

Reports from Observatories, University Departments and Research Establishments

INDIAN INSTITUTE OF ASTROPHYSICS

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(Report for year 1972 April 1 to 1973 March 31)

SOLAR PHYSICS

Isophotes obtained by equidensitometry techniques from four exposures of the 1970, March 7, corona have been used for derivation of intensity distributions along the equator, poles, streamers and dark 'gaps' in the visible corona. The composite of the isophotes has 23 contours covering values of r ranging from 1.1 to 3.5, r being the distance from the Sun's centre in units of the solar radius. Microphotometer scans along two diameters permitted the assignment of intensity values to each contour. The tie-up to absolute intensities was possible with the aid of Gulyaev's data obtained at the same eclipse. The polar and equatorial distributions differ from those given by van de Hulst for a maximum corona. The Kodaikanal measures agree well with the NRL measures of the outer corona made from a rocket coronagraph and together provide data from $1.2R_{\odot}$ to $8.0R_{\odot}$ along the solar equator. The intensity of coronal brightness along the streamers are in general higher than the equatorial intensity, while those in the 'gaps' are lower; but the intensity gradients in the streamers and in the gaps are almost alike. Radial intensity gradients for different position angles together with the Ludendorff parameters obtained characterize this corona as typical of the solar maximum.

Time sequence spectra covering the $H\beta$ region were obtained at the solar tower to study the velocity oscillations at the mean level of formation of $H\beta$ in the chromosphere.

Integrated spectra of the sun were obtained on several days to enable measurement of the K line width and K_{232} line profile representative of the Sun as a star.

Several sunspot spectra were obtained in the Zeeman-insensitive line 4912 \AA to study the fine structure of Evershed flow.

Modifications of the solar magnetometer were made during the year to enable operation soon in the multichannel mode. The 4.3-m spectroheliograph has been moved to the solar tower to enable its use with the larger image.

The solar telescopes at Kodaikanal continue to gather basic solar data which are utilized in research projects at the Institute and elsewhere. For the year ending 1973 March 31, whitelight photoheliograms were obtained on 297 days, H-alpha disc spectroheliograms on 285 days, K_{232} spectroheliograms on 279 days and K prominence spectroheliograms on 241 days. The spectrohelioscope was used for 988 hr of observation and 86 flares were observed. Of these 26 were of Class I, 9 of Class II and 51 were subflares. World Data Centres continue to get these observations regularly.

STELLAR PHYSICS

The principal highlight of the year has been the commissioning of a new 102-cm Cassegrain-Coudé system built by Carl Zeiss of Jena. The normal Ritchey-Chretien Cassegrain focus of $f/13$ aperture ratio provides a 45' field, where photography is possible on flat plates with the aid of a quartz field flattener. An $f/6$ transformation system attached to the Cassegrain focus gives the same extent of field at higher speed; its greatest use is in relatively fast photography. An $f/2$ transformation system, following Meinel's proposal, provides the overall combination with great speed and versatility. In this system, one can obtain slitless spectra of different dispersions with both grating and prism, or use interference filter, or Fabry Perotetalon on faint extended surfaces. Two additional features of the telescope are the provision for photoelectric guiding and a built-in computer device for rapid change in a programmed way from star to star amongst the members of a cluster.

The Cassegrain spectrograph with 600 lines/mm grating and 135-mm focus camera has been used on the 102-cm reflector for a study of selected binary systems. For γ Velorum, a whole set of plates in the blue have been obtained on high contrast emulsion to determine the O star orbit. In the yellow region, spectra obtained on III-F emulsion enable the derivation of the Wolf-Rayet star orbit from the C III 5696 Å line. An interesting result has been the presence of a sharp 5876 Å line, violet-shifted when 3888 Å shows a similar behaviour. There is also much fine structure in the emission band at 6560 Å.

Other binaries whose spectra have been observed are b Persei, HD 37756, HD 65041, HD 107325, ϵ Cr A and ν Centauri. The reduction of spectrograms of b Persei is complete. A change in ω of the order of 6°·8 per year suggests an apsidal motion period of 53 years.

Changes in some of the orbital elements from those derived earlier may be due to the distortion of the radial velocity curve by gas streams present in the system. In view of the flaring radio emission detected from this system and the variations of the orbital elements, it appears that the close binary system is in an active mass transfer phase. New elements of the binary system ν Centauri have been derived from spectra obtained during the year. An interesting result has been the finding that one component is a Beta Canis Majoris variable with a likely period of 0.275 days.

A 3° quartz prism in combination with the $f/2$ system gives ultra low dispersion spectra of objects over a 45' field. The spectra measures 250μ in length from the near UV to the red and facilitates study of objects down to magnitude nineteen. Use of this prism on quasi-stellar objects shows up in a striking manner the peculiar energy distribution in the object. In combination with the Eastman 103aE emulsion, the arrangement promises to be a very effective means of identifying quasi-stellar objects. Microspectra of 42 quasi-stellar objects, having z values ranging from 0.02 to 2.7, have been obtained to establish the selection criterion. Six of these have been of radio-quiet objects. UV excess objects, or those rich in red light, can be picked out with great ease. The superiority of the technique over that of UBV photography lies in the economy of exposure together with versatility of information.

