TUESDAY POSTER SESSIONS

Session 15: Radiative Transfer, Convection and Magnetic Diffusion

15.01
A New Theoretical Model Photosphere

Robert L. Kurucz (Harvard-Smithsonian CFA)

I have used my newly calculated iron group line list together with my earlier atomic and molecular line data, 58,000,000 lines total, to compute new opacities for the temperature range 2000K to 200000K. Calculations have been completed at the San Diego Supercomputer Center for 56 temperatures, for 21 pressures, for micro-turbulent velocities 0, 1, 2, 4, and 8 km/s, for 3,500,000 wavelength points divided into 1221 intervals from 10 to 10000 nm, for scaled solar abundances [+1.0], [+0.5], [+0.3], [+0.2], [+0.1], [+0.0], [-0.1], [-0.2], [-0.3], [-0.5], [-1.0], [-1.5], [-2.0], [-2.5], [-3.0], [-3.5], [-4.0], [-4.5], and [-5.0] (log abundance of elements heavier than helium relative to solar). I have rewritten my model atmosphere program to use the new line opacities, additional continuous opacities, and an approximate treatment of convective overshooting. Opacity can be interpolated as a function of depth-dependent microturbulent velocity. The opacity calculation was checked by computing a new theoretical model photosphere that matches the observed irradiance (Meckel and Labs 1984; Labs et al. 1987). I am confident that I have solved the missing opacity problem.

15.02
Frequency Redistribution in Solar Resonance Line Wings

K. Gayley (JILA/UColo)

For solar-like free electron densities, resonance line thermalization is affected by partially coherent scattering in the wings. However, frequency redistribution by Doppler diffusion yields a similar result for the thermalization depth as CRD over a Doppler profile. Thus a proper treatment of partially coherent scattering effects is critical only for determining the wing flux that emerges from well below the depth of thermalization. We show how to estimate this flux in quiescent and flaring cases, for resonance lines of H, Ca II, and Mg II, accounting for the influence of elastic collisions and interlocking transitions on frequency redistribution in the line wings.

15.03
Partial Redistribution Modeling of the CaII K Line

H. Uitenbroek (CFA)

Most numerical radiative transfer calculations treat scattering of line photons with the approximation of complete frequency redistribution. Usually this is both a valid and a viable approach, as it simplifies the numerical problem. This is no longer true for partially scattering with high opacity such as the resonance lines of Mg II and Ca II in the solar atmosphere. These lines form in the more tenuous parts of the atmosphere where electronic collisions are less frequent. The correlation between the incoming and outgoing frequency of a scattered line photon then plays an important role in the transfer of radiation, which must be treated with the more realistic approach of partial redistribution at the cost of a more complex numerical method.

A numerical scheme is presented that adds partially coherent scattering to the expedient Schärmer-Caswell operator perturbation method for multi-level non-LTE radiative transfer. The present method can handle both partial redistribution in resonance line scattering and cross redistribution with subordinate lines. The numerical method is here applied to the formation of the Ca II K line in the solar spectrum, but is not specific to this line and can be used in more general stellar atmospheres and with different atomic models.

Filtergrams made in the center of the Ca II K resonance line show the presence of strong magnetic fields on boundaries of supergranulation cells as a bright network. The emergent K-line intensity is computed from a number of composite atmospheric models containing hot magnetic flux tubes and a 'cooler' non-magnetic surrounding medium. The range of these models is constrained by comparing the computed spatial K contrast, the spatial averaged K emission and the behaviour of emission as a function of magnetic filling factor with typical observed values.

Apart from the more steady, symmetric, K- emission from the magnetic network, the interiors of supergranulation cells show short term (180 sec) variability mainly visible as very localised emission in the violet K$_M$ peak. These short period variations may contain information on the dynamic behaviour of the solar chromosphere and its mechanical coupling to the photosphere. A short review of observations is given and modeling efforts are discussed. Acoustic waves traveling upwards, steepening into shocks and thereby interacting with previous shocks seem to be the most likely explanation.

15.04
Three-Dimensional Hydrodynamic Stellar Convection

M. Hossain and D.J. Mullan (Bartol)

Using a pseudo-spectral code, we have obtained numerical solutions of three-dimensional compressible hydrodynamic convection in a stratified medium with open boundaries and radiative losses. We do not impose an entrant heat flux from below. Results are presented for three simulations in boxes with depths of roughly 2H$_P$, 3H$_P$, and 4H$_P$ (where H$_P$ is a pressure scale height). The code does not make the anelastic approximation: rather, it follows sound waves explicitly. The code remains stable for long time intervals: the number of sound crossing times which have been achieved so far in the three simulations are roughly 600, 600, and 400 respectively. By these times, a statistically steady state is well developed in all three cases, with significant upward heat fluxes. The high stability of the code is due in part to the fact that our effective "grid Reynolds' number" does not exceed unity: as a result, our flows are found to be organized spatially about time-dependent points of convergence and divergence, with lower amplitude convective flows superposed. Moreover, the spatial organization appears as vertical "stacking" of smaller structures on top of larger ones, with each structure being roughly 2H$_P$ in vertical extent. Compressibility effects are apparent in the density: snapshots indicate that in a horizontal plane, the density at certain points may be of order ten percent larger or smaller than elsewhere in that plane.

In the context of coronal heating, we are interested in fluxes of kinetic energy, both total fluxes and those in the horizontal direction. Also of interest from the point of view of resonant heating of coronal loops are the spectral distributions of power on a variety of length scales.

This work has been supported by NASA under grant NAGW-1295 from the Astrophysical Theory Program.

15.05
Comparison of Relationships Provided by Numerical Simulations of Turbulent, Compressible Convection with Mixing Length Theory

T. J. Lydon and S. Sofia (Yale/CSR)

Approximate relationships between convective fluxes and thermodynamic quantities such as temperature, pressure, and density have been formulated by Chan and Sofia (1989, Astrophys. J., 336, 1022) in a series of numerical simulations of turbulent, compressible convection. These relationships are compared to equivalent relations provided by standard mixing length theory. The Chan and Sofia results have also been incorporated into a stellar structure model; some preliminary results are presented. This work is supported by NASA's Graduate Student Researchers Program (Grant No. NAG - 50651).

© American Astronomical Society • Provided by the NASA Astrophysics Data System