INDIAN INSTITUTE OF ASTROPHYSICS

Annual Report for the year ending March 31, 1979

SOLAR PHYSICS

The 4.3 m spectroheliograph at the solar tower telescope has been fitted with a beam splitter. The two monochromatic images of the sun obtained simultaneously in the wing of the line FeI 6303Å — one in right hand circularly polarized light and the other in left hand circularly polarized light — are used to drive a magnetogram by the photographic subtraction technique. It is planned to obtain magnetogram sequences of active regions to study magnetic field changes leading to the stimulation of flares and post-flare configurations during the Solar Maximum year.

Sivaraman and Jagdev Singh have obtained spectra of bipolar spots at the solar tower telescope to study the Evershed flow pattern in such spots. Jagdev Singh has continued to obtain K-line spectra in integrated sunlight.

Gokhale and Sivaraman introduced $\int$ Adt as a measure of the magnetic flux reconnected through a quiescent prominence. Here, A is the instantaneous area of the chromospheric filament at the base of the prominence corrected for foreshortening and the integral extends over the life of the prominence. From the Kodaikanal spectroheliogroms in H-alpha they have determined the values of the yearly sums $\int$ Adt for quiescent prominences which occurred outside active regions during the years 1941–43, 1945 and 1946 after applying corrections for the days of misssing data etc. From these measures they show that reconnections through quiescent prominences outside the active regions might account for the removal of almost entire amount of magnetic flux emerging in active regions during on 11-y cycle of activity. The investigation is now being extended to other 11-year periods, particularly to the recent periods during which magnetogram data are available for comparison.

The total magnetic flux brought out to the photospheric layers from below and their variation from cycle to cycle is an important parameter needed for any theoretical formulation of the process of creation of magnetic fields in the solar interior and their transport to the photospheric layers with reference to the timescale of the solar cycle. Sivaraman and Gokhale find that the summation of the maximum values in the areas attained by each spot group extending over all the spots that appear during a cycle is a more realistic index of the magnetic flux brought out in each cycle than the daily sunspot numbers or the daily sunspot areas. This index is particularly useful as it makes possible the estimation of the flux reaching the surface for cycles prior to 1965 for which disc

magnetograms do not exist in the literature. This index is being computed from 1874 onwards from the Greenwich photoheliographic results.

The presence of two distinct components in the 11-y cycle of solar activity is an important observational constraint on the phenomenological models of the solar magnetic cycle. Ghokale finds that the two components and their important qualitative features follow automatically from the two "families" of magnetic flux tubes with different topological configurations present in his model of the 11–y solar magnetic cycle.

Hasan has examined the MHD stability of pre–flare loops in detail with the aim of finding out whether a stable configuration is possible for a loop in which adequate energy can be stored prior to a flare. From the stability analysis he has found that a structure in which the magnetic field has a constant pitch and is force–free, is always kink unstable for any degree of twist. However, a slight deviation from the force–free configuration, through the presence of a small positive radial pressure gradient, can stabilize the loop for moderate degrees of twist. Hasan has computed the range of wave numbers corresponding to the instability and the maximum growth rates, and finds that the pressure gradients required to stabilize the pre–flare loop do not conflict with observations.

Hasan and Venkatakrishnan have commenced a study of the time dependent flow of plasma in magnetic flux sheath, collapsing normal to itself, with a view to develop a model for spicules based on this mechanism. According to them, the spicular matter is driven upwards against gravity by forces arising from gradients in gas pressure along the magnetic field as well as the squeezing action when the field lines are brought close together by the transverse flow. Once the upward moving matter acquires a sonic velocity, it is accelerated to much higher velocities (Mach 2) by a flow through a de Laval nozzle, created by a shear in the transverse flow.

Venkatakrishnan has continued the study of the stability of polytropic fluid layers with a quasi–adiabatic approximation. The gradients in the mean molecular weight of the gas are seen to produce only a second order effect, which could possibly become significant under fully non–adiabatic conditions. He plans to examine a composite two–layer model of a convection zone consisting of a slightly superadiabatic layer underlying a highly superadiabatic one, which can impart an over stable acoustic spectrum to the composite layer as a whole.

