

COMMISSION No. 26

DOUBLE AND MULTIPLE STARS (ETOILES DOUBLES ET MULTIPLES)

PRESIDENT: Karl D. Rakos

SECRETARY: Harold A. McAlister

The program for Commission 26 at the Baltimore General Assembly consisted of an opening business session held on 4 August 1988 followed by three scientific sessions during the remainder of that same day. A second business session was held on the morning of 10 August 1988. The Commission also participated in the Joint Discussion on *Formation and Evolution of Stars in Binary Systems* held on 3 August 1988 and in the Joint Commission Meetings on *Stellar Photometry With Modern Array Detectors* and *Formation of Binaries*, held on 8 and 9 August respectively.

The scientific sessions held by Commission 26 and their chairmen were:

1. *HST/Hipparcos Missions and Binary Star Research* - H. McAlister and J. Dommange
2. *Improvements in Classical Research of Double and Multiple Stars* - J. Dommange
3. *Present and Future Cooperative Projects in Binary Star Research* - K. Rakos

FIRST BUSINESS SESSION

The President served as Session Chairman and opened the meeting by welcoming the 14 members who were present. The Chairman reviewed the consideration undertaken by the IAU Executive Committee for the abolition of Commission 26 and reported that the Commission was approved for an additional five years, at which time the appropriateness of maintaining the Commission would be reviewed. During the extended period in which this question was before the IAU Executive, the Chairman polled the 67 members of the Commission to ask their individual opinions as to the abolishment of Commission 26. Of the 41 members who replied, 37 stated that the Commission should be continued and 4 felt that it should be abolished. A similarly positive opinion had been expressed by the participants in IAU Colloquium No. 97 on *Wide Components in Double and Multiple Stars* held in Brussels, Belgium during 8-13 June 1987, by passing a resolution supporting continuation. The Chairman stated that the success of Colloquium No. 97 (a gathering that included a diversity of scientists and which was dedicated to Professor Willem J. Luyten), the opinions directly expressed to the General Secretary by commission members, the advent of powerful new techniques for the study of binary star systems, and the potential for attracting an expanded membership into the Commission were all considered by the Executive as justification for preservation of Commission 26. The great success of the Joint Discussion held on 3 August

was clearly indicative of the diverse and widespread interest in binary and multiple stars.

Because of the relatively small attendance at the business meetings of the Commission during the New Delhi General Assembly, the election of new Commission officers was carried out by mail balloting during the year prior to the Baltimore General Assembly. This procedure provided for participation in elections by all members who chose to respond to the ballot. The Organizing Committee for the first time served as the Nominating Committee, and the ballot provided for writing in the names of additional candidates. Twenty-six members replied to the mail ballots and the results of the election were:

President: H. McAlister

Vice President: H. Abt

Organizing Committee: P. Couteau, R. Harrington, A. Kiselyov, K. Rakos, E. Van Dessel, P. Bernacca

Nominating Committee: A. Poveda (Chairman), A. Batten, J. Dommanget, O. Franz, G. Salukvadze

Following a discussion of the matter of future selection of a nominating committee, it was decided that nominations for this committee would be taken from the floor during the first business session at a General Assembly, with the provision that commission members not attending the General Assembly can propose in advance a name to the President. The chairman of the nominating committee will be the person receiving the most votes with a tie being decided by the President. The work of the nominating committee will be initiated no later than one year prior to the next General Assembly. It is expected that these procedures will continue to ensure the broadest participation in the election of officers for Commission 26.

