COMMISSION 35: STELLAR CONSTITUTION (CONSTITUTION DES ÉTOILES)

Report of Meetings, 15, 17 and 21 August 1979

PRESIDENT: B. Paczyński VICE-PRESIDENT: R. J. Tayler

BUSINESS MEETING 15 August 1979

The following nominations were approved:

PRESIDENT: R. J. Tayler (Astronomy Centre, University of Sussex)

VICE-PRESIDENT: A. N. Cox (Los Alamos Scientific Laboratory, New Mexico)

ORGANISING COMMITTEE: D. J. Faulkner, P. Giannone, I. Iben, R. Kippenhahn, B. Paczyński, G. Ruben, D. Sugimoto, A. Tutukov, J-P. Zahn.

There was a discussion about the manner in which the new organising committee had been chosen, which followed consultations amongst the existing organising committee and some past officers. Although no objection was raised to the proposed membership, it was suggested that in future members of the commission should be invited to nominate members of the organising committee. It was also suggested that normally members of the organising committee should not serve for more than two terms. These two proposals were agreed.

Forty six new members of the commission were elected after a discussion in which several members suggested that the credentials of the candidates should be examined carefully. Finally, it was agreed that any member of the IAU who expressed a wish to take part in the work of the commission should be entitled to join it.

This led to a general discussion concerning communication within the commission. It was explained by R. J. Tayler, who had been responsible for coordinating the production of the draft reports, that these had not been circulated to members of the commission because his institution could not afford to pay the costs of the offprints and of their postage. As the commission had no budget it was difficult to see how communication with an increasingly large number of commission members could be maintained. Several members of the commission urged that the commission should try to facilitate exchange of information amongst its members, in particular concerning availability of tabular material and numerical codes. The incoming President was asked to raise the problem of commission expenses with the incoming General Secretary.

SCIENTIFIC MEETINGS

Theory of Rotating Bodies 15 August 1979

This three hour meeting was organised and chaired by B. F. Schutz and it was concerned with the effect of rotation in both stars and disks. M. Clement (Toronto) presented results of numerical calculations of the structure of

differentially rotating stars and of some of their non-axisymmetric normal modes of adiabatic pulsation. He commented that the numerical problems need delicate handling particularly for modes with corotation points but that the numerical method appeared to work. B. Schutz (Cardiff) presented similar normal mode calculations for self-gravitating Bardeen disks, commenting also on the marked difference between modes with and without corotation points. He attributed this to the differences between the discrete and continuous spectrum. Y. Sobouti (Teheran) discussed problems in identifying g-modes of rotating fluids and showed that one must exercise caution when obtaining g-mode frequencies for slow rotation by a perturbation method. B. Durney (N.C.A.R., Boulder) presented some new calculations on the effect of rotation on the solar convection, taking into account both turbulent viscosity and thermal conductivity. He also discussed the loss of angular momentum by stars, involving dynamo build-up of a magnetic field followed by magnetic braking. E. Schatzman (Nice) summarized the highlights of papers presented at the Erice Workshop on Stellar Rotation (2-10 June 1979), in particular considering two questions; are laboratory experiments done so far relevant to astrophysics and what new experiments should be done? V. Icke (Minnesota) presented numerical calculations and computer generated films of accretion on to rotating disks, suggesting that well-collimated jets of plasma might be produced from the accreting cloud. R. C. Smith (Sussex) suggested that the interaction of circulation and tidal torques in close binary stars might prevent them from possessing a time independent state of rotation. D. Sugimoto (Tokyo) concluded the meeting by pointing out that the incompressible limit of a sequence of polytropes with a given (rapid) rotation is not necessarily the Maclaurin spheroid, but may be a toroid for rapid enough rotation. The Maclaurins may not be reliable analogues to compressible configurations in such cases.

Pulsars (Joint Meeting with Commissions 40, 48) 17 August 1979

This three hour meeting was organised by R.J. Tayler. The first session was devoted to pulsar observations and the second to pulsar theories.

