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High flow speeds and transition-region like temperatures in the chromosphere caused by reconnection

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Flux emergence in the solar atmosphere is a complex process that causes release of magnetic energy as heat and acceleration of solar plasma. We analyse imaging spectropolarimetric data taken in the He I 1083 nm line at a spatial resolution of 0.26”, a time cadence of 2.8 s, and a spectral range of 150 km s^{-1} around the line. This data is complemented by imaging spectropolarimetric data in the Ca II K, Fe I 617.3 nm, and Ca ii 854.2 nm lines. We compute He I 1083 nm profiles from a radiation-MHD simulation of the solar atmosphere to help interpret the observations.

We find fast-evolving blob-like emission features in the He I 1083 nm line at locations where the magnetic field is rapidly changing direction, and these are likely sites of magnetic reconnection. We fit the lines with a model consisting of an emitting layer located below a cold layer representing the fibril canopy. Numerical modeling provides evidence that this model, while simple, catches the essential characteristics of the line formation. The morpholoigy of the emission in He I 1083 nm is localized and blob-like, unlike the emission in the Ca II K line, which is more filamentary.

Based on the high temperatures needed for He I 1083 nm emission, the high Doppler speeds in the emission features, and their blob-like appearance, we conclude that at least a fraction of them are produced by plasmoids that occur during magnetic reconnection.

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