Raju in collaboration with B. N. Dwivedi of Banaras Hindu University completed the investigation of electron density dependence of solar emission lines from the carbonlike ions, NeV, MgVII, SiIX and SXI which are representative of the chromosphere–corona transition region and the corona. The emission lines considered in this study pertain to the various transitions between the first fifteen levels of these ions. The first five levels constitute the ground term and the transitions between the ground levels give rise to forbidden lines. Intensity ratios for different lines were calculated based on Elzner's spherically symmetric model of the quiet sun. These are found to be sensitive to electron density variation and yield reasonable values of electron density for the various emission regions. Recent observations of active regions show forbidden and inter–system lines belonging to carbon–like ions and their intensity ratios can particularly be useful for density determination of active regions. Computed absolute fluxes from the entire solar disc at earth's distance for various strong and weak lines are in reasonable agreement with the observations.

PHYSICS OF THE SOLAR SYSTEM

Bhattacharyya, Bappu and Mohin in collaboration with Mahra and Gupta of the U. P. State Observatory have completed a detailed analysis of the records obtained at Kavalur and Nainital on March 10, 1977, to bring out a more detailed picture of the ring system of Uranus. Both records indicate the presence of a complex structure of distribution of occulting materials surrounding the planet. The results confirm the existence of a very shallow broad ring system with local condensation lanes of norrow and intermediate widths. A system of numerous thin rings are also present around the planet in the equatorial plane.

STELLAR PHYSICS

The programme of photoelectric recording of selected lunar occultations was continued by Bhattacharyya and collaborators at the 102-cm reflector. Out of about 38 selected events, good records for 9 were obtained for this period.

Kameswara Rao observed both photoelectrically and spectroscpically the star BD–18° 1967, which lies at the centre of the nebula VV 1–7. Differential photometry of this star (spectral class AO–AIV or AOIV) with reference to BD–10° 1965 for the period April 1978 to April 1979 shows a recovery in light from minimum on two successive nights in

April 1978. Rao has observed the change in differential magnitude of 0.11 in the course of two hours on April 14, and of 0.22 magnitude on the following night. The photometric observations on several nights in the period January-April 1979 show a constant enhanced brightness. Rao finds a radial velocity of $-3 + 10$ km s^{-1} from two spectrograms of 70Å/mm dispersion obtained in March. Comparing this with the value of radial velocity of $+73.4 + 7.1$ km s^{-1} obtained by Kohoutek, Rao is of the opinion that the star may be a binary. He has plans to observe this object to confirm the preliminary findings. Rao continued to obtain spectrograms at H-alpha with the Varo image tube for weak G-band stars to obtain the absolute magnitudes from H-alpha line widths. Investigations of the board-line spectrum and the neutral helium line intensities in the spectrum of R CrB at minimum light were continued.

Parthasarathy using thirty spectra of HU Tauri obtained in the blue and H-alpha region in 1974 with the 102-cm Kavalur reflector and Cassegrain spectrograph has studied the radial velocity variation of the primary component. He has combined these observations with the blue and yellow light curves obtained earlier by him and Sarma with the 38-cm refractor of the Nizamiah Observatory, to drive the absolute dimensions of the components of HU Tauri. The primary component is a B_9 V star with a mass of 4.3 $M\odot$ and radius of 2.7 $R\odot$. The secondary component has a mass of 1.2 $M\odot$ and radius of 3.4 $R\odot$, and has filled the Roche lobe and is loosing mass. He finds that the system of HU Tauri is a typical Algol system.

