Observations and modeling of the fine structure of loops in the transition region and corona

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The physical dimensions of loops hold important clues to the coronal heating process. Theoretical arguments universally indicate that coronal heating should operate on very small spatial scales and loops should be unresolvable by current instrumentation. There are a number of observational results, however, that suggest that coronal loops are organized on spatial scales of several hundred km. For example, recent observations from IRIS have discovered a new class of low-lying dynamic loops structures, and it has been argued that they are the long-postulated unresolved fine structures (UFS) that dominate the emission of the solar transition region. Here we show that the properties of the UFS (intensities, lengths, widths, lifetimes) are consistent with 1-D non-equilibrium ionization simulations of an impulsively heated single strand, suggesting that they are resolved, and that the distribution of UFS widths implies that like coronal loops they are also structured on a spatial scale of a few hundred km. Spatial scales of a few hundred kilometers appear to be typical for a range of chromospheric and coronal structures, but it is unclear whether the true distribution of loop widths is normalized around this scale, or whether it extends to much smaller scales - perhaps by a power-law - below the resolution of current instruments. We have extended our previous modelling of the cross-field intensity profiles of coronal loops observed by EIS and AIA, to investigate what the modelled profiles would look like at Hi-C resolution, what they would look like if loops are composed only of < 10km threads, and what they would look like if there is a power-law distribution of loop widths. We find that the models with strands on spatial scales of a few hundred km are most consistent with the data. Very small threads do not produce smooth profiles when their properties are driven by the measured temperatures and densities, and the intensity profiles from the power-law simulations are dominated by emission from the largest strands.