Title: Exploring the Cool Pockets in the Solar Atmosphere

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Abstract:

A challenging problem arises when interpreting the observed spectral line cores of the carbon monoxide vibration-rotation transitions near the solar limb. They imply the presence of material with temperatures below the limit of the classical temperature minimum which is in contrast to the inferred temperatures from atomic spectral lines observed in the same layers of the solar atmosphere. I used the Radiative Transfer Code (RH), developed by Dr. Han Uitenbroek, to produce CO spectral lines from recent MHD atmospheric simulations. I analyzed 1D and 2D atmospheric models to compare their spectra in cases of both local thermodynamic equilibrium and non-LTE assumptions. Our models predict that non-LTE and LTE spectra were found to be nearly identical for 2D atmospheric models which confirms that the low temperatures inferred from the CO spectral lines near the solar limb are not due to LTE assumptions. The more recently developed 2D atmosphere model BIFROST produced deep line cores which implied temperatures of 3158 K. It was concluded that the BIFROST model contains too cool of temperatures; the effects of adiabatic cooling from the expansion of overshooting granules creates cool temperatures in CO forming layers that is not adequately balanced with heating from ambipolar diffusion. Therefore, the model is not yet a complete representation of the real dynamic solar atmosphere. The calculated CO spectra will give guidance on what to look for when observing this dynamic photosphere chromosphere interface with the new DKIST NSO facility in Hawaii.