INDIAN INSTITUTE OF ASTROPHYSICS

(ANNUAL REPORT FOR THE YEAR 1974 APRIL 1 to 1975 MARCH 31)

SOLAR PHYSICS

A study on the brightness fluctuations due to the different sizes of structures in the solar atmosphere as seen in the Balmer lines has been completed by Sivaraman and Venkitachalam. The analysis aims at finding the dependence on the relative r.m.s.brightness fluctuations with heliocentric angle and for different wavelength positions within the line. Selected spectra of H_α, H_β, H_γ and H_δ obtained on occasions of good seeing at the Kodaikanal Solar Tower have been used for the study. The spectra of each line cover the positions μ =1.0; 0.8; 0.6; 0.4 and 0.3. The intensity fluctuations at different wavelength positions ($\pm\Delta\lambda$) within each line and similarly for each of the different positions of μ on the disc have been evaluated. A power spectrum analysis of the brightness variations can be grouped into three sizes 1200-6000 kms, 6000-15000 kms and 15000 to 35000 kms. The entire intensity data is then treated with a band pass filter with sine-truncation function and the contribution due to each of the three size groups to the observed brightness fluctuation, evaluated. Thus the r.m.s. intensity variations due to the three sizes of structures for the four Balmer lines are obtained as a function of $\Delta\lambda$ for each line and also of heliocentric angle. In all lines, the r.m.s.brightness variation increases from the smallest to the largest of the size groups with the chromospheric network showing the maximum spatial brightness variation.

A plot of the r.m.s. intensity fluctuation with the heliocentric angle shows in general two maxima with a dip around μ =0.6. Photospheric lines show, in general, a single maximum somewhere between μ=0.8 and μ =0.6. The D-lines of sodium also show a double maximum. It seems that the change in centre-limb aspect of this variation takes place in the low chromosphere. The plot of the r.m.s. brightness fluctuations (and hence the temperature fluctuations $\frac{\Delta T}{T}$) for the different values of $\Delta\lambda$ shows maximum contrast at $\Delta\lambda = \pm 0.6$Å for H_α, $\Delta\lambda = \pm 0.3$Å for H_β and at the line core for H_γ and H_δ.

Sivaraman and Venkitachalam have commenced a detailed study of the time evolution of the profiles of the bright points of dimension 1000-1500 km seen in the H and K lines, with a view to understand the mode of propagation and dissipation of mechanical energy in the chromosphere. The material for this study is an excellent time sequence centred on the H line obtained by Beckers with the Sacramento Peak Vacuum Telescope. Preliminary results based on the study of profiles of six bright points over a 25-minute duration are summarized herewith. The commencement of a disturbance at the lower levels can be seen as an impulse in the neighbouring FeI line in a location where there is no emission at H_{2V} or H_{2R}. The H_3 central intensity is high, possibly due to energy dissipation effects of an earlier impulse. After 48 seconds a brightening appears, first at H_1 and within 12-24 seconds that follow, the emission streak has already reached the H_2 level with H_{2V} showing enhanced intensity. By t=85 seconds both H_{2V} and H_{2R} show emission giving the familiar double peaked profile in the bright point. The H_{2R} emission is seldom seen when a dark condensation is observed in the H_3 core. At t=150 seconds, little remains of the H_{2V} emission streak that existed earlier; a dark streak prevails which also decreases in wavelength extent, finally disappearing within 100 seconds of formation. Six of the bright points studied have an average lifetime of 100 seconds with the dark streaks also having a similar duration of visibility.

A study is in progress by Raju aimed at finding line intensity ratios that are sensitive to temperatures and electron densities, especially in the chromosphere-corona transition region. Line intensities from the lower ions in the carbon, nitrogen and oxygen sequences seem capable of being such indicators and a detailed quantitative study assuming multi-level atom model is in progress.

Fine scans over supergranular dimensions with the magnetometer, along with simultaneous K intensity values, have been attempted on several occasions by Bhattacharyya, Saxena and Singh. These have been made in a search of very weak fields in the bright points of ionized calcium. Morphological studies of bright points and their association with the network as well as the dark condensations in K_3, as seen on calcium spectroheliograms, have been commenced by Bappu, Saxena and Singh.

