Active Region Loop Diagnostics using Hinode/EIS

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Deriving the physical plasma parameters in coronal structures such as active region loops is of fundamental importance to the understanding of the existence of active regions. The Extreme-ultraviolet Imaging Spectrometer (EIS) on board Hinode provides excellent opportunity to measure electron density, temperature, and plasma flows in coronal loops in great detail. We have carried out a study of an active region observed by EIS on May-19-2007. The observations showed that the active region structures which are clearly discernible in cooler lines (1MK) become 'fuzzy' at higher temperatures (2MK). The active region was comprised of red (downflow) and blue-shifted (upflow) emission in the core and at the boundary respectively. The flow velocities in two loop footpoint regions showed downflows at transition region and upflows at coronal temperatures. The outflow speed in these two regions increased with temperature. A well resolved coronal loop showed downflow along its length. The downflow was localized towards the footpoint in transition region lines Mg VII and towards the loop top in high temperature lines such as Fe XIV and Fe XV. By carefully accounting for the background emission we found that the loop structure was close to isothermal for each position along the loop, with the temperature rising from around 1 MK to 1.5 MK from the close to the base to higher up towards the apex (75 Mm). Electron densities along the active region loop were found to vary from 10^{10} cm^{-3} close to the footpoint to $10^{8.5}$ cm^{-3} higher up. A lower electron density, varying from 10^{9} cm^{-3} close to the footpoint to $10^{8.5}$ cm^{-3} higher up, was found for the lower temperature density diagnostic. Using these densities we derived filling factors along the coronal loop which was obtained to be as low as 0.02 near the base of the loop at a temperature of log T = 6.2 and it increased with projected height of the loop. This study provides important constraints on loop modeling.