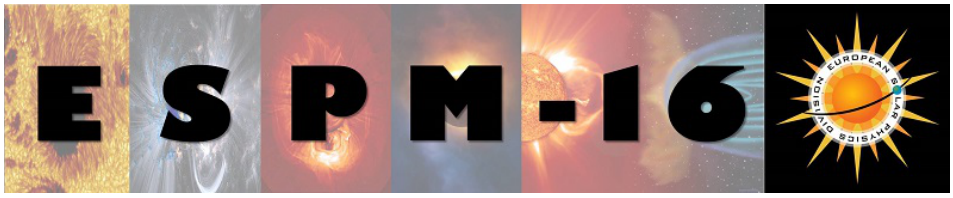

Contribution ID: **378** Type: **Poster**

The opacity pipeline: from atomic data to realistic RMHD simulations

Wednesday 8 September 2021 16:30 (13 minutes)

Comprehensive radiative MHD simulations of the solar atmosphere depend directly on few free parameters. However, the microphysics of the problem (including atomic and molecular data) is hidden in the opacity and equation of state used by numerical codes. We address the importance of various opacity contributors in 3D simulations of the solar photosphere done with the MANCHA code. This is critical for studies where highly accurate synthetic spectra are needed. For example, for solar irradiance variations (Criscuoli et al, 2020) or for abundance determinations.

We have developed a pipeline that starts with atomic and molecular data tables for computing monochromatic opacities using an open-source code (Synspec, Hubeny and Lanz, 2017), and finally constructs the opacity distribution function (ODF) and opacity bins that are used in convection simulations. We have run the MANCHA code, starting from the same initial state and for the same amount of solar time, with ODF and different numbers of opacity bins. The results of these runs are compared to test how accurately opacity binning approximates the full non-grey problem. In addition, we compare the results with similar simulations obtained using opacities produced by the ATLAS9 code (Castelli and Kurucz, 2003). Apart from analyzing the opacity bins and their influence on the temperature, we also compare the radiative output from snapshots (Fe I line and center-to-limb variation of the continuum). Having a well-tested and fully controllable pipeline for the opacity treatment is essential to extend MANCHA convection simulations to the case of other main sequence cool stars.

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Session Classification: Poster Session 8.1

Track Classification: Session 2 - The Solar Atmosphere: Heating, Dynamics and Coupling