Evolution of compact binaries
ASP Conference Series, Vol. 447
Linda Schmidtobreick, Matthias Schreiber, and Claus Tappert ,eds.

The η-Muscae Multiple System

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Abstract. We discuss the multiplicity of the system η Muscae, containing a light pre-main sequence component as well as massive stars.

1. η Muscae: a multiple system with massive and light stars

η Muscae (V = 4.8 mag) consists of at least three components: a massive close binary with two components of $\approx$ 3.3 $M_\odot$ separated by 14 $R_\odot$ in a 2.4-day circular orbit, and a much less massive pre-main sequence component (η Mus C), at 300 AU, first seen by Medici & Hubrig (2000) and not contributing to the visual spectra. At 6300 AU, there is an Ap star, η Mus B, which may not be bound to the system, in view of its radial velocity differing by 13 km/s from the centre-of-mass radial velocity of the close binary. Its kinematics suggests that it belongs to the Lower Centaurus-Crux (LCC) OB association.

The close binary η Mus Aab produces (partial) eclipses due to the orbital inclination of 77°. Orbital and stellar parameters for the close binary have recently been determined (Bakış et al. 2007) combining their high-resolution spectroscopy with photometry from Hensberge et al. (2007). The distance found from the close-binary analysis (103 pc) is slightly small, compared to the trigonometric distance of 124 [−8;+10] pc derived from the HIPPARCOS astrometry. Both papers agree on the age of 20 Myr for the system. Hensberge et al. (2007) use the non-grey non-rotation evolutionary tracks of Landin et al. (2006) to estimate the mass of the PMS star near 0.8 $M_\odot$ (Fig. 1), whilst Bakış et al. (2007) use main-sequence isochrones from Bertelli et al. (1994) and pre-main sequence isochrones from Siess et al. (2000).

Neither the age of the stars, the distance or its kinematics exclude that η Muscae is potentially a member of LCC, but the conclusion on its membership remains uncertain.

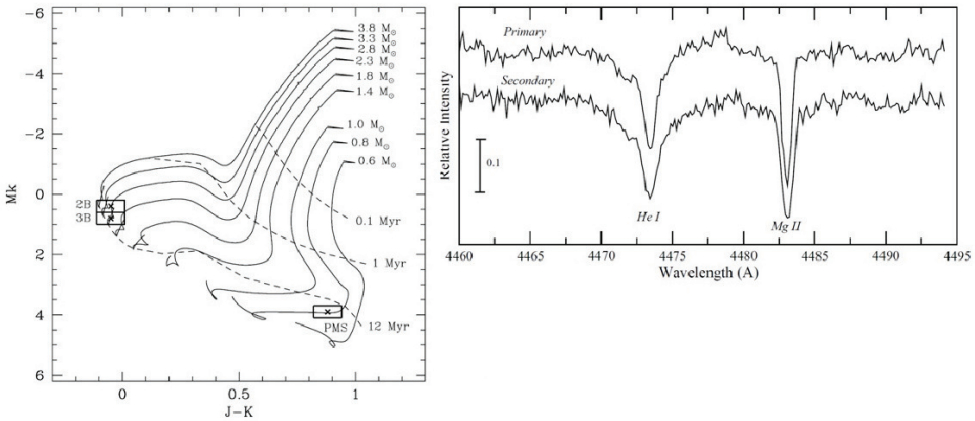

Figure 1. *Left:* Position of the components of η Mus in the (M_k, J–K) diagram with a set of evolutionary tracks (solid lines) and isochrones (dashed lines). The presence of a third late-B-type component would change the position of the close-binary components from '2B' to '3B'. *Right:* Disentangled spectra of the components of η Muscae (from Bakış et al. 2007), obtained from the Mount John spectra. They give evidence for a broad component underlying the Mg II lines of the components.

There are indirect indications for a fourth, (early-A?), component:

a) in between the Mg II lines of the close-binary components, the continuum is never reached, independent of the Doppler separation (suggesting an underlying, broad component);

b) the trigonometric distance of η Muscae is reproduced by the close-binary analysis if an additional component contributes 20 per cent of the visual light;

c) one of the close-binary stars rotates faster than the other one. Lack of orbit-spin synchronisation is not expected, and possibly a consequence of the presence of an additional body.

The existence of this component will be checked by three-component spectra disentangling, or, more directly by interferometry. This may clarify the relation of η Muscae with LCC, since the present systemic velocity estimate of Aab is sensitive to such wide orbit. If the system belongs to LCC it sets useful limits on the age of the PMS star and therefore on PMS tracks.

Acknowledgements. N. R. Landin would like to thank CNPq, CAPES, and FAPEMIG.

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