The collection of basic solar data with the solar telescope has been continued. For the year ending

1975 March 31, white light photoheliograms were obtained on 312 days, H-alpha disc spectroheliograms on 282 days, K_{232} spectroheliograms on 273 days and K prominence pictures on 241 days. The spectroheliscope was used for 918 hours of observation and 17 flares were observed. Solar data have been sent each month to various agencies in India and also to the World Data Centres.

STELLAR PHYSICS

Spectra of five bright members of the Scorpio-Centaurus Association have been obtained by Rajamohan at high dispersion with an echelle spectrograph at the coude focus. These spectra have been utilised to derive helium abundances using the HeI lines 4009Å, 4026Å, 4143Å, 4388Å and 4471Å. UBV data and the observed H_γ line profile give θ_e and log g and the mean value of N_{He}/N_H for the five objects is 0.096, as derived from the equivalent widths. Available data in the literature, together with the values derived above, show that no discernible differences are noticed between the values obtained of the two main subgroups of the association; the Upper Centaurus-Lupus and the Upper Scorpius groupings. The observed line profiles of HeI 4026Å, 4388Å and 4471Å of the three sharp lined stars τ Sco, μ^2Sco and κ Cen fit well the theoretical non-LTE profiles, especially in the line core, where differences between LTE and non-LTE profiles are most pronounced.

Parthasarathy has analysed the two colour observations of UW Canis Majoris made earlier at Kodaikanal by Doss. The ratio of radii is 0.813 and in combination with the spectroscopic elements of the system derived by Struve and collaborators, the masses of the components are found to be $24M_{\odot}$ and $29M_{\odot}$ for the primary and secondary stars respectively.

Many other spectroscopic binaries are under study spectroscopically. Rajamohan has completed observations of HD 65041 at 47Å/mm. Parthasarathy has complete coverage of ϵ CrA, HD 2421 and HD 5638 and HU Tauri. The H_{α} observations of this last system obtained at 17Å/mm show cyclical variations of emission intensity. Parthasarathy has also monitored in the blue and at H_{α} the X-ray binaries X per, HD 77581, HD 206267 and HD 153919. Bappu, Nandy, Parthasarathy and Rajamohan have scanner observations of HD 77581 which show the reddening law derived from this star in the wavelength range 3300-6600Å to be essentially the same as the normal law observed in most other regions of the sky.

The equilibrium structure of a tidally distorted rotating gaseous mass with a magnetic field has been examined by Kochhar. Toroidal and poloidal fields affect the gas mass differently, if its shape is that of an ellipsoid. The toroidal field tends to decrease the orbital period of the binary, while the poloidal field tends to increase it. The component of the magnetic field normal to the orbit plane has a value less than the corresponding value for a single star and cannot exceed a critical value determined by the geometry of the configuration.

Bappu and Parthasarathy have continued the search for red objects in the direction of the Large Magellanic Cloud with the aid of ultra-low-dispersion spectra. Several additional fields were covered during the winter season. Many red stars and reddened early type stars have been picked out on very low dispersion spectra of regions in and around Carina OB1, Carina OB2 and Mon OB1.

Scaria has continued his study of isophotes of globular clusters using the Sabattier technique. Isophotes for about ten clusters derived from V photographs are now complete. Additional photographs in the B and infrared regions are being obtained for the brighter clusters.

INTERSTELLAR MEDIUM

Simple models of a reflection nebula in the form of a plane parallel slab containing smooth spherical solid particles in submicron size range have been considered by Shah. Single scattering has been assumed and the case of the star behind the nebula examined. The effects of varying the composition and size distribution function of the grains have been brought out in the calculations using Mie theory of scattering. The analytical part of the geometry of the problem has been treated quite rigorously and the resulting expression for nebular intensity presented in a new form.