PULSAR OBSERVATIONS

Review Talk J. H. Taylor

There are at present 328 pulsars known but it is unlikely that there will be a very large increase in number in the near future because of limitations of existing telescopes. Almost all pulsars have periods between 0.2s and 2s and there is a genuine fall off at each end. The dispersion measure ranges from 3 to 500 cm^{-3} pc. There are many different timescales associated with pulsars; pulse, pulse width, subpulse, micropulse, pulse nulling, pulsar lifetime. The average pulse shape does not change very much with period; the pulse width is typically a few per cent of the period. There are double peaked profiles with a continuum of separations, the Vela pulsar being double in optical and X-ray but not in radio. Subpulses and micropulses also seem to scale with period. Pulsars are nearly all very good clocks when account is taken of $\dot{P}$, being accurate to a few milliseconds in 10 years. A few are not such good clocks. In particular glitches have been observed for Vela, Crab and PSR 1641-45 and a few others have residuals which wander around. If $\dot{P}$ is plotted against P, there is a cut-off in the diagram which cannot be due to observational selection but which must be due to a real physical effect. This could be produced by the decay of the magnetic field at the light-cylinder to a critical value or it could arise from lack of further pair creation at the polar cap. The distances derived from dispersion measures are statistically rather reliable, with 0.03 electrons cm^{-3} being a good average. Pulsars are concentrated towards the galactic plane but not as strongly as population I objects; $\bar{z} \approx 400$ pc. The distribution of pulsars appears to peak near 5 kpc. from the galactic centre in good agreement with various indicators of current and recent star formation. It appears that one pulsar is formed about every 10 years.

Short Contributions

A. G. Lyne	Pulsar Proper Motions
G. S. Downs	Preliminary Results of Timing Measurements of Four Pulsars
M. Bartel	Simultaneous Two Station Single Pulse Observations of the Radio Pulsar PSR 0809+74
D.H.P.Jones	Changes in the Optical Light Curve of the Crab Pulsar between 1970 and 1977

Lyne reported that he and his colleagues had now measured 26 pulsar proper motions which ranged from a few milliarcseconds per year to 400. Suggestions that pulsars received a high velocity at the time of formation were confirmed. Parallax measurements were also being made. Downs reported preliminary evidence for discrete changes in P and $\dot{P}$ for four pulsars. Bartel discussed simultaneous observations of the same pulsar in the German Federal Republic and the USSR. Jones described seven years' study of the stability of and small changes in the optical light curve of the Crab pulsar. In addition to these advertised short contributions, B. Robinson reported that a second pulsar had been discovered to be a partner in a binary system with a period of about 1265 days.

PULSAR THEORIES

Review Talk on Pulsar Magnetospheres L. Mestel

Mestel started by reviewing the standard picture of a pulsar as an obliquely rotating magnetised neutron star, whose main loss of energy is through the emission of low frequency electromagnetic waves. The radio pulse energy is always less than the total energy by several orders of magnitude. As a result, explaining the radio pulses is perhaps not the primary task of the theory. It, however, appears that the pulsed γ-ray emission can sometimes be a major source of energy loss. Theory should therefore demonstrate that in some circumstances a significant fraction of the wave energy can be converted into energy of highly relativistic particles, which can then radiate γ-rays close to the light-cylinder. He then outlined progress that had recently been made in trying to produce a self consistent model of a pulsar magnetosphere. Models have been obtained for magnetospheres of pulsars in which the magnetic and rotation axes are aligned. Electrons pulled out of the polar regions of the neutron star are driven across the light-cylinder by centrifugal forces, moderated by the electric field component along the magnetic field. Just beyond the light-cylinder the electrons become highly relativistic and emit high frequency radiation, which carries away energy and angular momentum, so braking the star. The aligned pulsar cannot possess all the properties of an obliquely rotating pulsar but preliminary investigations in the latter case suggest that the essential features of a generally aligned pulsar are the emission of a low frequency wave and of very high frequency γ radiation.

Short Contributions

M. Salvati	γ-rays and Pulsars
V. Radhakrishnan	The Effect of the Diffuse γ Radiation on Pulsars
F. Pacini	γ-rays from Young Pulsars
P. A. Sturrock	Electric Fields in Pulsar Magnetospheres

Salvati reiterated that γ-ray pulsed emission is always the main form of pulsed emission and that in slow pulsars it may be the major emission. The shape of the γ-ray pulses suggests that γ-ray emission occurs near to the light-cylinder. Radhakrishnan proposed that the breakdown of pulsar gaps could be produced by the diffuse γ-ray background. This seems possible if the gap magnetic field is $\sim 10^{12}$ gauss. Pacini discussed the production of γ-rays by nuclear collisions in an expanding supernova shell and suggested there might be a strong detectable flux of

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γ-rays some time after a supernova explosion. Sturrock discussed some of the problems relating to the structure of electric fields in pulsar magnetospheres.

Structure and Evolution of Variable Stars (Joint Meeting with Commission 27) 21 August 1979

This three hour meeting, which was organised by B. Paczyński and J. Smak, is reported by Commission 27.

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