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Hot X-ray Onsets of Solar Flares

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The study of the localized plasma conditions before the impulsive phase of a solar flare can help us understand the physical processes that occur leading up to the main flare energy release. Here, we present evidence of a hot X-ray 'onset' interval of enhanced isothermal plasma temperatures in the range of 10-15 MK up to tens of seconds prior to the flare's impulsive phase. This 'hot onset' interval occurs during the pre-flare time during which elevated GOES soft X-ray flux is detected, but prior to detectable hard X-ray emission. The isothermal temperatures, estimated by the Geostationary Operational Environmental Satellite (GOES) X-ray sensor, and confirmed with data from RHESSI, show no signs of gradual increase and occurs regardless of flare classification or configuration. In a small sample of four representative flare events, we identify this early hot onset soft X-ray emission mainly within footpoint and low-lying loops, rather than with coronal structures, based on images from the Atmospheric Imaging Assembly (AIA) and the use of limb occultation. These hot X-ray onsets appear before there is evidence of collisional heating by non-thermal electrons, and hence challenges the standard flare heating modelling techniques.

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