39.05

Effect of Turbulent Viscosity and Variations in Initial Conditions on Protostellar Collapse

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Two different models of viscosity and a wide range of initial conditions have been employed in studying the early stages of collapse of a protostellar cloud. The results of the following cases will be presented: (1) Non-rotating clouds a) without random fluctuations and b) with random fluctuations in initial density and/or velocity; (2) Rotating clouds without turbulent viscosity a) without the fluctuations and b) with the fluctuations; (3) Rotating clouds with turbulent viscosity for similar initial conditions.

The fluctuations span a wide range in magnitude and represent several distributions.

The models of viscosity are:
- (1) Coefficient of viscosity proportional to characteristic length scale,
- (2) Coefficient of viscosity proportional to the rate of strain tensor.

General trends in the results include the suppression of the central density with increased fluctuation magnitude, and its enhancement with increased turbulent viscosity coefficient.

39.06

IRAS Observations of 47Tuc

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IRAS observations of the globular cluster 47 Tuc reveal extended 12, 25, 60 emission associated with this source. The integrated flux is roughly consistent with an extrapolation of the stellar component to 12 μ and a significant excess at longer wavelengths. In spite of strong evidence for current mass loss from stars in 47 Tuc, no more than 10^−6 M_⊙ of intra cluster dust appears to be present in the central region. Possible explanations are discussed.

IRAS was developed and is operated by NASA, NSRO, and SDRC.

39.07

CO Line Emission from the Expanding Circumstellar Envelopes of Red Giants.

W.K. Rose (University of Maryland)

We have calculated theoretical models for CO line emission from the expanding circumstellar envelopes of red giants that are undergoing rapid mass loss. We describe our method of solution, which requires the simultaneous solution of the radiative transfer equation for the CO emission lines, the equations of statistical equilibrium that determine the populations of the rotational levels of the CO molecule, and an energy equation, which determines the kinetic temperature distribution of the envelope if the level populations and radiation field are known. We discuss our solutions, which were calculated for a range of physical input parameters and compare our calculated models to observations of IRC 10216.

39.08

On the Interpretation of the Sandage Period Shift Effect Among Globular Cluster RR Lyrae Stars

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Sandage (1982, Ap. J., 252, 553) has established that the pulsation periods of globular cluster RR Lyrae stars at a given effective temperature correlate with metallicity according to the relation log P = -0.160[Fe/H]. We have derived a similar theoretical relation by including the full dependence of the RR Lyrae luminosity and mass on core mass, Z and Y and have found that, for constant Y, all current ZAHB models predict a negligible period shift with metallicity and thus fail to reproduce the Sandage effect. This discrepancy between the observed and theoretical period shifts might arise from an uncertainty in the input physics used in the RG and HB models and thus might not necessarily imply an anticorrelation between Y and metallicity. To test this possibility, we have computed a number of stellar models to determine the sensitivity of RR Lyrae models to changes in the input physics which affect the core mass and radiative opacity. The results for a set of red giant evolutionary sequences show that changes by a factor of 2 in either the neutrino emission rate or the conductive opacity do not significantly alter the metallicity dependence of the core mass, and thus uncertainties in the input physics of red giant models are unlikely to explain the Sandage effect. In contrast, our ZAHB models show a marked sensitivity to the metal opacity around 10^5 K. An increase in this metal opacity by a factor of 5, as could be caused by enhanced abundances of CNO and N, reproduces the observed period shift. We suggest that the Sandage effect may in fact be an indication for a systematic enhancement of CNO and N by the amount [CNO/H] = 0.7 to 1.0 in globular cluster RR Lyrae stars.

39.09

The Subgiant Branch Gap in Several Globular Clusters

P. Demarque, T.E. Armunduff (Yale University)

A mechanism is proposed to explain the gap observed in the stellar distribution on the subgiant branch of the globular clusters σ Cen, NGC6752, NGC288 and Kron 3. The existence of such a rapid phase of evolution at this point is not predicted by standard stellar evolution theory. It is proposed that the increased evolutionary rate is due to the passage of the hydrogen-burning shell through a chemical composition discontinuity due to internal mixing. The thermal-profile history of the star constrains this mixing to occur only during a short period following the main-sequence turnoff. Calculations show a brief phase during which the rate of evolution is increased by a factor of two, which may be sufficient to explain the observed gap. Plausible causes for internal mixing are also discussed. This work was supported in part by grant AST86-23743 from the National Science Foundation.

39.10

Convective Heating of the Inner Core During the Core Helium Flash

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The effects of convective energy transport across the temperature inversion in the core of red giants were investigated from the onset of the core convection zone to the peak of the core helium flash. A model for convective overshooting in stellar evolution based on 2D and 3D hydrodynamic simulations of the core helium flash was developed. One major effect of the overshooting is the substantial heating of the material interior to the temperature inversion, producing a smoother temperature profile. Interior heating is negligible until approximately one week preceding the time of maximum temperature, but then alters both the thermal and mass structure (hence, the degeneracy of the material) on a time scale short with

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