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GNAT & the Red Dwarfs

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Abstract

The fundamental properties of low-mass stars are not as well understood as those of their more massive counterparts. The best method for constraining these properties, especially masses and radii, is to study eclipsing binary systems, but only a small number of late-type, low mass M stars have been identified and characterized to date. In this colloquium, the discovery and characterization of six new M dwarf eclipsing binary systems will be presented. The twelve stars in these eclipsing systems have masses spanning 0.38-0.59 solar mass units and orbital periods of 0.6 -1.7 days, with typical uncertainties of ~0.3% in mass and ~0.5-2.0% in radius. Combined with the six known systems having high precision measurements, the results reported herein reveal an intriguing trend in the low-mass regime. For stars with masses ranging from 0.35 to 0.80 solar mass units, components in short-period binary systems (P<1 day) have radii which are inflated by as much as 10 % with respect to evolutionary models for low mass main sequence stars, whereas components in longer period systems (P>1.5 days) tend to have smaller radii. This trend supports the hypothesis that short-period systems are inflated by the influence of the close companion, most likely because they are tidally locked into very high rotation speeds that enhance activity and inhibit convection. Thus, very close binary systems seemingly are not representative of typical M dwarfs, but the results for longer-period systems indicate the evolutionary models are broadly valid in the mass range ~0.35-0.80 solar mass units.