

## COMMISSION No. 27

### VARIABLE STARS (ETOILES VARIABLES)

Report of Meetings: July 26, 31, 1991

PRESIDENT: Michel Breger

SECRETARY: Thomas Barnes

#### 1. BUSINESS MEETING (July 26, 1991)

- 1.1. M. Breger called the business meeting to order at 1400 hours and welcomed the members of the Commission. He presented an introduction to the meetings of the Commission during the General Assembly. Approximately 50 members of the Commission were in attendance.
- 1.2. There followed a brief discussion of the availability of the General Catalogue of Variable Stars. H. Bond enquired as to how members in the USA may obtain a personal copy. J.A. Mattei responded that the GCVS is distributed in the USA by the American Association of Variable Star Observers through an agreement with the Sternberg State Astronomical Institute. She noted that the first four volumes are currently available for \$50 plus \$5 for shipping per volume. Requests should be sent to the AAVSO, 25 Birch Street, Cambridge, Massachusetts 02138, USA. A fifth volume on extragalactic variables is in preparation in the USSR.
- 1.3. B. Szeidl, editor of the Information Bulletin on Variable Stars, reported on the status of the Bulletin. He noted that the Bulletin is now in its thirtieth year of publication, and he expressed his hope that it will continue for another thirty years. However, after twenty-five years as editor, he decided that it was time to retire from that position. L. Szabados and K. Olah, both of Konkoly Observatory, accepted to be editor and co-editor effective immediately. J. Smak rose to offer very great appreciation from the variable star community to B. Szeidl for his many years of outstanding service as editor of the Bulletin. These remarks were followed by great applause.

B. Szeidl also drew the members' attention to serious economic problems in publication of the Bulletin. At present the Bulletin is mailed to approximately 600 addresses, which includes 350 institutions. The financial resources of the Konkoly Observatory no longer permit this number of mailings, and B. Szeidl suggested that the Bulletin be distributed only to institutions. There followed an extensive discussion of the finances of the Bulletin. M. Breger said that Commissions 27 and 42 (Close Binary Stars) have asked the IAU Secretariat for \$500 over three years to assist with the distribution of the Bulletin. B. Koch (President of Commission 42) remarked that Commission 42 strongly supports financial assistance to the Bulletin as about 50% of the activity of that Commission involves variable stars. The Secretariat has not yet indicated its willingness to provide this financial assistance. E. Malone moved that Commission 27 request all possible financial support for the Information Bulletin on Variable Stars from the Secretariat. This motion was seconded and accepted by the members. E. Malone also suggested that the Commission may wish to appoint an editorial board to assist with publication of the Bulletin. M. Breger reported that the new editors of the Bulletin have proposed an editorial board of L. Balona, M. Breger, M. deGroot, D.S. Hall, R. Koch, J.M. LeContel, J. Percy, M. Rodono, J. Smak, and C. Sterken. A. Landolt moved the acceptance of this editorial board by the Commission. The motion was seconded and accepted by the members. Concerning the suggestion that personal copies of the Bulletin be discontinued, numerous members said that they have access to the Bulletin only through their personal subscriptions and they requested that these be continued.

H. Bond enquired whether submissions to the Bulletin are reviewed. B. Szeidl responded that the editors act as referees in the interest of rapid publication, and that 15–20% of the submissions are rejected. In questionable cases, an informal referee system is used.

- 1.4. M. Breger reported on the IAU Archives for Unpublished Photoelectric Observations of Variable Stars. The number of files in the archive has increased from 174 in 1988 to 221 (not including 14 incomplete files) at present. Copies of the archives now exist in France, the USSR, and the United Kingdom. Researchers may submit and retrieve files electronically, with details of the procedure given in the current Transactions of the IAU. Approximately 1–2 requests come each month to each center for access to the files.
- 1.5. M. Breger also reported on the Delta Scuti Newsletter, which has now grown to 22 pages per issue. There have been three issues of the Newsletter and the next issue is anticipated for distribution in November. Copies are sent to interested individuals active in the field only. M. Breger expressed his appreciation to all contributors to the Newsletter.
- 1.6. The following slate of officers was proposed for Commission 27: President: J. Percy; Vice-President: M. Jerzykiewicz; Organizing Committee: T. Barnes, M. Breger, J. Christensen-Dalsgaard, R. Gershberg, D. Kurtz, J. Mattei, M. Rodono, N. Samus, M. Smith, B. Szeidl, and M. Takeuti. The members approved these officers by unanimous vote. Approximately 50 new members were proposed for the Commission and were approved by vote of the members. This brings the membership of the Commission to about 400 members.
- 1.7. M. Breger reported on the situation at Sonneberg Observatory which is proposed to be closed by the German government. The Sonneberg Observatory has conducted important research for 66 years in the field of variable stars and has a valuable, archival plate collection. M. Breger submitted to the members for discussion a joint resolution with Commission 42 to the General Assembly in support of the research of the Sonneberg Observatory. The (final) text of the resolution is as follows:

“IAU Commission 27 considering that the systematic coverage of the long-term behavior of the population of variable stellar objects, such as the sixty years of measurements made at Sonneberg Observatory, makes a major contribution to Astronomy and Astrophysics, recommends that all efforts be undertaken to continue these important measurements and to ensure the appropriate maintenance and availability of the data.”

