Spectropolarimetry of Coronal Lines: Forward Modeling Tools and Their Applications

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Forward modeling is a powerful method for studying the behavior of spectral lines under various physical conditions. In this talk, I will review some of the available forward modeling tools for coronal lines, with a focus on P-CORONA, a recently developed, publicly available code. P-CORONA models the intensity and polarization of both forbidden and permitted lines using three-dimensional magnetohydrodynamic simulations of the corona. It accounts for the spectral line polarization caused by anisotropic radiation pumping, magnetic fields through both the Hanle and Zeeman mechanisms and incorporates the influence of non-linear solar wind velocities. I will present key results obtained with P-CORONA for a range of lines from ultraviolet to infrared, including those observed by the Daniel K. Inouye Solar Telescope (DKIST). Finally, I will discuss how such forward modeling tools can support various applications, including exploring how different physical parameters affect coronal emission, testing theoretical models by comparing them with observations, and guiding the design of instruments by predicting which spectral lines and polarization signals are most useful for specific science goals.