsecond in angular distance, which is limited by the angular resolution of the telescopes. Coronal loops are considered to have sub-structures with a narrower width, threads, within the observed structures, as inferred from the measured volume filling factor and multiple Doppler-shift components at the footpoint of a coronal loop, both of which were found by the Hinode EUV observations. The HiC sounding-rocket EUV imaging observations with 0.3” spatial resolution have recently shown the direct evidence for such small-scale structures in coronal loops. Observations of the sub-arcsec coronal structures will be of crucial importance in understanding the mechanism of coronal heating. We do not, however, have high-resolution coronal imaging data outside the HiC observing period of five minutes. In order to access the sub-arcsecond structures in the coronal loops, we have analyzed the data from Atomospheric Imaging Assembly (AIA) and Interface Region Imaging Spectrograph (IRIS). While AIA observes the coronal structures in 1.2 arcsec resolution with 12 sec cadence, IRIS mostly observes the chromosphere and transition region in 0.4 arcsec with 10 sec cadence, latter of which is the region located between the chromosphere and corona. Our idea is to use IRIS imaging observations in a Si IV emission line for studying the sub-arcsecond coronal threads that connect to the transition-region structures at the coronal base in the active-region plage where the unipolar vertical kG magnetic fields are found at the photosphere. We have found intermittent structures in a Si IV line with 0.5-1.0 arcsec FWHM diameter in intensity at the base of the coronal loops. The intensity and position of such sub-arcsec structures in Si IV change with time within a cross section of a coronal loop at the base. In addition, the intensity of coronal loops at the base increase with a time lag of 10-30 sec after the appearance of the sub-arcsec TR structures in Si IV line. We will discuss what structures are formed in broader coronal loops and the formation mechanism.

Keywords: sun, coronal loop, transition region, IRIS