A comparison of the theoretical results with the observations of the Merope nebula shows that dirty ice grains with index of refraction at 1.3-0.1i and size parameter $a = 0.5\mu$ give reasonable agreement with the colours. Simultaneously, the polarization in the visual and blue wavelength bands agree approximately upto offset angle of 6 minutes of arc. The larger offset angles pose an intriguing problem. The general trends of nebular colours and polarization with variation of real and imaginary parts of index of refraction and the size distribution parameter have been tabulated to serve as a guide for further study of reflection nebulae with the star in the rear. The thermal emission by circumstellar or nebular grains in modifying colours and polarization has not received attention hitherto. On the basis of observations available, a factor of this kind may play an important role in models of certain reflection nebulae. The difficulty encountered in matching observation and theory also indicates the need of use of bimodal or multivariable size distribution functions.

The problem of the reflection nebulae with star in rear is directly applicable to the calculation of intensity and polarization of x-ray halo associated with certain sources produced by interstellar grains. Shah and Manchanda are investigating this problem. Observations on polarization of x-rays scattered by interstellar grains are not available, but this lacuna will undoubtedly be rectified before long.

Shah has also commenced a study of the circular polarization produced by interstellar grains. Theoretical models with obliquely oriented homogeneous circular cylinders composed of the pure as well as dirty ices have been constructed. In a representative calculation Shah has demonstrated that ice grains can reproduce the interstellar circular polarization from the Crab Nebula within the present large limits of observational error.

Mallik has extended the scope of earlier models computed by him of weak D-type fronts to include the emission line structure in the fronts along with the temperature and velocity structures. The model fronts have been used to explain the forbidden line observations of singly ionized sulphur in the light of dynamical processes at the edges of gaseous nebulae. The models of ionization fronts provide a ready explanation for the inner H II regions being of lower excitation than the outer H II regions, without invoking abundance anomalies or peculiarities of radiation fields in the nuclei of galaxies. Details of the ionization of disk galaxies are presently being worked out in an attempt to match recent high resolution image tube spectra.

While most of the Ionization-Front models are of the weak D-type the detailed structure of strong D-type models remains to be worked out. Preliminary calculations by Mallik show that for a smooth transition from subsonic to supersonic flow the velocity of the gas should tend to the adiabatic sound velocity at the point where heating and cooling balance each other exactly. In other words the sonic point has to be located within the ionization structure although its exact position is not determinable.

Mallik and Venkatakrishnan have worked out a theoretical line profile programme to analyze available high resolution Fabry-Perot observations. This involves a deconvolution of the observed profile taking into account effects of thermal Doppler broadening, turbulence and systematic motion. Information on the spatial variation of turbulence inside a H II region and or radial motion thus becomes available; the procedure has been successfully applied to the H and [NII] line profiles in Orion and shows the turbulence to increase marginally from centre outward.

LOW FREQUENCY ANTENNA SYSTEM

An antenna system is under construction at Gauribidanur under Sastry's supervision which is designed to yield a circular beam of about one degree and a capability of detecting radio sources of flux densities above 30 Jy. The system is expected to detect brightness temperature variations of the order of 1000°K and will be used for the detection and study of H II regions in the galaxy.

QUASI-STELLAR OBJECTS

A collaborative study of Kapoor with Narlikar and Chitre has shown that gravitational synchrotron radiation emitted in the forward direction by charged particles moving in highly relativistic circular equatorial orbits of radii slightly in excess of 1.5 times the Schwarzschild radius of a highly collapsed mass situated at the centre, is strongly blue shifted when it reaches a distant detector. A ring shaped emitting region composed of such orbiting particles has a power law spectrum of the form as seen by a distant stationary observer. The astrophysical consequences of such a model have been mentioned briefly with reference to quasi-stellar objects, since the ν^{-1} spectral characteristic is common to many extragalactic radio sources and quasi-stellar sources.

Microspectra of 10000A/mm dispersion have been obtained of a few fields in the south galactic pole in a search for quasi-stellar objects. This survey is being extended to the blue objects of the Luyten star survey for the identification of QSOs.

