Binary Stars as Critical Tools & Tests
in Contemporary Astrophysics
Proceedings IAU Symposium No. 240, 2006
W.I. Hartkopf, E.F. Guinan & P. Harmanec, eds.

doi:10.1017/S1743921307004395

Poster Abstracts (Session 7)

(Full Posters are available at http://www.journals.cambridge.org/jid_IAU)

Algols Contribute to the Interstellar Mass

Jean-Pierre De Greve, Camiel De Loore, and Walter Van Rensbergen
Astrophysical Institute, Vrije Universiteit Brussel, Brussels, Belgium

We revisited analytical expressions for the distribution of orbital periods and mass ratios for non-evolved binaries with a B-type primary. Selection effects governing the observations were taken into account in order to compare theory with observations. Theory was optimized so as to fit best with the observed P- and q-distributions of non-evolved SB1s and SB2s listed by Pourbaix *et al.* (2004) and the on-line SB9 catalogue of Pourbaix. Van Rensbergen *et al.* (2006) showed that the accuracy of the theoretical mass ratio distribution function is however hindered by the uncertainties on the observations. Our further computations compare statistically the observed distributions of orbital periods and mass ratios of Algols with those obtained from the Brussels binary evolutionary code. Conservative Roche Lobe Over Flow (RLOF) reproduces the observed distribution of orbital periods but fails to explain the observed mass ratios in the range $q \in [0.4\text{-}1]$. In order to obtain a better fit the binaries have to lose a significant amount of matter, without losing too much angular momentum. We tested the following binary evolutionary scenario: The mass acquired by the gainer during RLOF enhances the rotational velocity of the latter, as was shown by Packet (1981) and later refined by Wellstein (2001). Tidal forces counteract this acceleration (Zahn, 1977). Both mechanisms may speed up the equatorial velocity of the gainer close to its critical value leading to an enhanced stellar wind as shown by Langer (1998). The luminosity of the gainer is amplified with the accretion luminosity in the equatorial region, leading to a hot spot in the case of direct hit (e.g., Peters & Polidan, 2004) or a hot line in the case of an accretion disk (e.g., Bisikalo *et al.*, 2005). Only during a short time lapse of rapid RLOF spinning-up and accretion luminosity act together to remove mass and angular momentum from the gainer and blow it into the interstellar space. Consequently also Algols enrich the ISM. Consequently, the binaries persist for a longer time with a larger mass ratio compared to conservative evolution. Since the mass is blown away from the gainer as an enhanced stellar wind not much angular momentum leaves the system; hence the obtained distribution of the orbital periods of Algols differs not very much from what was obtained with the conservative scenario. The proposed time-dependent liberal scenario reproduces the observed distributions of mass ratios and orbital periods of Algols better than conservative evolution would do. As a test case we present the evolution of a binary with a 6 $M_\odot$ primary, a 3.6 $M_\odot$ companion and an initial period of 2.5 d. Only during ∼150,000 years of early RLOF A evolution some 1 $M_\odot$ is lost from the system. Later some 0.05 $M_\odot$ is lost during ∼30,000 years of RLOF B. Typically, RLOF occurs almost always in a conservative way, but during a short lapse of time the gainer is not capable of grasping the incoming material from the donor.

References

Bisikalo, D., Kaygorodov, P., Boyarchuk, A., & Kuznetzov, O. 2005 *Astron. Rep.* 49, 701

Langer, N. 1998,*A&A* 329, 551

Packet, W. 1981,*A&A* 102, 17

Peters, G. & Polidan, R. 2004 *Astron. Nach.* 325, 225

Pourbaix, D., Tokovinin, A., Batten, A., *et al.* 2004, *A&A* 424, 727

Pourbaix, D. 2006, *The 9th Catalogue of Spectroscopic Binary Orbits*, `http://sb9.astro.ulb.ac.be/`

Van Rensbergen, W., De Loore, C., & Jansen, K. 2006, *A&A* 446, 1071

Wellstein, S. 2001, *Ph.D. thesis, Potsdam*

Zahn, J.-P. 1977, *A&A* 57, 383

Candidate Common Velocity Stars from the AGK3 Confirmed with Radial Velocity Measurements

J.-L. Halbwachs[1], M. Mayor[2], and S. Udry[2]

[1] *Observatoire Astronomique de Strasbourg, Strasbourg, France,*
[2] *Observatoire de Genève, Sauverny, Switzerland*

Two set of CPM stars were extracted from the AGK3 a while ago. The first one contains 326 CPM stars with a high probability (99%) to be physical binaries. For the second set (113 pairs), this probability was estimated around 60%.

In order to select the actual physical binaries, a long program of radial velocity (RV) measurements was initiated, using the spectrovelocimeter Coravel. It includes 90 stars from the first set and 177 from the second one. The spectroscopic binaries (SB) that were found were followed during about 15 years.

The RV difference between the components was obtained for 36 pairs from the first set and for 68 pairs from the second set. It appears that the physical wide pairs have components with RV differences less than 1.5 km/s. Only one pair from the first set is *slightly* beyond this limit, with a difference of 2.3 km/s. In the second set, 33 pairs among 68 seem to be optical, in good agreement with our expectations.

