## M13a Imaging Spectroscopy Diagnostics of the Cool flare Loops on 2017 September 10

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On 2017 September 10, the active region NOAA 12673 produced the second largest solar flare (class X8.2, peak 16:06 UT) of solar cycle 24. This event resembles the classical model of solar flares, in which a flux rope eruption was followed by the formation of a current sheet and an extended arcade flare loops lasting for many hours. The late gradual phase of the flare in question was captured in multi-spectral imaging by the Solar Magnetic Research Telescope (SMART/SDDI) and Domeless Solar Telescope (DST/UTF) at Hida Observatory. In this work we present H$\alpha$ imaging spectroscopy diagnostics of the cool flare loops, observed between 22:05 and 22:30 UT. We computed wavelength-integrated intensities over the flare loop apex and derived the emission measure by applying the non-LTE theoretical relations. The emission measure along with the geometrical thickness inferred from our observation led us to estimate the electron density of about $5 \times 10^{10}$ cm$^{-3}$, which is high even several hours after the flare peak. Jejčič et al. 2018 and Koza et al. 2019 found the electron density of the order of $10^{12}$ cm$^{-3}$ during the flare peak. Our result indicates that the flare process, i.e., magnetic reconnection, is still ongoing even on much longer time scales. Additionally, using SDO/AIA and Hinode/XRT observations we also derived the differential emission measure, temperature, and density of the hot coronal flare loops. We discuss the physical process of the flare and the long-duration of the cool and hot flare loops.