

**COMMISSION 26: DOUBLE AND MULTIPLE STARS  
ETOILES DOUBLES ET MULTIPLES**

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**Introduction**

The last years have been an exciting time in double and multiple star research, both observationally and theoretically, with the continued development and use of powerful new observational tools, as well as for the insights gained concerning binary star formation and evolution. In addition to many new results in the literature, two colloquia have greatly contributed to this: "The Origins, Evolution, and Destinies of Binary Stars in Clusters", held at the University of Calgary (Canada) in June, 1995, and the workshop "Visual Double Stars: Formation, Dynamics, and Evolutionary Tracks", held at the University of Santiago (Spain) in July, 1996.

During this report period the application of speckle techniques has continued to enrich the quantity and quality of double star measurements. Now long-baseline optical interferometers have begun to make even more precise observations, and actual imaging has been reported from both the COAST and NPOI projects. CCD astrometry is also being employed, although there seem to be unresolved problems with some of this work. Of course, classical visual and photographic astrometry continue, although they are playing less of a role. Also, as of this writing, the long anticipated HIPPARCOS and TYCHO results are not yet available.

Combined astrometric and spectroscopic investigations have been made for a number of objects. With the improved accuracy now attainable for the orbits and radial velocities, significant gains in the definition of the fine structure of the mass-luminosity relation is to be expected.

A new edition of the Washington Visual Double Star Catalog (1996.0) has been prepared by Worley and Douglass. It contains information on 78100 systems, extensive revisions and additions to the basic astrometric data, as well as much new data concerning magnitudes, spectral types, proper motions, orbits, and notes. The catalog has been transmitted to the data centers, and is also available at the website maintained by the U.S. Naval Observatory on the World Wide Web.

**Observations and Orbits**

Because of personal equation, micrometer measures are made and listed by individuals. In this report period, Couteau, Docobo, Gili, Heintz, Ling, Muller, Prieto, Popovic, Thorel, and Zulevic have contributed observations. Other observations, made presumably in an "impersonal" way, are often presented as group efforts, and in these cases only the first author is cited. Speckle measures have been made by Balega, Douglass, Horch, Hartkopf, Mason, McAlister, and Miura, CCD observations by Argue and van Dessel, photographic measures by Jasinta, and phase-grating observations by Tokovinen. There remains a critical lack of southern hemisphere observations by any and all techniques.

The resurveys of the Northern sky by Couteau, Heintz, and Muller have been largely completed, and have yielded more than 4000 new pairs. Thus, as has been rarely true in astronomy, the completeness of the Northern survey now approaches that of the earlier Southern work!

CHARA has continued duplicity surveys by speckle, and has completed one for all O-stars brighter than  $V=8$ , as well as all known photoelectric occultation binaries and stars in several clusters. It is their intention to observe all the stars in the Bright Star Catalogue, a program which is now more than 20% complete.

New orbits appear frequently, and often without good scientific justification. In fact, the number of orbits computed since the 1983 Worley-Heintz orbit catalog now almost equals the total contained therein. On the other hand, we are also beginning to see orbits of much higher quality, based on the superior accuracy of interferometric measures, as well as on the now substantial time interval which these measures cover.

### Hipparcos, Tycho, and HST

Preliminary reports on the Hipparchos/Tycho project (Halbwachs and others) indicate that a large number of both known and new double stars was detected, but that complete reductions will be available for only a fraction of them. Therefore, this writer is unable to estimate the impact of this project on both visual double astronomy and upon the WDS. One of the serious defects of the WDS however-the lack of any homogeneous magnitude system-is likely to be considerably alleviated by the new data, and this is indeed welcome news.

Scheduled observing time for binary stars with HST is extremely limited, and targets must be very carefully selected. Therefore, it is unrealistic to expect a large contribution from this source.

### Interferometric Programs

By the achievement of phase-closure, two long baseline optical interferometers, COAST and NPOI, have now produced images of the pairs Capella ( $P = 104d$ ) and Zeta UMa ( $P = 20.5d$ ). These first results portend an era where many spectroscopic binaries will be resolved, thus providing much new and very accurate fundamental data. Construction at Mt. Wilson Observatory of the CHARA array of five to seven 1m telescopes, with maximum baselines of 350m, has begun, and first fringes are expected in 1999. The system will resolve binary stars to about the 150 microarcsecond level, and to a relatively faint magnitude limit. The resultant scientific harvest will be impressive.

The CHARA group also has initiated a program to derive differential magnitude and color information using the adaptive optics capabilities of the Starfire Optical Range 1.5m telescope. They plan to continue this work with the new AO system presently installed on the Mt. Wilson 2.5m instrument, which they are regularly using for speckle observations.

The 66cm refractor of the U.S. Naval Observatory in Washington has been used regularly for speckle observations since 1990. More than 8000 successful measures have been made, in a program designed both to bridge the gap between speckle with large telescopes and the classical observations, and at the same time to provide quality and repeated observations for many pairs not observed with the larger instruments.

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A group has used the Yale southern facilities, as well as the CASLEO 2.1m telescope, for badly needed southern observations, and Japanese observers have used the Mexican 2m reflector at San Pedro Martir. Groups in Russia and the FSU remain active, using telescopes ranging in aperture from 6 to 1m.

### Catalogs

A "Third Catalogue of Interferometric Measurements of Binary Stars" was published by Hartkopf. It contains all measures made by speckle or other interferometric techniques, and is available on the World Wide Web. There are plans to update it regularly.

As mentioned in the Introduction, Worley and Douglass have issued a new edition of "The Washington Visual Double Star Catalog" (WDS), dated 1996, and it, plus supporting documents, is available on the World Wide Web. Work also routinely continues on the updating and correction of the Catalog of Observations, where the tabulated means now exceed 453000. Information continues to be gathered for an eventual new edition of the Orbit Catalog.

### Miscellaneous

Loden has studied the relationship between small open clusters and widely separated multiple systems. He finds that there is no observational way to distinguish between these two types of objects.

It is obvious from the replies received to the solicitation of information for this report that many European colleagues have been largely occupied in the reduction of the enormous amount of data arising from the Hipparcos project. We await release of this data with great interest. One should bear in mind, however, that even with the many accurate parallaxes that will result, the short operational life of Hipparcos will not provide much information on binary orbits or mass-ratios, hence the immediate effect on improving the Mass-Luminosity Relation will not be great. Follow-on projects of the same or similar type, as well as the exploitation of ground based techniques, are necessary.

In this report I have not attempted to list extensive references, as I believe such to be entirely redundant considering the material which is readily available in Astronomy and Astrophysics Abstracts and other abstracting resources.

I thank those who have contributed to this report.

Charles E. Worley,  
President Commission 26