Taking into account the parallaxes from Hipparcos, we obtain a sample of 65 wide binaries (WB) with apparent separations more accurate than 25%. The separations range from about 1000 to around 30,000 AU. Among the 130 WB components, 31 are SB, including 24 with periods less than 10 years. The SB frequency is thus similar to that found among solar-type stars in the solar neighbourhood. It is not related to the separation of the WB, neither to the fact that the other component is also a SB. We conclude then that the SB found in WB have the same statistical properties as those found among single stars.

https://doi.org/10.1017/S1743921307004395 Published online by Cambridge University Press

Eclipsing Binary Stars in the Globular Cluster M71

Y.-B. Jeon, S.-L. Kim, and C.-U. Lee
Korea Astronomy & Space Science Institute, Daejeon, South Korea

To search for variable stars in the globular cluster M71, we obtained time-series CCD images for 32 nights from 2000 July 8 to 2004 August 24. The CCD images were obtained with a thinned SITe 2K CCD camera attached to the 1.8-m telescope at the Bohyunsan Optical Astronomy Observatory in Korea. The field of view of a CCD image is $11\farcm6 \times 11\farcm6$ ($0\farcs34$/pixel) at the f/8 Cassegrain focus of the telescope. We adjusted the exposure times from 50 s to 200 s (typically 100 s) in V band depending on the seeing ($1\farcs0 - 3\farcs3$) and transmission of the night sky. After photometric reduction, we detected 24 eclipsing binary stars. They are classified 8 EAs, 5 EBs and 11 EWs on the base of light curve shape. Ten of them are newly discovered in this research. We also have detected 16 the other type variable stars. Most of them are long-period variable stars.

Monitoring Open Star Clusters

A.S. Hojaev and D.G. Semakov
UBAI, CfSR, UAS, Tashkent, Uzbekistan

Star clusters — especially compact ones (with diameter of few to ten arcmin) — are suitable targets to search of light variability for an orchestra of stars by means of an ordinary Casegrain telescope plus CCD system. A special patrol with short time-fixed exposures and mmag accuracy could also be used to study stellar variability for groups of stars simultaneously. Extra-solar planet transit event detection might be a by-product of long-term monitoring of compact open clusters as well.

We presented a program of open star cluster monitoring with the Zeiss 1-m RCC telescope of Maidanak Observatory (Uzbekistan), which has been automated recently (Hojaev, 2005). In combination with quite good seeing at this observatory (see, e.g., Sarazin, 1999) the automatic telescope equipped with a large-format (2K×2K) CCD camera AP-10 available will allow to collect homogeneous time-series for analysis.

We started this program in 2001 and had a set of patrol observations with the Zeiss 0.6-m telescope and AP-10 camera in 2003. Seven compact open clusters in the Milky Way (NGC 7801, King 1, King 13, King 18, King 20, Berkeley 55, IC 4996) have been monitored for stellar variability and some results of photometry will be presented. A few interesting variables were discovered and dozens were suspected of variability to the moment in these clusters for the first time. Some of them show periodic variability and probably might be eclipsing binaries. It is also shown how observations like these could feasibly be used to look for exo-planets.

https://doi.org/10.1017/S1743921307004395 Published online by Cambridge University Press

Statistical Modeling and Analysis of Wide Binary Star Systems

K.B. Johnston[1], T.D. Oswalt[1], and D. Valls-Gabaud[2]

[1] *Florida Institute of Technology, Melbourne, FL, United States,*
[2] *Paris Observatory, Paris, France*

Post-main sequence (MS) mass loss causes orbital separation amplification in fragile (i.e., common proper motion) binary star systems. Components typically have separations around ∼1000 AU. Such wide pairs experience negligible tidal interactions and mass transfer between companions; they evolve as two separate but coeval stars. In this paper we compute the rate of mass loss during the components' lifetimes and attempt to model how it will statistically distort a frequency distribution of fragile binary separations. Understanding this process provides a robust test of current theories of stellar evolution and sets constraints on the dynamics of the Galactic disk.

The Kinematics and Morphologies of Planetary Nebulae with Close-Binary Central Stars

D.L. Mitchell[1], T.J. O'Brien[1], D. Pollacco[2], and M. Bryce[1]

[1] *The University of Manchester, Manchester, United Kingdom,*
[2] *Queens University Belfast, Belfast, United Kingdom*

A programme is currently underway to study the kinematics and morphologies of PNe known to contain close-binary central stars. Three of the observed PNe have eclipsing binaries: Abell 63, Abell 46 and SuWt2; these objects are important because their physical parameters can be determined in a model independent way. The properties of these PNe can then be used as tests of stellar evolutionary theory.

Long-slit spectra of northern sky targets were obtained in 2004 with the Manchester echelle spectrometer combined with the 2.1-m San Pedro Martir telescope. Southern sky targets were observed in 2005 using UCLES onboard the 3.9-m Anglo-Australian telescope, and the EMMI spectrograph combined with the 3.58-m ESO New Technology Telescope in La Silla.

The test case of the programme is Abell 63 as it contains an almost totally eclipsing binary core. The nebula has two faint, elongated lobes and a tube-like appearance. Two end-caps are visible in [NII] at the tips of the lobes. Slits were positioned along the major and minor axes of the nebula. The longslit spectra from the major axis show clear Hα line-splitting, which can be attributed to receding and approaching sides of an expanding hollow tube. The longslit spectra from the minor axis show a velocity ellipse, which is characteristic of viewing a hollow tube in cross-section.

Soker (1998) predicted that bipolar nebulae with very elongated lobes must be produced by an intrinsically collimated fast wind (or jets) puncturing through a pre-existing spherical AGB wind. Soker proposed that the presence of a low-mass companion star is necessary for the production of jets via an accretion disk around the secondary. We tested this hypothesis for Abell 63 using a hydrodynamic simulation of a low-density 400 km s^{-1} jet blowing into a uniform, static AGB wind. The resulting morphology closely resembled that of Abell 63.

https://doi.org/10.1017/S1743921307004395 Published online by Cambridge University Press