The H-alpha line in the spectra of HU Tauri shows variations similar in character to that found in U Cep and U CrB. Several spectra of HU Tauri show the doubling of H-alpha line. This is interpreted by Parthasarathy as either due to the H-alpha absorption line of the secondary or due to the sharp emission feature of the gaseous stream falling on the red edge of the H-alpha line thus creating an impression of an absorption component agree with the expected radial velocity amplitude of the secondary component. A single spectrogram obtained on January 3, 1974 shows a violet-shifted broad emission feature. The peak velocity of the emission feature is found to be -600 km s^{-1}. This large negative velocity indicates that either the material is being ejected from the system at a high velocity or the B9V component possesses a transient disk which is expanding.

Bappu and Scaria have used isophotes of stellar images obtained on high contrast photographic films for the determination of magnitudes

This method is found to be accurate and linear over a magnitude range of 6 to 7 magnitudes. Scaria has in progress the analysis of the photo-electric observations using the pulse counting technique, in UBVRI colours on the globular cluster Ω Cen along the major and minor axis. Preliminary results show large radial inhomogeneities and colour variations on the cluster.

Rajamohan and Venkatakrishnan, have used the ratio of timescales of synchronisation to main sequence life-times as a parameter, to evaluate the effect of the companion on the primary, of close binary systems, for which rotation data are available. A plot of the ratio of the orbital to the rotation period against this parameter shows that most of the systems with synchronisation timescales less than their main sequence life time are synchronous. Among those systems with synchronisation time scales larger than main sequence life times, a few were found to be non-synchronous; However, the rest were found to be synchronous and a majority of this class are Am stars.

Pati and Rajamohan have continued the study of the possible origin of peculiar early-type stars. A detailed study of the upper Scorpius region indicates that the early type peculiar stars could have resulted from the interaction between supernova ejecta and close lying dense interstellar clouds. The young stars in this region would have to accrete the heavy-element-rich material in sufficient quantities to exhibit the peculiarity. They have commenced a detailed study of the kinematics of the peculiar stars in upper Scorpius, with determination of the absolute magnitudes by H-gamma photometry.

Babu and Bappu have commenced a survey of young galactic clusters containing stars of spectral type B3 or earlier using objective grating techniques. A search for these faint clusters is made in an effort to trace the spiral structure of our galaxy at large distances. Subsequent studies of selected clusters will involve radial velocity determination and colour magnitude array determination by photoelectric techniques.

Peraiah has studied the partial frequency redistribution extensively in a medium expanding radially outwards in the observer's frame of reference. He has examined the dipole scattering with angle dependent R_I redistribution function and a non-LTE two level atom model. These results are compared with those calculated by using a Doppler profile and angle dependant R_I function with isotropic scattering. The differences are quite large among the results of various cases of scattering functions.

When the velocity at the outer-most layer of the medium exceeds 2 or 3 mean thermal units, P Cygni type profiles are obtained. This effect is prominently displayed in the spherically symmetric approximation than in the plane parallel approximation. Dipole scattering seems to give smaller emergent fluxes than those by isotropic scattering. He finds that for a given velocity distribution, as the geometrical extension increases, the emission also increases, whereas when the velocity increases for a constant geometrical extension the emission does not increase proportionately. This gives the lines calculated in the rest frame of the star. This procedure has several disadvantages in that, high velocities cannot be taken into account and further the frequency and angle grid has to be made very fine leading to a large number of frequency and angle points. This can be handled only by huge machines with large capacities. However, observations reveal that the matter in the atmospheres of some stars is flowing outwards with speed as large as 100 mean thermal units. This type of matter moving with such high velocities cannot be treated in the star's rest frame, but however can be solved by considering the line transfer in the co-moving frame of the gas. Here the observer moves with the gas and does not notice the Doppler shift in the line due to the motion of the gas. However, the observer counts the number of photons in terms of the source function and this can be easily translated into the rest frame of the star. In this method large velocities can be treated easily without employing large grids of frequencies and angles. Co-moving calculations have been sucessfully completed taking into consideration the complete redistribution with Doppler Voigt and Lorentz profiles and the angle averaged partial redistribution function R_1 with isotropic scattering upto a velocity of the gas equal to 100 mean thermal units. The method is considerably simpler than that adopted by Hummer and Mihalas. It requires the calculation of a single band matrix which contains the frequency derivative. As it need be calculated only once, the increase in the time requirements on the computer over the usual line calculation is neglegible. However, the transformation of co-moving frame radiation field to observer's radiation field requires about 3-6% of the time required for the line radiation field depending upon the velocity range and optical thickness of the medium. In the case of partial frequency redistribution the extra time could be as much as 20%.

