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Evidence of chromospheric molecular hydrogen emission in a solar flare observed by the IRIS satellite

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We have carried out the first comprehensive investigation of enhanced line emission from molecular hydrogen, H₂ at 1333.79 Å, observed at flare ribbons in SOL2014-04-18T13:03. The cool H₂ emission is known to be fluorescently excited by Si IV 1402.77 Å UV radiation and provides a unique view of the temperature minimum region (TMR). Strong H₂ emission was observed when the Si IV 1402.77 Å emission was bright during the flare impulsive phase and gradual decay phase, but it dimmed during the GOES peak. H₂ line broadening showed non-thermal speeds in the range 7-18 km/s, possibly corresponding to turbulent plasma flows. Small red (blue) shifts, up to 1.8 (4.9) km/s were measured. The intensity ratio of Si IV 1393.76 Å and Si IV 1402.77 Å confirmed that plasma was optically thin to Si IV (where the ratio = 2) during the impulsive phase of the flare in locations where strong H₂ emission was observed. In contrast, the ratio differs from the optically thin value of 2 in parts of ribbons, indicating a role for opacity effects. A strong spatial and temporal correlation between H₂ and Si IV emission was evident supporting the notion that fluorescent excitation is responsible.

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