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New insights from umbra modelling and new questions for cycle 25

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Despite the recent lull in solar activity, the community has seen new observational discoveries and new advances in the modelling of the umbra. The presence of coronal and transition region downflows have been repeatedly reaffirmed, their role in the typical umbral upper chromosphere remaining unconstrained. A connection between small-scale dynamic fibrils and umbral flashes has been established using semi-empirical inversions that leave open questions regarding the top-most chromospheric temperatures. In parallel ALMA has confirmed the presence of increased radio emission from the chromospheric umbra of unknown source and at unconstrained formation heights. It is not clear how, if at all, these three pieces of the puzzle fit together. We review these advances together as the new open questions were not obvious before. Using synthetic observables from different inversions set in such a way that they lead to the very different models found in the literature, we present how some of the open questions can be answered either in the optical or, even more promisingly, in mm wavelengths. In the process we settle the formation heights for multiple ALMA passbands in the umbra and provide approaches to solve non-LTE inversion degeneracies in the optical. High quality SST data is very briefly presented in the context of dynamic fine-structures and how such features might impact the also recently discovered resonant mode signatures.

Student poster?

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