The following new members were added to Commission 26: W. van Altena (USA), A. Argue (UK), W. Bagnuolo (USA), Y. Balega (USSR), W. Beardsley (USA), W. Beavers (USA), D. Bonneau (France), P. Broche (FRG), B. Campbell (USA), L. Fredrick (USA), I. Furenlid (USA), G. Gatewood (USA), W. Gliese (FRG), J. Halbwachs (France), W. Hartkopf (USA), G. Hill (Canada), P. Ianna (USA), C. Jaschek (France), Z. Kopal (UK), D. Latham (USA), M. Lattanzi (Italy), J. Ling (Spain), L. Loden (Sweden), E. Oblak (France), T. Oswalt (USA), L. Saba-dos (Hungary), P. Schmidtke (USA), J. Smak (Poland), J. Stein (USA), A. Toko-vinin (USSR), V. Trimble (USA), A. Upgren (USA), and M. Valtonen (Finland). This very significant increase in the membership of Commission 26 was welcomed as a major step in revitalizing the activities of the Commission. C. Hernandez (Argentina) and M. Tapia (Mexico) resigned as members of the Commission.

A letter written by P. Couteau, who could not be present in Baltimore, was presented by J. Dommanget. Dr. Couteau asked for a discussion of the future of the Commission's *Circulaire d'Information*, a publication begun by P. Muller in 1954 who continued to edit it until 1983, at which time it was turned over to Dr. Couteau. The *Circulaire* has provided a rapid means for distributing new orbits and discoveries among those active in double star research, but as pointed out by Dr. Couteau, relatively few individuals have contributed to it in recent years. In

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response to a question by L. Loden, it was pointed out that this is a publication that can be referenced in the literature. W. Bagnuolo asked if distribution via a computer network might enhance usefulness. The discussion concluded that the *Circulaire* should continue to be issued in fulfillment of its original goal and that its use should be publicized and encouraged. Upon the recommendation of H. Abt, the thirty years of service by Dr. Muller and the continuation of the *Circulaire* by Dr. Couteau were applauded. The new President will forward these sentiments to Dr. Couteau.

An issue related to the above discussion is the reluctance of the editors of some journals to publish measures of double stars that are not accompanied by some kind of analysis, in spite of the fact that supplement series to journals were initiated to serve in such a capacity. Such demands by editors were felt to be inappropriate and would actually tend to dampen activities in this field. Although these measurements could be directly inserted into data bases without being published in the normal means, it was agreed that this made it difficult for the users of these data to keep up with the field and would discourage young astronomers from pursuing activities in which their efforts do not receive the normal recognition from publication. It was agreed that the President would write letters to the editors of relevant journals expressing the concerns of the Commission.

SCIENTIFIC SESSIONS

Approximately 60 people were present during the Commission's scientific sessions. For the first session, reports on the application of the Hubble Space Telescope and the HIPPARCOS astrometry satellite to the study of double and multiple stars were given by L. Fredrick (HST) and by J. Dommanget and P. Bernacca (HIPPARCOS). HST will detect binaries through the fine guidance sensors due to the high sensitivity of the FGS to non-single sources. Because the FGS will inspect very large numbers of guide stars, these sensors have the capability of a very extensive survey for duplicity. Ground-based observations using high resolution techniques can then follow up by confirming these discoveries. Efforts have been completed to minimize the impact of the FGS' inability to lock onto binaries as guide stars.

A detailed discussion of the application of HIPPARCOS to binary star astronomy is presented in the triennial report of Commission 26. A great deal of effort has gone into the preparation of the *Catalogue of the Components of Double and Multiple Stars* as a part of the *HIPPARCOS Input Catalogue*. Eighteen months following the launch of HIPPARCOS, a list of double stars will be available for circulation among the community for confirmation and subsequent measurement. The responsibility for the preparation and circulation of this first list of suspected binaries belongs to the Italian representatives to the *Input Catalogue Consortium*, and suggestions for the most effective distribution of these first results are solicited.