SOLAR TERRESTRIAL RELATIONSHIPS

Geomagnetic Crochets (s.f.e.) observed at Kodaikanal during the period 1966-1971 have been studied in relation to Solar X-ray bursts (observed by NRL satellite-SOLARAD 9 in the bands 0.5 - 3Å, 1 - 8Å and 8-20Å) and microwave bursts in the frequency range 1000-17000 MHZ. It was inferred that large X-ray flux enhancements are necessary to produce s.f.e.'s compared to other SID's and this accounts for the relatively low frequency of occurrence of s.f.e.'s compared to other SID's SWF, SCNA, SPA, SEA and SES. The amplitude of s.f.e. is linearly correlated with the peak flux of X-ray burst in the 1-8Å and 8-20Å bands. The single frequency correlation of s.f.e.'s with solar microwave bursts is a flat maximum in the frequency range 2000-3750 MHz. S.f.e.'s are mostly associated with 'A' type burst spectra and show poor correlation with 'G', 'C' and 'M' type spectra (following AFCRL classification of microwave bursts). The above features of the association of s.f.e.'s with solar X-ray and microwave bursts differ from those of other SID's reported earlier. A comparative study of the characteristics of S.f.e.'s associated with Proton flares (PCA events) with those of normal flares showed the former are characterised by larger rise time and slower decay compared to the latter.

Using the Watson magnetogram data for the period Jan-Dec 1973 it was found that the occurrence of Pi2 micropulsations at Kodaikanal is a broad maximum around local mid-night. The dependence of the occurrence of Pi2 micropulsation on magnetic activity is of a composite nature in that the occurrence is positively correlated with K_p index in the range 0^+ to 2 and negatively correlated with K_p index in the range 2 to 5.

A qualitative explanation was proposed for the difference in the recovery nature of LF field strength in simple and complex SFA patterns observed on the Tashkent-Delhi path. The recovery nature is mainly governed by the range of heights over which the excess flare-induced ionization is produced. Following this argument, simple SFA patterns (TYPE II and IV) may be understood as due to extensive ionization at heights below 60 km (due to hardening of X-ray flux in the 1-20Å band) and above 75 km (due to X-ray flux enhancement 1-20Å band, without hardening of the spectrum) respectively, while the complex SFA patterns (TYPES I, Ia and III) are due to excess ionization in the height range 60-70 km. Thus the recovery in complex SFA patterns is controlled by the negative ion chemistry of the disturbed D-region and the relatively slow recovery nature of complex SFA patterns is due to the slow release of electrons from negative ions by photo detachment process.

A careful examination of normal run magnetograms data of Kodaikanal showed several instances during night time when there are conspicuous short-lived perturbations in geomagnetic elements. These perturbations were noticed to occur (75% of the cases) in concurrence with both solar X-ray flares and SID's in the sunlit hemisphere, lending support to the earlier observation of Ohshio (1964) that geomagnetic effects of solar flares do occur even in the dark hemisphere. A detailed study of these night time geomagnetic effects of solar flares (referred to as NTSFE) at Kodaikanal for the period 1969-1971 was made. It is noticed that the occurrence of NTSFE is a maximum around midnight and NTSFE starts after the beginning of solar X-ray flare (1-8Å) and the maximum of NTSFE usually occurs after the maximum of the solar X-ray flare. The time difference (usually lag) between NTSFE maximum and solar x-ray flare maximum varies over the wide range of 1-52 min and no definite trend is seen in the variation of this time lag with the time of occurrence of NTSFE. Further NTSFE's are characterised by longer rise time and slower decay compared to SFE's (day time effects) observed at Kodaikanal over the three year period mentioned. A more direct approach made later, consisting of a comparative study of the characteristics of NTSFE's at Kodaikanal in relation to the simultaneous SFE's at Huancayo over the same period of 1969-1971 confirmed this feature.

