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Investigating the break in the Cepheid period-luminosity relation and its implications

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Abstract

The Cepheid period-luminosity (PL) relation is a major component in the distance scale ladder. This relation has been considered to be linear (within period ranges of ~ 2 to ~ 100 days) and universal (i.e., metallicity independent) for a long time. However, recent work has strongly suggested that the PL relation for the Large Magellanic Cloud (LMC) Cepheids is non-linear with a discontinuity at 10 days. In addition, the LMC period-color (PC) relation is also shown to be non-linear. Besides this, the Cepheid PL relation could also be non-universal. The aim of this Thesis Dissertation is to investigate these two problems of the Cepheid PL relation, in particular to examine the non-linearity of the LMC PL relation and its implications in the distance scale studies, as well as for the stellar structure, pulsation and evolution. ^ The works for this Thesis Dissertation involve both the empirical and statistical analysis of the existing Cepheid data in different metallicity environments (Galactic, LMC and SMC) to characterize the break of the PL and PC relations, and the construction of stellar pulsation models using existing pulsation codes in attempt to understand the physics behind the break in the LMC PL and PC relations. The universality of the Cepheid PL relation is also studied with similar approaches. These works include: (a) developing the Fourier techniques to improve the Cepheid light curve fitting method; (b) testing the non-universality of the PL relation by comparing the Cepheid distances to *HST* observed galaxies with the Galactic and LMC PL relations and the statistical test of the consistency of Galactic and LMC PL relation; (c) analyzing empirically and statistically for the non-linear PL, PC and AC (amplitude-color) relations for the Galactic, LMC and SMC Cepheid at maximum, mean and minimum light; (d) investigating the effect of non-linear PL relation in distance scale studies; and (e) constructing the Galactic and LMC models with the stellar pulsation codes in attempt to account for the non-linear and/or non-universal Cepheid PC and PL relations. ^

Subject Area

Astronomy

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