17.04

Shock Formation from the Nonlinear Evolution of Instabilities in Line-Driven Stellar Winds

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We are continuing our numerical hydrodynamics study of the nonlinear evolution of instabilities in line-driven stellar winds. We have now computed the wind evolution with sufficient spatial and temporal range to follow the growth of initially small perturbations into large amplitude velocity waves that eventually steepen into shocks. The waves we find appear spontaneously out of an otherwise smooth, steady flow near the wind base and have persisted for as long as we have run the calculations, which is about 25 wind flow times past the CMB initial conditions. The waves have a relatively large scale (i.e., several Sobolev lengths), and recur, sometimes quite regularly, with a period of about an hour. They typically reach an amplitude of several hundred km/s before steepening into "sawtooth" shock structures at heights above about 1 R*, whereupon their amplitude levels off and begins a slow decay as they become shadowed from the star's driving radiation by newly amplified waves below.

The accompanying poster paper will further describe the dynamical properties of these waves and their dependence on various parameters and assumptions. We will also report on our current efforts to identify the exact source of the persistent perturbations at the wind base.

17.05

Diffraction-Limited Imaging of Alpha Orionis

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The M21ab giant star Alpha Orionis has been a frequent target of the visible speckle imaging program at Steward Observatory (SO) for the past 6 years. It has been observed at the SO 2.3m, the KPNO Mayall 4m and the coherently cophased 6.5m Multiple Mirror Telescopes. We summarize the results obtained from this imaging program. We have used Alpha Orionis as a test object for a number of imaging techniques and the results from the different telescopes using different techniques are consistent. Multi-bandpass 4m observations have shown that the star has three components: (i) a 42 milli-arcsecond major limb-darkened photophore, (ii) a complicated chromospheric envelope (in non-H features) 2 R*, and (iii) a surprisingly thick H-alpha envelope whose faint extensions have been detected to 24 R*. There is also evidence of a disk diameter wavelength dependence -8(±1) x 10^-5 mas/nm. In addition we have measured asymmetries in both the disk and envelope components. The extended B-alpha chromosphere has been mapped at the full diffraction-limited resolution (20mas) of the co-phased MMT. These measurements show excess intensity when compared to Alfvén wave driven chromospheric models. Although asymmetric, our images do not show direct evidence for the existence of a recently proposed companion.

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17.06

The Absolute Magnitudes of the Barium Stars

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Barium stars are G- and K-stars (generally assumed to be giants) whose atmosphere contain excesses of S-process elements. They are identified and subclassified primarily by the strength of the 4554 Å Bal II line (which is denoted as the barium intensity). Due to the abnormal temperature in S-process shell strengths (which are luminosity indicators in normal late-type giants), absolute magnitudes of individual barium stars are known over a wide range, from M=3 to M=5.

The mean absolute magnitude of barium stars has been previously calculated to be M0=0.5. Using an updated barium star catalog, this value is re-examined. The reflex motion for barium stars is found and is used to determine statistical parallaxes. This, when combined with the large dispersion in absolute magnitudes of known stars, indicates that M0=0.0, and implies that the majority of barium stars might be subgiants.

There is no apparent correlation of absolute magnitude with barium intensity.

17.07

Lithium in the Alpha Per Cluster

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We have studied lithium abundances in G and K stars in the open cluster Alpha Per. The observations were made using the echelle spectrometer at the 4m telescope at KPNO. The stars observed have rotational velocities, \( v_{\sin i} \), between 10 and 100 km/s. We observe a definite correlation between the lithium abundance and \( v_{\sin i} \).

While slower rotors have a range in lithium abundance, rapid rotors show little lithium depletion and have abundances near the 'cosmic' value. Rapid rotors when braked by winds and magnetic fields after their arrival on the main sequence may begin to rotate differentially as their outer layers spin down first. We surmise that the lithium depletion in these stars, which appear to be rotating slowly, can be caused by mixing induced by differential rotation.

17.08

\( B_n \) as a Tracer of Stellar Mass Loss in Metal-Poor Galaxies

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The theory of stellar mass loss from OB stars predicts significantly lower mass-loss rates in metal-poor galaxies than in the Galaxy. As a consequence, a variety of modifications for the properties of the primary mass-loss mechanisms can be expected (e.g. number of WR stars, chemical enrichment, evolution of H II regions). However, no extragalactic OB stars have systematically been investigated for their mass-loss characteristics. Since observational constraints rule out any mass-loss tracer other than \( B_n \) for most extragalactic stars, we have investigated the use of \( B_n \) as a mass-loss probe. A large sample of Galactic OB stars with UV data, we find simple scaling relations bringing \( B_n \) mass-loss rates in very good agreement with empirical data and with the pre-