A detailed study was made of the various aspects of equatorial spread-F using the quarter-hourly ionogram data of Kodaikanal for the period 1964-1969. An interesting aspect of equatorial spread-F brought to light is the observation of several instances when spread-F condition suddenly disappears and subsequently reappears over a span of a couple of hours or even less, during a night. Detailed analysis of such events show that this feature of equatorial spread-F is not associated with systematic height changes of the layer as expected on the basis of the existing theories which invoke height as the controlling factor. There does not seem to be any threshold height for the irregularities responsible for the spread-F, below which they may not sustain. An investigation of the characteristics of the two basic forms of equatorial spread-F revealed that both range and frequency spread configurations at Kodaikanal show a positive correlation with solar activity and the monthly occurrence patterns of the same show significant correlation. In view of the controversy on the case of the two basic forms of equatorial spread-F and since the present study shows a close similarity in the statistical behaviour of both range and frequency spread configurations, a preliminary study was made of the transition from range to frequency spread for a number of nights. It was found that on many occasions, range spread gradually decays into frequency spread, lending support to the contention of King (1970) that frequency spread is a decay product of range spread. However on some occasions the transition from range to frequency spread was noticed to occur with a rather abrupt discontinuity in spread-F activity, indicating no association between the two. Definite conclusions on this aspect of equatorial spread-F await the completion of a detailed study that is in progress.

The effect of solar activity on the relative trends in the asymmetry of the noon 'bite-out' effect in foF2 (represented by the ratio P1/P2) at Kodaikanal during quiet and disturbed magnetic conditions was studied. It was found that around the period of moderate solar activity, the ratio P1/P2 is high during disturbed conditions compared to quiet conditions, while the behaviour is exactly opposite around the period of low solar activity. This feature defies even a qualitative understanding in terms of vertical drift and subsequent horizontal diffusion of ionization along field lines considered to be responsible for the afternoon peak in foF2 at equatorial latitudes.

The characteristics of night sporadic-E(E_s) at Kodaikanal have been studied using both ionogram and published ionospheric data. It is noticed that night sporadic-E on Kodaikanal ionograms usually manifests in two other configurations: blanketing type and multiple layered structure type, besides the well-known flat and low blanketing type. A consideration of the occurrence of night sporadic-E in relation to the variation of the horizontal component of the magnetic field showed that there is no threshold limit for the night time electrojet for the occurrence of night sporadic-E. These observations were discussed in the light of the relevant theoretical considerations for the origin of night sporadic-E. It was further observed that the blanketing frequency as well as the transparency range of night E_s is independent of solar activity, and the distribution of the virtual height of night E_s shows a distinct local time variation that is dependent upon solar activity. A comparison of these results with those of earlier workers supports the existing view that the characteristics of night sporadic-E exhibit a longitude dependence.

Field strength of LF transmissions from Madras on a frequency of 292 KHz is being recorded to monitor the solar flare effects (SFA), besides study the response of the equatorial lower ionosphere to other geophysical events. Faraday fading of beacon transmissions from the satellite-INTASAT on a frequency of 40.01 MHz is being recorded since the launching of the satellite, on 15 November 1974. The Faraday fading data will be used for the studies of latitudinal variation of total electron content, large scale ionospheric irregularities and scintillations.

INSTRUMENTATION

Optics for the two coude cameras of focal lengths 61cms and 285cms have been completed by Jayarajan. The former has a 30cm aperture glass corrector and has performed well in star field photography. The longer focus camera will function without a corrector. A Maksutov camera with a meniscus of aperture 70mm, for use in the cassegrain spectrograph, was also completed during the year.

The optics of a 130mm aperture cassegrain telescope have been completed and delivered to Space Applications Centre. The telescope is to be used in a multispectral scanner for airborne surveys of vegetation. Technical help has been given to the Aeronautical Development Establishment with regard to optical display systems in their projects related to flight simulation.

An analog system for recording rapid changes in intensity for use in lunar occultation observations has been designed and constructed in the electronics laboratory. Several other pieces of electronic control for use with the scanner and microphotometer have been fabricated by the same team. These include a new FET input pulse preamplifier, a sensitive discriminator and pulse shaper for pulse counting techniques in photoelectric photometry, a stable frequency generator and 500W power amplifier for the drive system of the 50cm reflector at Kodaikanal, an n-pulse generator for use with the spectrum scanner on the 102cm telescope at Kavalur, and precision timers for use in the laboratories and at the telescope.

THE 234CM TELESCOPE

A Zerodur glass-ceramic blank 236cm in diameter has been received from M/s JENAer GLASWERK SCHOTT and GEN., MAINZ, West Germany. The blank is stored at Kavalur pending completion of the Optics Laboratory at Bangalore. The blank was tested under polarized light and found to be quite homogeneous and free from strain.

