

COMMISSION 26: DOUBLE AND MULTIPLE STARS

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Introduction

The nature of research on double and multiple stars has changed drastically during the past several decades. Prior to then the research was mostly concerned with visual measures for the purposes of obtaining orbital elements and masses. Then came spectroscopic studies that (1) when combined with the visual orbital elements allowed the determination of orbits in three dimensions and (2) started an emphasis on the astrophysical and evolutionary natures of the components in such systems. Unfortunately except for a few nearby systems, the systems with large enough separations for spectroscopic measures of individual components were just those with orbital periods too long for visual determinations, while those systems with short enough periods for spectroscopic determinations were too closely-spaced for visual measurements.

However even as far back as the work of Finsen, the importance of interferometric measurements for accurate measurements of double stars was realized down to the optical resolution of telescopes. With the development of the speckle technique of interferometry the efficiency of such measures led to the accumulation of exploratory measures (to search for close doubles) and repeated measurements (at rates of 200-300 stars per nights as practiced by McAlister) of discovered pairs.

More recently the limitation of the optical resolution of large telescopes is being overcome with the construction of long-baseline equipment being developed and used by groups under Townes at Mt. Wilson, Davis in Australia, Pan at Mt. Wilson, Mumma and others from Goddard and the U.S. Naval Research Laboratory.

The beginning of the windfall of results from the Hipparcos mission are starting to appear. We hope for the extension of that mission and another such mission in the future.

The recent launching of spacecraft for measurements in nearly all parts of the electromagnetic spectrum will undoubtedly have effects on double stars, such as the discovery of hot faint companions with IUE or cool companions with IRAS. The high resolution of the 2.3-meter HST is beginning to produce results on doubles under Franz and his colleagues.

The diversity of techniques now available to study double stars was well illustrated in IAU Colloquium No. 135: "Complimentary Approaches to Double and Multiple Star Research", held in April 1992 and published later that year in the Astronomical Society of the Pacific Conference Series as Volume 32. The conference was organized and the proceedings were edited by our commission Past President, Harold A. McAlister, and his colleagues, and it was dedicated to Alan H. Batten.

A sample of current programs by commission members is given below.

Astrometric Measures, Orbital Elements, Photometry, Spectroscopy, and Interferometry

We remain gratified that some astronomers continue to have the patience, critical eyesight, and observing time to continue with the discovery of new pairs and the continuation of observations of those systems known for decades or centuries; the latter increase the accuracy of the preliminary orbital elements and provide the basis of the stellar mass-luminosity relation.

In particular, we are grateful to Paul Couteau for his hundreds of new discoveries and elements of known systems, and his production and distribution of the commission's Circulaire d'Information. Those were started in 1954, with the first 90 issues produced by Paul Muller and the recent 30 issues by Couteau. Recently J. A. Docobo, assisted by J. F. Ling, has agreed to accept the responsibility for the circulars and he encourages all multiple-star astronomers to

communicate to him for publication information on new discoveries, calculated orbital elements, planned observing programs, extensive publications, plans for meetings, and other general notes.

In the past three years P. Muller has made 2060 measures with the 50 cm telescope at the Observatoire de Nice. M. Scardia has made 350 micrometer measures of 108 southern pairs at La Silla. He also continues to make photographic measurements at Merate in connection with the Hipparcos Catalogue of the Components of Double and Multiple Stars. In this connection, R. Pannunzio reports that the astrometric group of the Astronomical Observatory of Torino has been setting up a chain of computer programs for the analysis of Hipparcos double and multiple systems and provided the database for their evaluation. The group tested the programs on simulated systems and are now working with actual Hipparcos data, obtaining encouraging results.

P. Brosche, D. Sinachopoulos and their colleagues at Hoher List in Bonn have been evaluating the existing data on wide binaries in connection with current Hipparcos measurements. They are obtaining photometry, area scanners, and relative proper motions to judge whether those wide pairs are physical systems. Their numerous papers are all in A&A and A&AS.

E. Oblak at the Observatoire de Besancon announces the establishment of a European Network on Visual Double Stars. It consists of coordinated photometric and astrometric measurement of several thousand visual doubles selected from Annex 1 of the Hipparcos program with conventional and CCD techniques. One aim is to obtain V and I (or R) photometry and another is to obtain relative astrometry (to several hundredths of an arcsec) for comparison with Hipparcos measures.

The accuracy of CCDs for the photometric and astrometric measurements of double stars has been explored by R. Müller in Berlin and E. H. Geyer in Bonn. Empirically, H. A. Abt and C. F. Corbally in Tucson have been studying the reality of 268 possible Trapezium systems, using CCDs for photometry and astrometry as well as photographic spectral classification. They obtain accuracies of ± 0.020 mag, $\pm 0.06''$ in position angles, and $\pm 0.07''$ in separations

per measurement with a CCD.

At the Bosscha Observation in Indonesia, Jasinta, Sugiartini, and Raharto are analyzing photographic observations of 150 visual binaries along the lines of the work of Panjaitan and Herdiwidjaya (A&AS 88,63, 1991). From the latter list, 218 pairs showing no relative motions are being taken off the Bosscha observing lists while 68 pairs are showing physical motion. Southern bright close doubles are being observed for spectral classification, mostly to predict masses for stars above the main sequence.

The exciting double stars being discovered as central stars of planetary nebulae are being studied by Malasan at Bosscha under the guidance of K. Ishida in Japan. For V664 Cas the mass function yields a primary mass of 0.55-1.4 solar masses for the hot subdwarf and a secondary of 0.18-0.20 solar masses. For UU Sge the primary mass is similar while the secondary is between 0.27-0.48 solar masses.

Between 1975 and 1992 McAlister and his colleagues at CHARA (Center for High Angular Resolution Astronomy) obtained 12,000 speckle interferometric measures of over 3,000 stars with the 4-meter telescopes at KPNO and CTIO. Of those, 300 were newly-discovered interferometric pairs. That work is being transferred in 1993 to the newly renovated 100-inch (5 m) telescope on Mt. Wilson.

Catalogs

J. Dommanget and O. Nys of the Royal Observatory, Belgium are working on a two-part catalog of which the first (Definite) part consists of 31,305 systems with positional accuracies of 1" or better and contains all the multiple systems in the Hipparcos Input Catalogue. The second part will contain 31,178 systems with less accurate information.

J. Dommanget and O. Nys have completed their part in the preparation of Vol. 6 of the Hipparcos Input Catalogue, which lists double and multiple stars. They checked cross identifications of components, which is a difficult and important need.