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Formation Of The Lyman Continuum During Solar Flares

The Lyman Continuum (LyC; <912Å) forms at the top of the chromosphere, making it a powerful tool for probing the chromospheric plasma during solar flares. SDO/EVE has observed many LyC disk-integrated flares, though this is a largely untapped dataset (aside from Machado et al 2018). Further, SolO/SPICE also provides partial coverage of the LyC (704-790Å), whilst the upcoming Solar-C/EUVST will observe 460-1220Å. It is important, therefore, to have solid theoretical predictions of the LyC formation properties during flares for comparison with current/future observations. To understand the effects of non-thermal energy deposition during flares, we analysed LyC spectra from a set of radiation hydrodynamic flare models (RADYN). The spectral response of the LyC, and the resulting temporal evolution of the NLTE departure coefficient of hydrogen, b_1, and the colour temperature, T_c, was investigated in response to a range of non-thermal electron distributions. The LyC intensity was found to increase by 3-5.5 orders of magnitude dependent on the injected energy flux. Generally, b_1 decreased from 10^{2-3} to 10^{-1-1} indicating a stronger coupling to local plasma conditions, while Tc increased from 8-9kK to 10-16kK. Both optically thick and thin components of LyC were found, in agreement with recent observations. The optically thick layer formed deeper in the chromosphere during a flare compared to quiescent conditions, whereas the optically thin layers form at higher altitudes due to chromospheric evaporation in low-temperature, high-density regions propagating upwards. Our analysis paves the way for an interpretation of existing and upcoming LyC observations.

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