On the recommendation of a Committee appointed by Chairman of the Governing Council consisting of Drs.S.R. Valluri, S.Ramaseshan, M.R.Srinivasan, M.K.V.Bappu, the firm of Tata-Dilworth, Secord, Meagher & Associates, Bombay have been appointed as Consulting Engineers for the project. Their first task is to prepare a project report which includes a study of costs and the extent to which fabrication in India is possible.

Meanwhile, keeping in view the basic scientific projects for which the 234cm telescope is being constructed, a site survey has been commenced during the year. Locations of promise south of latitude 20°N, have been examined. Two additional locations surveyed north of this latitude limit have been Pachmarhi (lat: 22.5°) and Mt.Abu (lat: 24.5°). Tests of "seeing" made at all sites examined for the purpose are on the system and scale in use at Kavalur in order to have a systematic basis of comparison. A site that holds some promise is Sakanagere in the Chickmagalur district of Karnataka. This is an isolated hill with an altitude of 1300 metres. A detailed comparison of extent of clear skies as well as "seeing" between Sakanagere and Kavalur will be made shortly.

OBSERVING CONDITIONS

The Solar Tower at Kodaikanal was used on 146 days during the year. A distribution over the months is listed below:-

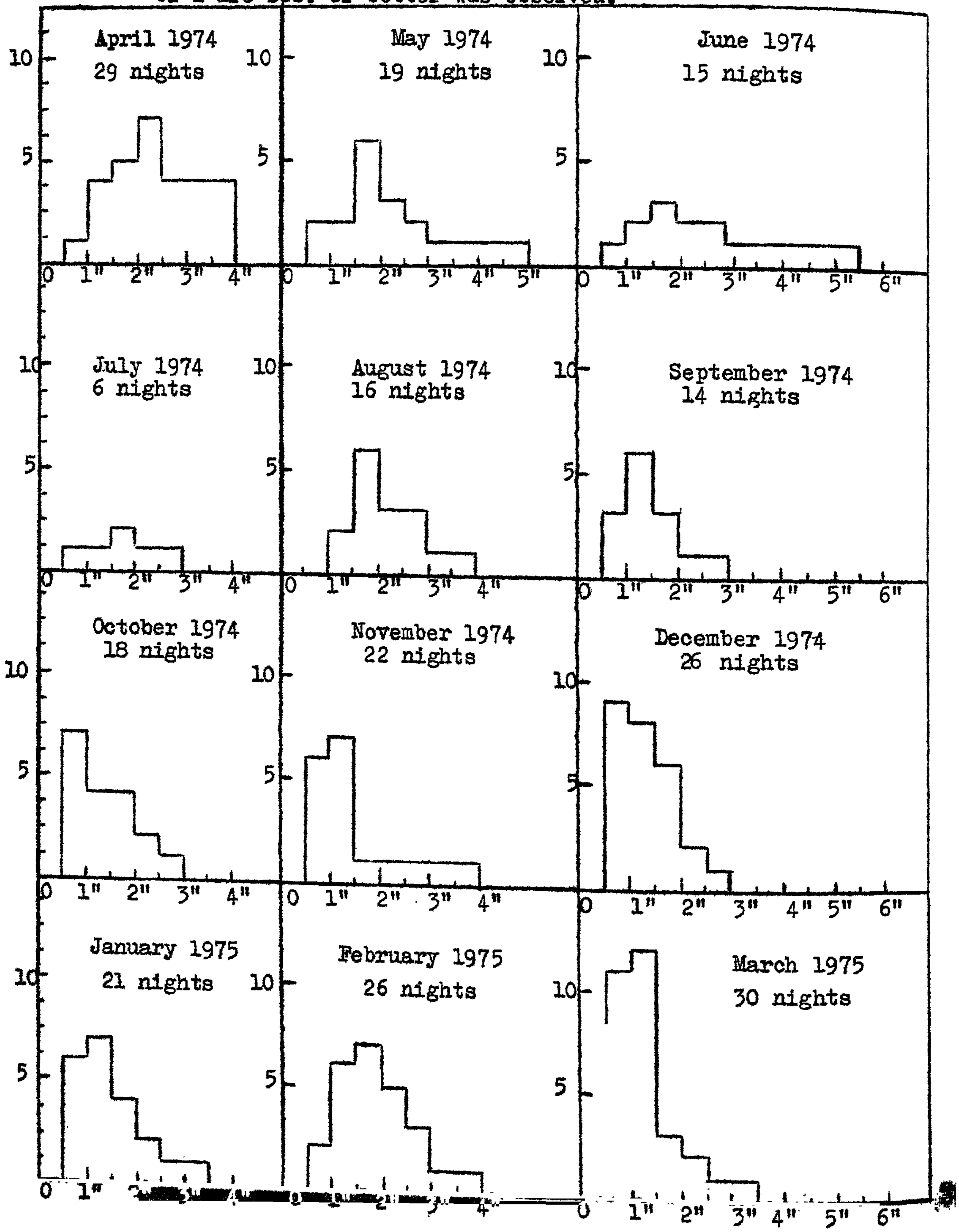
1974	April	2
	May	11
	June	2
	July	3
	August	10
	September	8
	October	16
	November	15
	December	19
1975	January	15
	February	23
	March	22
		146

