Hubble Space Telescope

Cycle 16 AR Proposal

The Effect of Metallicity on the Rotation Rates of Massive Stars

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Abstract

Stellar interior models are critical tools used in all branches of astronomy from chemical evolution and population synthesis studies to the determination of evolutionary masses. Until recently the effects of rotation were not included in these codes. The new models show that rotation induces interior mixing that produces some drastic external changes for massive stars while they are still core-hydrogen burning. While the inclusion of rotation was expected to explain the enhanced surface abundances seen in some stars, the prediction that massive stars have luminosities that are rotation dependent was not expected. This last prediction creates a serious scatter in the mass-luminosity relationship and makes the determination of an evolutionary mass essentially impossible. These new models must be tested to determine if their treatment of angular momentum is correct. A straightforward method is to determine if massive starsÕ rotation rates match those predicted by the new models. At solar or Galactic metallicity (Z = 0.020), massive stars are expected to quickly slow their rotation speeds while on the main sequence (MS). Stars at lower metallicity (Z) experience reduced mass loss rates and subsequently retain more of their angular momentum during the MS. The HST archive at the Multimission Archive at Space Telescope (MAST) contains spectra of 180 LMC (Z = 0.007) and SMC (Z = 0.004) O-type stars. This is an extremely large sample of O-type spectra, all observed with the same instrument. It contains both cluster and field stars. These stars represent a completely uniform, unbiased sample for evaluating the predictions from the new stellar interior models. Projected rotation velocities for all stars will be obtained through a cross-correlation methodology that we have used successfully in the past with both IUE and HST/STIS spectra. Comparisons of the rotation rates of unevolved (close to ZAMS) stars at low Z to those of the same classes at higher Z will determine if the initial rotation rates of massive stars are metallicity dependent. Comparisons of the rotation rates of evolved (close to TAMS) massive stars to the unevolved stars in the same metallicity environment will determine the extent of angular momentum (and hence mass) loss during the core hydrogen burning. The proposed survey represents a critical and needed test of the treatment of angular momentum in the new stellar models and the accuracy of the models predictions.

Investigators:

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Number of investigators: 1

Dataset Summary:

Instrument	No. of Datasets	Retrieval Method	Retrieval Plan
FOS	380	FTP	We plan to retrieve approximately 12 datasets per week during the academic year 2007/2008. The datasets will be reduced and analyzed at the same time.