Spectra of fainter members of the Scorpio–Centaurus association down to magnitude 8.5 have been obtained with the grating spectrograph for the study of rotational velocities. This completes the rotational velocity survey in the association, commenced earlier with the 51-cm reflector. Satisfactory progress has been made in measurement of line intensities and rotational velocities.

Direct photographs of some globular clusters have been obtained through a yellow filter and the $f/6$ camera. The plates are being used for derivation of isophotes in the cluster by the Sabattier technique. The ellipticities and intensity distributions thus derived are likely to have a dependence on other evolutionary parameters of the cluster.

Direct photography of selected fields in Monoceros, Puppis and Vela has been commenced as part of a programme of detection of spiral tracers. During the year, several photographs were obtained for the detection of variable stars. Microspectra will also be obtained of these fields to enable the detection of very early type stars.

THE SOLAR SYSTEM

The occultation of the eighth magnitude star SAO 186800 by the Jovian satellite Ganymede, was successfully observed with photo-

electric techniques on the 102-cm telescope at Kavalur. The photometer signal, recorded through a Wratten 89B filter by a cooled RCA 7102 photomultiplier was amplified by a General Radio 1230A electrometer and displayed on one of the four traces of a Tektronix 533A oscilloscope. The other three channels served as time markers. Both immersion and emersion light curves have been observed. The principal characteristic of the data obtained is that the fall and subsequent rise in intensity appear to be gradual rather than abrupt, thus indicating the presence of an atmosphere on Ganymede. The Kavalur observations, together with similar ones made at Lembang, serve to show that the Ganymede atmosphere has a surface pressure greater than 10^{-3} millibar. The two occultation durations yield a diameter of the satellite of 5270 km and thus the mean density is 2.0 grams per cubic centimetre.

THE 230-CM TELESCOPE PROJECT

The Governing Council has authorized the Institute to include in its immediate development plans the proposal to fabricate and place in operation a 230-cm aperture telescope. The figuring of the mirrors will be at the new optics laboratory of the Institute commissioned at Bangalore during the year.

RADIO ASTRONOMY

Observations with high resolution on the time, frequency and polarization structure of solar decameter radio bursts have been continued. The east-west positional data obtained previously are being analysed. Preliminary results indicate that the positions of the two components in a double burst can sometimes be different by a few minutes of arc. The data are being scrutinized for possible instrumental errors, ionospheric refraction effects, etc., and it is hoped that positional information on at least one hundred double bursts will be available. The dynamic spectral data are also being analysed for time and frequency structure information on the newly discovered Type III-b radio bursts.

Analysis of the data obtained during June 1971 on the occultation of the radio source in the Crab Nebula by the solar corona is complete. These data were obtained with the interferometer with a 30-wavelength base line operating at a frequency of 25 MHz. During the occultation period, i.e. from 1971 June 10 to June 25, fringes due to the Crab Nebula were recorded on nine days free from the contamination due to solar radio bursts and terrestrial interference. From the relative fringe amplitudes the apparent increase in the angular diameter of the radio source is calculated for each day.

The construction of an antenna system operating at a wavelength of 6 m is complete. It consists of two broadside arrays on an E–W base line. The eastern array has 128 half wave dipoles spread in 16 E–W rows of 8 dipoles each. The western one has 16 E–W rows each with 6 dipoles. The separation between the two arrays is about 6 wavelengths. The design and construction of a multiplying type interferometric receiving system is also complete. It is found that with this instrument it is possible to obtain a signal to noise ratio of better than 3 for sources with flux densities of about 150 flux units. The interferometer is at present being used for studying the interplanetary scintillation of the small angular diameter component of the Crab Nebula radio source. The instrument will be used for studying the properties of the solar wind, using the technique of interplanetary scintillations of point sources such as 3C 273, 3C 161, etc.

SOLAR-TERRESTRIAL RELATIONSHIPS

Regular soundings of the ionosphere by the CRPL automatic ionospheric recorder type C–3 were continued at Kodaikanal. A SWF recording instrument at 6.2 MHz was operated during daylight hours in close co-ordination with the optical and radio flare patrol units at Kodaikanal. Two sets of La Cour and Watson variometers were operated for continuous registration of the three geomagnetic elements. These units collaborated with other geophysical research groups in India in several projects carried out during this period that pertain to the equatorial ionosphere.

Investigations during this period were mainly concentrated on analysis of some past data. Balakrishnan *et al.* completed the study of horizontal field variations in low latitude stations during the geomagnetic storm of 1970 March 8–10. From the records of a number of stations situated in the low latitude belt, periodicities and coherence of the oscillatory components of the storm-time fluctuations were completed. Joseph succeeded in computing solar fluxes during a flare using a semi-analytic method from information available from ionospheric data. Rastogi investigated the conditions of disappearance of equatorial-type sporadic E over Kodaikanal.

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