Observing conditions were in general below average specially as far as "seeing" was concerned. There were eight days when the seeing was 1 arc second, forty six days of 2 arc seconds and seventeen days when it was found to be between 2 and 3 arc seconds.

Conditions at Kavalur for stellar research were good. There were 1736 hours of observing of which photometry could have been carried out for 877 hours or 50 percent of the time. On 148 of these nights spectroscopic work was carried out for a duration of 9 hours or greater. The table below shows the monthwise distribution of these features.

Month		Hours of Spectroscopic Work	Hours of possible Photometry	Number of nights when Spectroscopic work 9 hours or greater was done
1974	April	240	77	22
	May	123	41	10
	June	75	6	5
	July	23	8	1
	August	65	13	5
	September	46	10	3
	October	97	51	7
	November	170	107	16
	December	207	125	20
1975	January	207	108	18
	February	208	121	17
	March	275	210	24
		1736	877	148

Histograms of "seeing" at Kavalur during the year under review are shown below. On eightyone nights seeing of 1 arc sec. or better was observed.



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STAFF

Academic Staff in position during the year were as follows:

1. M.K.V.Bappu, Ph.D.	-	Director.
2. J.C.Bhattacharyya, D.Phil.	-	Associate Professor.
3. Ch.V.Sastry, Ph.D.	-	Reader.
4. K.R.Sivaraman, Ph.D.	-	Reader.
5. A.P.Jayarajan, M.A.	-	Reader.
6. G.A.Shah, Ph.D.	-	Reader.
7. P.K.Raju, Ph.D.	-	Reader.
8. D.C.V.Mallik, Ph.D.	-	Fellow.
9. Mahipal Singh, Ph.D.	-	Fellow.
10.J.Hanumath Sastri, Ph.D.	-	Fellow.
11.R.K.Kochhar, Ph.D.	-	Fellow.
12.K.C.Abdur Raheem, B.Sc.	-	Research Associate.
13.R.Rajamohan, M.Sc.	-	Research Associate.
14.M.Parthasarathy, M.Sc.	-	Research Associate.
15.K.K.Scaria, M.Sc.	-	Research Associate.
16.P.P.Venkitachalam, M.Sc.	-	Research Associate.
17.Jagdev Singh, M.Sc.	-	Research Associate.
18.R.C.Kapoor, M.Sc.	-	Research Associate.
19.A.K.Saxena, M.Sc.	-	Research Associate.
20.B.S.Murthy, M.Sc.	-	Research Associate.

The technical, administrative and non-technical maintenance staff numbered 113.

BUILDINGS & GROUNDS

An amount of Rs.8.7 lakhs has been deposited with the Central Public Works Department for the construction of the Optics Laboratory and Main Laboratory building at Koramangala.