The second scientific session consisted of presentations by individuals whose contributions are summarized in the following abstracts:

A New Catalog of Interferometric Measurements of Binary Stars - H.A. McAlister and W.I. Hartkopf, Georgia State University. A second catalog of interferometric measurements of binary stars will be issued in the fall of 1988. The first such catalog, issued in January 1984, contained 3,363 measures of 1,123 systems along with an additional 1,863 inspections by interferometry that failed to resolve known or suspect binary systems. The second catalog, with a cutoff date of 1 July 1988, will contain 8,976 measures of 2,995 systems with an additional 3,068 negative inspections for duplicity. There has thus been a substantial increase in interferometrically obtained data for binary stars in the 4.5 years between the two catalogs. The number of papers in which these data are presented has increased from 46 to 69. The mean separation in the latest data sample is 0.347 arcsec compared with 0.32 arcsec from the first catalog. Although the number of measures and, perhaps more significantly, the time base over which these observations are being made is increasing at a useful rate, it should be emphasized that the observations are being done primarily by only four groups in the USSR, France, and the USA. There is great potential in extending interferometric programs to telescopes that have moderate apertures in the range of 0.6 to 2.5 meters. Copies of the new catalog will be distributed to members of Commission 26.

Speckle Interferometric Orbits of Binary Stars - W.I. Hartkopf, H.A. McAlister, and I. Furenlid, Georgia State University. With nearly two decades of speckle observations now available, a growing number of binary systems have completed one or more revolutions and are ripe for orbital analyses based solely or primarily upon speckle data. Orbits have been published for a number of interesting objects, including the important Hyades binary 70 Tau (Fin 342) (*A.J.*, Oct 1988), γ Per (*A.J.*, 94, 700, 1987), and χ Dra (*A.J.*, 93, 1236, 1987). New or improved orbits for twenty binaries are being prepared for publication. The increased overlap between the visual and spectroscopic regimes resulting from speckle is especially important and should lead to a substantial increase in the number of accurately known stellar masses. A long-term collaboration between CHARA and INAOE for the precision measurement of radial velocities is expected to eventually permit the combination of the two types of data to yield masses with accuracies at the 1% level.

Binary Star Speckle Photometry - W.G. Bagnuolo, Georgia State University. A major goal of the GSU/CHARA program of binary star speckle interferometry has been to develop methods for accurately determining the magnitudes and colors of the individual components of binary stars with separations down to the diffraction limit. A new method of analyzing speckle images, called the *fork* algorithm appears to be a useful method for such *speckle photometry*, and simulations suggest that it can attain a SNR roughly 10 \times that of other algorithms such as triple correlation and shift-and-add. A simple application of speckle photometry is resolving the usual 180 $^\circ$ position angle ambiguity resulting from standard autocorrelation analyses of speckle images. In the case of the Hyades binary Finsen 342, resolving this ambiguity is not just a curiosity, because we can test the suggestion by Peterson and Solensky (1987) that the system has a short period eccentric orbit rather than a

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longer period circular orbit commonly assumed in the literature. Indeed, we show definitively that the period of Finsen 342 is 6.264 years and that the system has masses that are normal in comparison with other Hyades binaries. An initial estimate of the magnitude difference has also been determined. In a second application of the *fork* method, sets of speckle images of Capella taken in the Strömgren v, b, and y filters have been analyzed. These results show that the magnitude differences in v, b, and y are $m_{Av} - m_{Ab} = 0.54$, 0.23, and 0.09 magnitudes respectively. Thus, contrary to accepted beliefs, the more luminous star in these wavelengths is the hotter "F-star", Capella Ab, the spectroscopic secondary and the less massive component. The photometric indices are consistent with spectral types of G0 III for the secondary and G8/K0 III for the primary "G-star".

A New Program of High Precision Radial Velocity Measurements - I. Furenlid, Georgia State University, and O. Cardona, INAOE. A new international collaboration in instrument development and research has been established between INAOE and CHARA based upon spectroscopic programs to be initiated with the new 2.14-m telescope built by INAOE at the Cananea Observatory located in the state of Sonora in northern Mexico. The spectrograph, which is of the off-plane Ebert-Fastie type, uses a CCD detector system, and is fed starlight with an optical fiber bundle coupled to the telescope. For stability, the spectrograph is mounted on a platform away from the telescope. A general goal of the design has been to generate an instrument of good optical efficiency and very high stability with all major observing functions under remote control for warm-room operation. The spectrograph uses low spectral orders and only one stretch of spectrum is observed per CCD frame. The optical fiber bundle serves as an image slicer by being arranged in a close packed array at the input end and in a one-dimensional slit at the output. One major application of the new spectrograph will be to provide radial velocities of visual and interferometric binaries that are being followed by the CHARA speckle interferometry program. Improved sensitivity and signal-to-noise offer the promise of significantly improved velocities and the detection of secondaries that have eluded previous spectroscopic efforts.

