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Understanding CMEs using plasma diagnostics of the related dimmings

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Coronal Mass Ejections (CMEs) are often associated with dimmings that are well observed in Extreme Ultraviolet (EUV) wavelengths. Such dimmings are suggested to represent the evacuation of mass that is carried out by CMEs and are a unique and indirect means to study CME properties. While Earth-directed CMEs (on-disk CMEs) are difficult to observe due to the bright background solar disk and projection effects, their corresponding dimmings are clearly discernible and ideally suited for analysis. Using data from the 6 EUV channels of Solar Dynamics Observatory/Atmospheric Imaging Assembly for Differential Emission Measure (DEM) diagnostics, we determine the plasma characteristics of the dimming region. These data are well suited for this kind of study due to the good temperature ranges covered by the multiple passbands of the instrument. We analyse 7 on-disk and 5 off-limb events and derive the weighted density and temperature as a function of time, from the DEMs. From such an analysis we differentiate 2 types of dimming regions: core and secondary dimmings. Core dimmings often occur in pairs lying on either sides of the active region and in opposite polarity regions while the secondary dimming is more extended. In both the regions the derived plasma parameters reach a minimum within 30-60 min after the flare. For each event the core dimming region shows a higher decrease in density and temperature than the corresponding secondary dimming regions. The values of these parameters remains low within the core dimming region for the entire duration of this study ($\sim$10 hrs after the flare) while the secondary dimming region starts to show a gradual increase after 1-2 hrs. We also use spectroscopic data from Hinode/Extreme-Ultraviolet Imaging Spectrometer to differentiate core and secondary dimming regions. We find that the Fe XIII 202 Å line shows double component profiles within the core dimming region with strong blueshifts of 100 km/s while the secondary dimming region has weak upflows of 10 km/s. We conclude that the core dimming region corresponds to footpoints of the erupting flux rope from where there is continuous strong upflowing plasma for at least 10 hrs after the flare, while the secondary dimming region begins to refill within 1-2 hrs. These measurements can be used to deduce information about the mass of on-disk CMEs where white light measurements can fail. We also confirm that the dimmings are mainly caused by density decrease and not temperature changes. DEM analysis is a strong tool to decipher CME properties from dimming regions.