The firelines at Kavalur and Kodaikanal have been kept in good condition. Several trees and shrubs have been planted. Lawns and other vegetation were maintained around the telescope domes to minimize ground heating. The work on the road within the Kavalur campus was completed during the year. The civil work on the well at Kavalur has been completed, thus ensuring an adequate supply of water needed by the Institute over the years to come.

COUNCIL MEETINGS

The Governing Council of the Institute met twice during the year, at Bangalore and New Delhi. The Finance Committee met once at New Delhi.

SCIENTIFIC MEETINGS

The Institute was host to the Second Annual Meeting of the Astronomical Society of India from March 12, 1975 to March 14, 1975. Seventyeight astronomers from all over India participated.

Drs.M.K.V.Bappu, J.C.Bhattacharyya, J.H.Sastri, and Mr.B.S.Murthy attended the symposium on "Earth's Near Space Environment" during February 18-21, 1975 at National Physical Laboratory, New Delhi.

Mr.K.G.Narayana attended the symposium on "Some aspects of Astrophysics", during August 19-24, 1974 at Physical Research Laboratory, Ahmedabad.

A Summer School for Science Talent Students was conducted during June-July 1974.

FINANCES

Statement of Expenditure for the year 1974-75.

Non-Plan

RECEIPTS

Opening Balance.	Rs.	80,169-18
Grants-in-aid received		
1st Instalment on 21-5-1974	Rs.	3,50,000-00
2nd Instalment on 3-9-1974	Rs.	5,70,000-00
3rd Instalment on 13-12-1974	Rs.	6,16,000-00
4th Instalment on 7-3-1975	Rs.	5,20,000-00
Institute Receipts	Rs.	36,967-06
Total.	Rs.	21,73,136-24
Expenditure until March 31, 1975.	Rs.	20,51,399-19

DETAILS OF EXPENDITURE

Sl.No.	Heads	Revised Estimate approved by Governing Council 9-12-1974. Rs.	Actual Expenditure Rs.
I.	Salaries, Allowances & Provident Fund Contribution.	10,51,943	9,88,308-75
II.	Rent, Rates, Taxes etc.	1,51,000	1,37,666-12
III.	Office Expenditure.	1,50,000	1,30,649-77
IV.	Travelling Allowance.	1,00,000	54,989-00
V.	Books and Publications.	1,20,000	1,30,770-68
VI.	Laboratory Expenditure.	4,52,966	4,39,239-25
VII.	Capital Expenditure.	2,00,000	1,48,289-62
VIII.	Interest bearing advance.	50,000	3,034-00
IX.	Non-interest bearing advance.	15,000	1,880-00
X.	Grant-in-aid for Recreation Club.	800	399-00
XI.	GPF Advance initially paid from Institute funds to be recovered from the Accountant General, Madras.	--	16,173-00
		22,91,709	20,51,399-19

Plan

RECEIPTS

Opening Balance.	Rs.	nil
Grants-in-aid received		
1st Instalment on 21-5-1974	Rs.	5,00,000-00
2nd Instalment on 3-9-1974	Rs.	5,72,000-00
3rd Instalment on 13-12-1974	Rs.	9,00,000-00
4th Instalment on 7-3-1975	Rs.	5,90,000-00
Total.	Rs.	25,62,000-00
Expenditure until March 31, 1975.	Rs.	25,59,000-00

DETAILS OF EXPENDITURE

Sl.No.	Heads	Revised Estimate Approved by Governing Council 9-12-1974. Rs.	Actual Expenditure. Rs.
I.	Salaries and Allowances.	50,000-00	6,472-80
II.	Operational Expenses.	2,50,000-00	2,20,995-33
III.	Capital Equipment.	18,30,000-00	14,62,590-87
IV.	Capital Works.	8,70,000-00	8,68,941-00
		30,00,000-00	25,59,000-00

LIBRARY

The number of books purchased during the year is 348. 107 journals were on the subscription list. Exchange of publications with other institutions was continued.

VISITING SCIENTISTS

Dr.K.Nandy of Royal Observatory, Edinburgh was at the Institute for a month as a Visiting Scientist.

Dr.S.M.Alladin of Osmania University, Hyderabad gave a series of lectures on "Galactic Astronomy" during the year.
