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Flux-flux relations as statistical proxies of unresolved small-loop like structures

In the solar transition region small-scale loops (order of megameters) are found in abundance. Using data from the Interface Region Imaging Spectrograph (IRIS) we investigate some of these small loops on a case-by-case basis, in particular following their temporal evolution while they first heat up and then cool down. To get a broader description of how the structures seen at chromospheric and transition region temperatures relate to the magnetic field, we investigate the power-law dependency of the intensity in spectral lines on the underlying magnetic field. In particular, we use raster map from the Mg II, C II, and Si IV lines provided by IRIS and relate them to the line-of-sight photospheric magnetic field obtained by SDO/HMI. We find that the correlation between magnetic field and intensity decreases continuously with increasing temperature. The power-law indices show a more complex variation with temperature through the atmosphere. The power-law index first decreases from the photosphere towards the temperature minimum and then starts to increase throughout the chromosphere into the transition region. Firstly, it is remarkable to find such a well ordered (average) behaviour through the highly dynamic and structured chromosphere, and secondly, the variation with (average) temperature is a challenge to explain by models. While the increase from the chromosphere to the transition region might be due to the increasing sensitivity of the plasma to the heating process, the drop of the power-law index from the photosphere to the chromosphere remains elusive. It might be connected to early suggestions based on a geometrical model to explain the non-linear relationship of intensity and magnetic field in the chromosphere. Future work will have to address this problem.