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Information System on Binary Stars

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Abstract. We present a project of an Information system on binary stars (ISBS). The main goal of the system is to collect information on masses and other astrophysical parameters of components of binary/multiple systems. A first version of ISBS will contain astronomical data catalogues, related to observations of eclipsing binary stars. An interface will provide access to the summary description of the catalogues either by GCVS identifier or by evolutionary type. The ISBS will allow user to make statistical investigations as well as to obtain data on a particular binary system. The majority of the included catalogues are presented in machine readable form for the first time. It is likely that ISBS will be merged naturally into the Russian Virtual Observatory and into the Besancon database on binaries.

1. Introduction

Eclipsing binaries represent one of the most numerous type of binaries. Independent stellar mass and luminosity determination is possible only for components of eclipsing binaries, with the spectrum lines of the two components. They represent only some 5% of all known eclipsing binaries. So, for statistical investigations it would be advisable to estimate fundamental parameters (such as mass and radius) for eclipsing binaries with unknown spectroscopic elements.

That was a goal of authors of early catalogues (Brancewicz & Dworak 1980, Svechnikov & Kuznetsova 1990). But the number of known eclipsing binaries increases constantly; current version of the General Catalogue of Variable Stars, GCVS (Kholopov et al. 1985-1988; see also http://www.sai.msu.su/groups/cluster/gcvs/gcvs/ for living edition) contains about 6250 eclipsing binaries, in comparison with some 5000 systems in the 1988 version (this statistics does not include variables discovered in large surveys, like OGLE). Observational data is collected in a number of other catalogues, devoted to various types of eclipsing binaries.

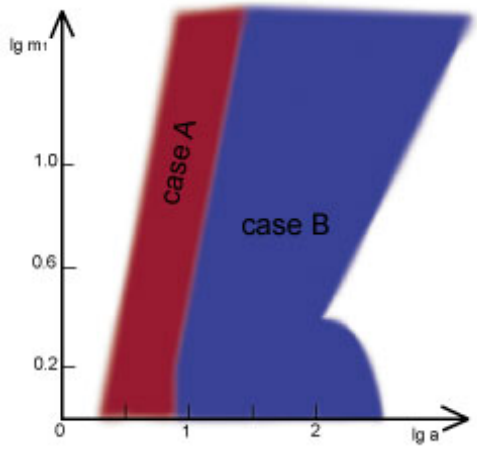

Figure 1. Close binaries evolutionary scheme. m_1 - initial mass of more massive component, in solar mass; a - initial semi-major axis, in solar radius; m_2 is adopted to be approximately equal to m_1. The figure is taken from Yungelson & Massevich (1982)

In this paper we present a project of an information system on binary stars. Our main goal is to collect information on masses and other astrophysical parameters of components of binary systems. ISBS will allow user to make statistical investigations as well as to obtain data on a particular binary system. A first version of the system will include data on eclipsing binaries. Future versions will include data on visual, spectroscopic and other types of binaries (allowing to determine astrophysical stellar parameters of components), particularly, data on evolved close binary systems (Cherepashchuk et al., 1996).

2. Classification of eclipsing binaries

Primaries in close binary stars can undergo Roche lobe overflow during various stages of their evolution. Cases A and B indicate systems where mass transfer starts at core hydrogen burning stage and at hydrogen shell burning stage, respectively. Fig. 1 illustrates mass transfer cases on the mass — separation diagram.

Eclipsing binaries in the ISBS are classified according to the following scheme, introduced by Svechnikov (1986):

DM — detached main sequence systems, where both components are main sequence stars, which do not fill their inner Roche lobes

SD — semi-detached systems, where the more massive component is a main sequence star, and the less massive secondary component is a subgiant which fills (or nearly fills) its Roche lobe

DS — detached systems with a subgiant secondary, where the less massive subgiant component distinctly does not fill its Roche lobe

AR — detached systems with two subgiant components, where both stars do not fill their Roche lobe (AR Lac-type systems)

CE — contact systems of early spectra, both components are close to their Roche lobes, and the spectrum of the more massive component is not later than about F0

CW — contact systems of W UMa-type with periods shorter than 0.5 days and where the spectrum of the more massive component is later than about F0

DW — systems, similar to W UMa-stars, where both components do not fill their Roche lobes, and their physical characteristics are similar to those of CW-systems (short-period RS CVn-type systems)

GS — systems with at least one supergiant or late type giant.

We assume that, depending on age, separation between components and masses, mass transfer in a system of Case A can be observed as a DW-, CW- or CE-type system, while in a system of Case B mass transfer can be observed as a AR-, DS- or SD-type system (a few exceptions are possible). GS-type systems can undergo Roche lobe overflow during helium burning stage (Case C, not shown in Fig 1). DM-type systems do not (yet) undergo Roche lobe overflow and, during their evolution and depending on separation between components and their masses, can belong to any of the three cases.

3. Catalogues of binaries

The first version of the ISBS will include catalogues of eclipsing binary stars and will give access to the summary description of the catalogues and to catalogue data. Stars from the following catalogues will be included in the first version of ISBS: Catalog of orbital elements, masses and luminosities of close double stars (Svechnikov & Bessonova 1984); The catalogue of approximate photometric and absolute elements of eclipsing variable stars (Svechnikov & Kuznetsova 1990); The catalogue of orbital elements, masses and luminosities of detached main-sequence eclipsing variable stars with known photometric and spectroscopic elements (Svechnikov & Perevozkina 1999); The catalogue of orbital elements, masses and luminosities of detached main-sequence eclipsing variable stars with known elements of photometric orbit and unknown spectroscopic elements (Perevozkina & Svechnikov 1999); The catalogue of photometric, geometrical and absolute elements of semidetached eclipsing binary systems with known spectroscopic orbits (Surkova & Svechnikov 2004a); The catalogue of photometric, geometrical and absolute elements of semidetached eclipsing binary systems with known photometric orbits and unknown spectroscopic orbits (Surkova & Svechnikov 2004b); The catalogue of photometric, geometrical and absolute elements of contact binary stars of the early spectral type (Bondarenko & Perevozkina 1996); Massive close binaries with early-type components of main sequence catalogue. Observed characteristics (Polushina 2004); Catalogue of pre-contact, short-period RS CVn-type systems (Dryomova 2004); Catalogue of astrophysical parameters of binary systems (Malkov 1993); Stellar mass catalogue (Belikov 1995); Age and metallicity estimates of intermediate mass stars in eclipsing binaries (Kovaleva 2001).

It is likely that ISBS will be merged naturally into the Russian Virtual Observatory (Dluzhnevskaya et al. 2003) and into the Besancon database on binaries (Oblak & Debray 2004).

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