Considerable discussion on how this important work could best be supported followed. In particular, J. Smak noted that the context of this resolution is to assist the Sonneberg astronomers in finding support for their work and their archive and not to interfere in any decisions being taken by national governments. The members then voted on the resolution, 43 votes for the resolution and no votes opposed. The members of the Commission also authorized M. Breger to make minor editorial changes to the resolution (if necessary) and to present this resolution to the IAU General Assembly.

- 1.8. M. Breger brought forward the suggestion of the Secretariat that each Commission examine its reason for being, and he proposed for discussion a merger with Commission 26 (Double & Multiple Stars) or 42 (Close Binary Stars). The members present opposed this possibility and strongly preferred to retain the present format of the Commission. Several members encouraged more interaction among the various astronomical fields allied with variable stars. J. Percy recommended that the Organizing Committee take an active role in proposing meetings involving more than one commission.
- 1.9. J. Percy raised the question of whether the members find the current Reports on Astronomy useful to them. Several of the Commission members spoke very positively about the value of the Reports. J. Matthews and O. Osborn suggested that the Reports are so useful that they should be published more widely than just in the Transactions of the IAU.
- 1.10. W. Wamstecker proposed a resolution to the Commission in support of World Astronomy Days. The text of the resolution was “Recognizing that the detailed planning of the World Astronomy Days in the context of the International Space Year is in full concordance with the

IAU Resolution A4 (XXth General Assembly), Commission 27 supports the activities and hopes that ALL OBSERVATORIES will be able to cooperate to make these World Astronomy Days a successful activity involving astronomers from all IAU member countries." W. Wamstecker explained that the resolution was intended to encourage all observatories to cooperate in multi-site observations during World Astronomy Days. He reported that Commissions 28, 42, and 44 had approved the resolution and that other commissions would be considering it in their business meetings. Various opinions on the import of the resolution were offered by the members. C. Sterken noted that multi-site observations are of considerable value for standard star observations because good estimates of the external errors can be obtained. D. Kurtz expressed doubt that major observatories will be able to devote their larger telescopes to such a program. E. Malone suggested that the scientific value of the observations should be the driving force behind such collaborations. The resolution was approved by the members by a vote of 27 in favor to none opposed.

## 2. FIRST SCIENTIFIC SESSION (JULY 26, 1991)

### New Developments in Variable-Star Research

CHAIRMEN: M. BREGER AND J. PERCY

The first scientific session of Commission 27 began immediately following the close of the business meeting. Seven papers were given, each followed by lively discussion. Approximately 50 people attended the session.

P.A. Whitelock reported on the long-term variability of luminous supergiant stars from infrared JHKL observations. She showed a quasi-periodic variability of Eta Car on a time scale of 2000 days, as well as a secular increase for the same star over the period 1974–1991. VY CMa showed similar behavior: a secular decrease with a quasi-period near 1500 days. For the star AG Car, she noted brightening in an emission shell phase in 1982 and a rapid increase in brightness in 1990. For the latter star, additional observations are urgently needed.

H. Bond discussed pulsations of central stars of planetary nebulae. Six such stars are now known. They are non-radial pulsators with typical periods of 16–31 minutes. All are extremely hot, carbon and nitrogen rich objects, supporting a pulsation mechanism involving cyclical ionization of C and O. Analysis of the pulsations may lead to determinations of the stellar mass, interior structure and evolutionary contraction rate.

The Livermore OPAL opacities have been used by A. Cox to calculate models of double-mode RR Lyrae variables (RRd class). The opacity decreases in the region below  $10^5$  K, changing the models and making all radial mode periods larger. This results in lower period ratios and higher RRd masses than other opacity codes. These masses are now possibly even larger than evolution masses. If so, new horizontal branch evolution tracks should be calculated.