Spectroscopic Observations of Close Multiple Stars - F.C. Fekel, Vanderbilt University. For over ten years, high dispersion spectroscopic observations have been obtained for a number of spectroscopic/visual multiple stars. Preliminary long-period orbits have been computed for some of these systems including ADS 14839 and ψ Sgr while nearly definitive orbits are available now for others such as HR 6469, μ Ori = ADS 4617, 13 Cet = ADS 490, and 63 Gem. When combined with visual and/or speckle data, fundamental parameters can be obtained as in the case of the double-lined spectroscopic binary χ Dra that has also been resolved by speckle interferometry. Continued collaboration with speckle observers will be of great importance for most of these systems.

Occultation of SAO 79241: A Double Star? - C. Meyer, Y. Rabbia, M. Froeschle, G. Helmer, and G. Amieux, CERGA. The disappearance behind the moon of the star SAO 79241 (HD 56176) was observed at CERGA on 27 February 1988 at

a wavelength of 410 nm using the lunar laser ranging 1.5 m telescope. The light curve clearly shows a double event, and analysis of the tracing yields the vector angular separation of 0.0994 ± 0.0009 arcsec directed towards position angle 129.2 degrees and a magnitude difference of 0.8 magnitudes. No indication of duplicity for this star were found in the Sky Catalog 2000.0 and the SIMBAD data base at Strasbourg, and it is likely that this is a newly discovered double star.

Wide Binaries in a Sample of Common Proper Motion Stars - J.L. Halbwachs, Observatoire de Strasbourg. Common proper-motion stars were detected using data from the AGK 2/3 Catalogue (Halbwachs 1986). The probability of a pair being optical was evaluated from the apparent separation, ρ , and from the proper motion, μ . Among 113 pairs with ρ/μ between 1,000 and 3,500 years, 40% should be optical. To date, the radial velocities of both components of 50 pairs have been measured at least twice, using the CORAVEL radial velocity scanner. Nine pairs contained spectroscopic binaries, but among the 41 remaining pairs, 22 had components with identical velocities. This indicates a proportion of 54%, in agreement with the prediction. These 22 binaries have separations around 10^4 AU, and confirm that the frequency of wide binaries is not negligible.

The final scientific session was a discussion of the needs and means for cooperative undertakings in binary star research. Such cooperation will become increasingly important with the advent of HST and HIPPARCOS and with the overlap in accessibility of many systems to observation by different techniques practiced by specialists in different fields. Dommagnet gave as an example of cooperation the compilation of the *HIPPARCOS Input Catalogue* by a consortium of twelve different groups, including amateur astronomers. Commission 26 can serve as a vehicle for furthering such cooperation.

FINAL BUSINESS SESSION

H. McAlister served as session chairman. The excellent service of Prof. Rakos during his term of President of Commission 26 was acknowledged with applause by the members present. Prof. Rakos has seen the Commission through an important transition period, and his efforts have ensured that double and multiple star studies will play a continuing role in the IAU.

As a brief continuation of the scientific sessions, C. Worley described his adopted nomenclature in the *Washington Double Star Catalog*. The Commission expressed its thanks to him for this substantial and continuing contribution to the field of binary star astronomy.

As the last matter of business before the Commission, the Chairman initiated a discussion concerning the desirability of a colloquium to be sponsored by Commission 26. It was concluded that such a colloquium is desirable considering the advent and extensive use of techniques at the frontier of our field.

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