19.09

Effects of Coronal and Shock-Produced X-rays on the Ionization Distribution in Hot Star Winds

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Results are presented from calculations in which we examine the effects of coronal and shock-produced X-rays on the ionization balance in hot star winds. Detailed statistical equilibrium calculations were performed using detailed atomic modeling and including Auger ionization due to the X-ray radiation field. We will show how the spatial distribution of the X-ray source affects P-Cygni profiles and the emergent X-ray flux. We examine in detail the particular case of Zeta Puppis (OM 41), and compare calculated OVI P-Cygni profiles and X-ray spectra with observation.

19.10

HD 229041: An X-ray Bright A-Type Giant?

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X-ray emission is virtually unknown from evolved A-type stars. However, Einstein IPC and ROSAT PSPC observations reveal the presence of an X-ray bright source about 20 arcsec away from the unreddened late A/early F giant HD 229041. We present an analysis of about 18 ks of ROSAT PSPC data from this source which shows an unabsorbed thermal X-ray spectrum having log (T) (K) = 6.96. If the source of the X-rays is HD 229041, then the star has Lx/Lbol = 3 x 10^-5. We also present UBV photometry of the star obtained with the Automated Photometric Telescope on Mt. Hopkins. Analysis of this photometry suggests possibly periodic variability on a timescale of about 17 days.

19.11

Non-LTE Line Blanketed Model Atmospheres: Application to A-stars

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We present a new method for calculating realistic line blanketed model atmospheres without the assumption of local thermodynamic equilibrium (LTE). The method is based on complete linearization, with the following two important modifications with respect to the standard variant:

i) Instead of dealing separately with individual energy levels of a complicated metal species (e.g. Fe II), several levels with the same parity and close enough energy are grouped together to form a "superlevel". Transitions between superlevels, the so-called "superlines", are treated by resampling the detailed absorption cross-section and forming a partial "NLTE opacity distribution function", which is representable by a relatively small number of frequency points (typically 15 - 30 points per superline).

ii) The radiative rates (together with the heating/cooling rates, and the contributions to the rates in other important transitions - e.g. the hydrogen and carbon continua) are not fully linearized. However, in contrast to the earlier approaches, they are not held fixed. The only fixed quantity here is the approximate lambda operator. The new method is therefore a hybrid combining the complete linearization and the class of modern methods called accelerated lambda iteration (ALI).

We have contracted several non-LTE model atmospheres for T_{eff} = 10000 K, log g = 4, with H, C, C II, Mg II, and Fe II treated in NLTE. A variable number of Fe II lines, up to 45815 (i.e. all lines originating between the levels with measured energies), have been included, to form 221 superlines. The most interesting preliminary result is that the first 8 Fe II superlevels (about 13000 lines) produce most of the total blanketing effect.

The work on the project was supported by the NASA grant No.65 under program NRA 91-OSSA-12.

19.12

Recent Results from the Mark III Optical Interferometer


The Mark III Optical Interferometer is operated by the Naval Research Laboratory on Mt. Wilson, CA. Using active fringe tracking and baselines ranging from 3 to 31 meters in length, the instrument observes stars and stellar systems with a resolution down to a few milliarcseconds at visual wavelengths. We present highlights of recent observations with the Mark III Interferometer. Diameter measurements of Nova Cygni 1992 are presented by Elias et al. in another paper.

TiO Band Observations: Accurate stellar diameters for about 10 K and M giant and supergiant stars have been measured using observations in both the continuum and the TiO band at 712nm. These measurements show that the TiO band becomes optically thick at a much greater stellar radius than the continuum band, making the stars appear larger in the TiO band than in the continuum. The magnitude of this effect increases with later spectral type and with luminosity class. These observations represent the first observation of this effect in normal giant stars.

Be Stars: Hydrogen disks surrounding 3 Be stars have been resolved using observations in the Hydrogen alpha line. The observed disks are large compared to the continuum star diameter and are not circularly symmetric. Data for Beta Cassiopeiae shows an unresolved (~1 milliarcsecond) stellar component with a well resolved, roughly 5 milliarcsecond elliptical disk, corresponding to a physical size less than 1 AU.

Stellar Limb Darkening: Observations of Alpha Bootes confirm the presence of substantial limb darkening for the star. Interference fringes were tracked with a wide band red filter, where the star is only partially resolved. It was then possible to measure the fringe amplitude at 550nm. At 550nm, the fringe spacing is beyond the first null in the fringe visibility for the star. The observations allow differentiation between a simple uniform disk model and a limb darkened model. Uniform disk models are ruled out. Models with 80% limb darkening are a reasonable fit, which agrees with theoretical expectations.

Binary Star Orbits: Beginning with a complete set of known spectroscopic binary stars, a program is underway to determine accurate orbital elements for all systems which are accessible to the Mark III and resolvable. To date, orbits have been determined for about 20 spectroscopic systems which has been previously unresolved or poorly resolved. Typical orbits have a major axis of about 5-50 milliarcseconds, determined to about 1% accuracy.

Session 20: X-Ray Binaries

Display Session

Pavilion

20.01

BBXRT Observation of the Black Hole Candidate Cygnus X-1


The 0.4 to 11 keV spectrum of the black hole candidate Cyg X-1 was determined during a 1250 second observation on 6 December 1990 with the BBXRT experiment aboard Astro 1. This is the first moderate resolution (R ~ 60) X-ray spectrum of a galactic black hole candidate in the important Fe K emission band. The integrated spectrum is well described as a simple power law with absorption by cold material, but the amount of absorption varied by ~50% during the observation. There is also clear evidence for a broad emission line at about 6.3 keV with an equivalent width of about 130 eV and an intrinsic FWHM of about 1000 eV. We will discuss this spectrum in terms of a Compton scattering model and models of emission from a relativistic accretion disk.