T. Barnes presented recent work done in collaboration with T. Wilson, S. Hawley, and W. Jefferys on the Cepheid distance scale. A maximum-likelihood statistical parallax analysis of classical Cepheids was performed to determine kinematical and absolute magnitude parameters. The proper motion data used were taken from the extensive compilation by D. K. Karimova and E.D. Pavlovskaya. The best estimate for the mean absolute magnitude at  $\log(\text{period}) = 0.8$  mag. is  $-3.46 \pm 0.33$  mag. He emphasized that any improvement in this statistical parallax result will require marked improvement in the proper motions.

M. Breger presented new results on Tau Peg which impact our understanding of the singly-periodic Delta Scuti stars. Although Tau Peg shows a dominant pulsation frequency of 18.4052 cycles per day, it is not a radial pulsator. He identified the frequency as a non-radial  $p_3$  or  $p_4$  mode with  $\ell = 2$  by examining the amplitude ratios and phase differences between observed light and color variations as well as from the derived Q value of  $0.016 \pm 0.003$  days. Thus for small amplitude stars, the existence of a single frequency of oscillation cannot be taken as evidence of radial pulsation.

C. Sterken communicated a study of period changes in Beta Cephei by A. Pigulski and D. Boratyn. Beta Cep has a pulsation period of 0.1905 days and is also a member of a multiple system. One visual companion is located at 13.4 arcsec and another has separation decreasing from 0.25 to 0.07 arcsec in less than 20 years. The pulsation period of Beta Cep underwent a sudden decrease of about  $10^{-5}$  days in 1920. Period changes are common in Beta Cep stars, but have never been solidly explained by any mechanism. This work analyzed 70 years of photometric and spectroscopic data and showed that the period variations of Beta Cep could be completely explained by the light-time effect in the binary system. From this, they also obtained a preliminary solution for the orbit of the system, which has a period of 92 years.

The observed period ratio of double mode Cepheids, approximately 5/7, is larger than the theoretical one obtained from models having standard evolutionary masses. This disagreement is not yet resolved to everyone's satisfaction. M. Takeuti discussed the discrepancy in terms of the coupling between two different modes of pulsation. The coupling can decrease the period ratio until a synchronized state is reached with ratio 1/2. Using LNA wave functions, the strength of non-adiabatic coupling was calculated. He found that the non-adiabatic coupling is stronger than the adiabatic one for radiative model Cepheids which suggests a possible mechanism for the observed period ratio.

### 3. SECOND SCIENTIFIC SESSION (JULY 31, 1991)

#### The Role of Rotation in Stellar Variability

CHAIRMEN: J. PERCY AND M. BREGER

The final scientific session of Commission 27 was re-scheduled to the morning of July 31 because of the fire in the conference hall. As not all members and speakers could be notified of the new time and place of the session, only about 25 people attended the session.

The  $\alpha$  Cep star HR 3831 has a pulsational period of 11.677 minutes and a variable amplitude of 0 to 5 mmag. D.W. Kurtz presented results by himself and his collaborators A. Kanaan, P. Martinez, and P. Tripe based on 516 hours of new high-speed photometry. They showed that the period of pulsation amplitude modulation is equal to the period of mean light variation. They also demonstrated that the times of pulsation maximum and magnetic extremum coincide and are different from the time of mean light extremum. From these circumstances, they concluded that HR 3831 is an oblique rotator with the magnetic axis and pulsational axis aligned, rather than a spotted pulsator with amplitude modulation caused by surface inhomogeneities.

L. Mestel presented a discussion of the rotational evolution of solar-type stars with different degrees of core-envelope coupling. The results suggested that weak coupling can give a reasonable agreement to observations of rotational properties in the Alpha Per, Pleiades and Hyades clusters. In weak coupling the supply of angular momentum from the core does not affect the surface rotation up to the Pleiades age, but does have some influence at the Hyades age. This model also predicts that the Sun began main-sequence life with rotation at 40 km/s.

The interaction of rotation and pulsation in early-type stars was discussed by D. Baade. Among OB stars, variability is ubiquitous; only stars with strong magnetic fields and/or surface abundance anomalies may be exceptions. In un-evolved and moderately evolved stars, amplitudes drop steeply beyond B7. Although numerous subclasses of variables have been suggested, most lack physical justification. Only the Beta Cephei stars, with short periods and (usually) radial modes, may be a distinct class. In young stars, rotation is important, and the distribution of  $v \sin i$  values shows a lack of narrow-lined O stars, whereas in B stars there is a slowly rotating population (largely Cp stars) and a rapidly rotating population (largely Be stars). Non-radial pulsation (NRP) can change a star's rotational profile, including its apparent surface rotation rate. Conversely, homogeneous evolution in the presence of rapid rotation would modify the opacity profile and so give rise to different pulsation properties. This may explain the general weakness of low-order NRP modes in Bn stars, whereas they are predominant in Be stars; indeed, they may contribute to the episodic mass loss.