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Final Technical Report for NASA Grant NGL 06-003-057: Basic Research in Solar Physics

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This grant, dating back more than 20 years has supported a variety of investigations of the chromospheres and coronae of the Sun and related cool stars by the Principal Investigator, his postdocs and graduate students, and colleagues at other institutions. This work involved studies of radiative transfer and spectral line formation theory, and the application of these techniques to the analysis of spectra obtained from space and ground-based observatories in the optical, ultraviolet, x-ray and radio portions of the spectrum. Space observations have included the analysis of spectra from OSO-7, Skylab, SMM, and the HRTS rocket experiments.

Recent work has concentrated on the interaction of magnetic fields, plasma and radiation in the outer atmospheres of the Sun and other magnetically active stars with different fundamental parameters. Our study of phenomena common to the Sun and stars, the "solar-stellar connection", can elucidate the fundamental physics, because spatially-resolved observations of the Sun provide us with the "groundtruth," while interpretation of stellar data permit us to isolate those parameters critical to stellar activity.

Recently, we have studied the differences in physical properties between solar regions of high magnetic flux density and the surrounding plasma. High-resolution CN and CO spectroheliograms have been used to model the thermal inhomogenieties driven by unstable CO cooling, and we have analyzed spatially resolved UV spectra from HRTS to model the thermal structure and energy balance of small-scale structures. The study of nonlinear relations between atmospheric radiative losses and the photospheric magnetic flux density has been continued. We have also proposed a new model for the decay of plages by random walk diffusion of magnetic flux.

Our analysis of phenomena common to the Sun and stars included the application of available spectroscopic diagnostics, establishing evidence that the atmospheres of the least active stars are heated at a "basal" rate that is also found in the centers of solar supergranules, and using the Doppler-imaging technique to measure the position, size, and brightness of stellar active regions. We are computing multi-component models for solar and stellar atmospheres, and models for coronal loops and for the transition-region downflows. The study of solar and stellar flares permits us to assess the role of turbulent energy transport, to pinpoint the mechanism behind Type I radio bursts, to determine whether plasma radiation or cyclotron maser is responsible for microwave flares on M dwarfs, and to extend our knowledge of the basic physics pertinent to cyclotron-maser processes operating on the Sun. F N/D

The following is a list of publications supported by this grant since 1987. Earlier publications are listed under earlier reports and proposals.

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