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Title: The Curious Case of the Solar Temperature Minimum

Abstract: Back in the mid-1970's, a debate raged in the solar community -- among the 3 or 4 people who actually cared -- concerning the minimum temperature in the Sun's outer atmosphere, at the chromosphere-photosphere interface. The main players in the debate were the Harvard group, Gene Avrett and collaborators, and JILA's Cool Star Mafia, mainly myself and Jeff Linsky, but with considerable help from our friends, especially Dimitri Mihalas and the HAO radiative transport gang. The debate not only focused on the specific issue of the Tmin, but also more broadly on the efficacy of different classes of radiation transport numerical techniques: the Harvard group championed the so-called integral equation approach, while the Colorado folks promoted the difference equation strategy pioneered by Auer, Mihalas, Heasley, and Milkey, among others. Much hot air was expended in those days touting the benefits of one approach over the other; not unlike the Mac vs. Microsoft debates occurring in office hallways these days. The Tmin issue was considered important at the time, because its value—in the context of the then popular 1D semiempirical models --played a key role in deducing the energy budget of the low chromosphere, where the bulk of the supra classical ultraviolet radiation of the Sun is produced; of relevance to a variety of related issues, not the least of which is Space Weather. The Harvard group had derived a Tmin temperature of about 4150 K based primarily on UV continuum diagnostics, while the JILA investigators had deduced a higher value, 4400–4500 K, based on a detailed analysis of the inner damping wings of the Ca II H & K lines (near 395 nm), utilizing a "Partial Redistribution" approach to more accurately describe the semi-coherent scattering nature of the radiation transport outside the line Doppler core. Dimitri was one of the instrumental forces in developing the underlying theory, and the new PRD approach later was adopted, albeit reluctantly, by the Harvard group (whose initial resistance was fostered in part by the difficulty of implementing the new scheme in their integral equation approach; versus the transparent, intuitive assimilation of PRD into the difference equation treatment). Case seemingly solved! In hindsight, the historical Tmin arguments over a mere few hundred K out of more than 4,000 K, parallels the equally hotly debated contemporary Solar Oxygen Crisis: only among solar physicist could so much heat be generated over a difference that our friends on the dark side would view as rather good agreement. Furthermore, now four decades later, we recognize that what had appeared to be a simple question back then—What is the value of Tmin?—has morphed into a much more complex and subtle issue: In fact, does the Sun even have a full-time chromosphere at all? Despite all that, the legacy of PRD radiative transfer scheme developed by Dimitri and collaborators lives on, although it continues to numerically bedevil those who wish to utilize it to improve the accuracy of spectral simulations in state-of-the-art 3D solar atmospheric models.