10.14

A Non-Radial Radiation Force in Hot Star Winds

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The line radiation force acting on the wind from a uniformly rotating hot star has an azimuthal component as well as a radial component. This component arises from the fact that if the photospheric intensity is a function of frequency, the Doppler shift due to the rotational motion makes the radiation force due to the scattering of photons coming from the opposite limbs of the star have different magnitudes. If the intensity of radiation from the star is a strong function of frequency (such as in a photospheric absorption line), the resulting azimuthal force can be of the same order of magnitude as the radial force. If the intensity decreases with frequency, this force acts opposite the direction of rotation, thus spinning down the wind, and if the intensity decreases with frequency, the force acts in the same direction as the rotation. We have constructed simple numerical models of a hot star wind acted on by this force, to investigate the details of the azimuthal and radial flow. A Gaussian absorption profile was assumed for the photospheric intensity. In some of these models, the azimuthal velocity could be reduced by a factor of four compared to angular momentum conservation. This force can have an additional effect on the wind in a non-rotating star with a magnetic field, namely, the amplification or damping of Alfvén waves. We speculate on the application of this effect to cool supergiant winds.

10.15

Activity Cycles of Lower Main-Sequence Stars: Eighteen Years of Research


For almost two decades nearly one hundred lower main-sequence stars, spanning spectral types of F-M, have been monitored for long-term chromospheric variations indicative of stellar activity cycles at Mt. Wilson. Measurements of the chromospheric Ca II H and K emission strength that were begun by C. Wilson on the 100" telescope in 1966 have continued on the 60" telescope since 1977. As concluded by Wilson (1978), many cool dwarf stars show significant chromospheric variations over long timescales that are reminiscent of the 11-year solar activity cycle. Currently, the combined sets of measurements provide unparalleled 18-year time series that detail the nature of long-term activity variations in this sample of stars. In addition, nightly measures during several seasons have revealed the rotation periods of over half the stars in the sample. The range of observed activity cycle periods as a function of stellar macroscopic properties, such as rotation, chromospheric activity strength and mass will be discussed.

10.16

Objective Characterization of Stellar Cycles

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We present results of sensitivity analyses of simulated data and solar data sets to delineate our ability to quantitatively characterize stellar cycles from Ca II H & K index time series. The primary noise source in the Mt. Wilson-CFA S-index data set on the timescale of cycles is undersampled rotational modulation from many active regions. Random clumps of stochastically distributed active regions over the 18 year domain for which data exists can appear as highly significant stellar cycles to a naively applied power spectrum analysis. Finite lifetimes for the simulated active region forces the anomalous signal to periods ≈ 10 times the exponential growth-decay timescale. The derived anomalous power scales as the square-root of active region lifetime. If the active region lifetime is known, or assumed, then the power spectrum can be scaled down such that statistical estimates of significance of peak power for null experiments are reasonable. This adjustment is particularly important in analysis of the chromospherically active stars for which the ratio of cycle to rotational modulation is not large.

10.17

Comptonization in a Trapped, Divergent Flow

P.A. Becker, M.C. Bregman (JILA, Univ. of Colorado & NASA)

The physics of repeated Compton scattering by electrons in a trapped, steady flow is treated in a co-moving reference frame. The flow field is assumed to have a divergent, spherically symmetric form, and an initial photon distribution is imposed at some arbitrary injection radius. We present solutions to the modified Kompaneets equation derived by Blandford and Payne (1981, MNRAS, 194, 1033) to include the adiabatic effects present in a moving medium. The electron energy density is assumed to be small compared to the photon energy density, and diffusion of photons is neglected, as are stimulated processes.

When the initial electron temperature is not equal to the initial inverse Compton temperature of the photons, there is a region of small Compton y parameter within which the electron temperature changes rapidly, but the inverse Compton temperature remains unchanged (to first order). After the temperatures have equilibrated, the electron temperature tracks the inverse Compton temperature throughout the remainder of the trapped region, and the spectrum is driven towards a Wien shape. The solutions obtained in the trapped region are matched to diffusive solutions valid beyond the trapping radius to predict the spectrum observed at infinity.

Solutions are presented for the spectra resulting from different initial photon to electron energy density ratios and different initial spectra. We will discuss possible applications to the modeling of X-ray bursts with super-Eddington luminosities and quasar winds.

10.18

Observational Studies of Cepheids. III. Catalog of Light Curve Parameters

T.J. Moffett (Purdue U.), T.G. Barnes III (McDonald Obs.)

The BVRR light curve parameters of 104 galactic Cepheids are derived from over 4000 photometric observations by...