Peraiah has made a fresh attempt to solve the line transfer in co-moving frame with high velocities and the statistical equilibrium for a non-LTE two level atom simultaneously. The iteration converged within 3-4 cycles. He finds that the occupation numbers of the two levels are strongly dependant on the type of velocity distribution of the gas. Even

when the upper level is totally depopulated at the bottom of the atmosphere where the velocity is set equal to zero, it will have an equa population at the top of the atmosphere which is moving with a velocity of 50 or 60 mean thermal units. Here only a Doppler profile has been used and further work is in progress.

INTERSTELLAR MEDIEM

Shah in collaboration with Krishnaswamy of the Tata Institute of Fundamental Research, Bombay has extended the models of the reflection nebula in the form of homogeneous plane-parallel slab to include single scattering silicate and graphite grains taken one species at a time. The wavelength dependent indices of refraction of these materials have been used throughout. The colour differences between the star and the nubela as well as the polarization of the nebular light in the far ultraviolet wavelength range have been calculated. The results have been compared with the recent ANS satellite obsrevations of the far-ultraviolet surface brightness of the Merope reflection nebula. It has been concluded that the ice and silicate grains are likely to be important constituents of the interstellar grains in the Merope reflection nebulosity.

Mallik reanalysing Lasker's work has calculated the energy input into the interstellar medium by ionization limited HII regions using Mihalas non-LTE model atmospheres and the recent calibration of spectral type and absolute magnitude of the O-stars. He finds that the ionization limited HII regions are ineffective in accelerating the clouds to their observed velocities and that the kinetic energy input falls short by more than an order of magnitude to explain the velocities which are of the order of 10 km s^{-1}.

GALAXIES

Prabhu has investigated the central regions of Sersic-Pastoriza (S-P) galaxies using high resolution direct and filter photographs and low despersion spectra. With the aid of direct photographs of fifty galaxies supplemented by published as well as new spectroscopic evidence, he has evolved a classification to single out different evolutionary stages of the formations, beginning with the transient burst of star formation. Quasi-independent formations of different sizes have been indentified in the central regions of S-P galaxies. Most of the galaxies have been seen to contain two bright components—a nuclear component and a perinuclear component; the former being redder than the latter. Prabhu has

determined the light distribution for the majority of the galaxies examined. He has also evolved a method to estimate the velocity field in the 'hot-spot' subgroup of S–P galaxies using one or preferably two slitless spectra in an emission line and a direct photograph in the light of the same emission line.

The programme of detection of red stars in the Large Magellanic Cloud by the technique of microspectra has been continued and several fields photographed during the winter months.

Mallik has been working on a model of chemical evolution of our Galaxy. The intrinsic physics input into this model comes from the recent stellar evolution calculations of Iben and Truran for low and intermediate mass stars and of Arnett for the massive ones. The extrinsic physics depends upon the initial mass function, the flow of gas both radial and from outside into the plane of the Galaxy and on the presently observed distribution of stars and gas in the plane. Since all these factors are uncertain and the choice of each of these is open to question, Mallik has been trying to limit the scope of these choices by comparing models with the observed abundance distributions etc.

HIGH ENERGY ASTROPHYSICS

Das has continued with his work on associated objects showing anomalous redshifts. He has obtained numerical solutions of the equations of motion according to the conformal gravitation theory of Hoyle and Narlikar and is working out an observational interpretation based on the same.

The subject of white holes remains largely unexplored and only the idealizations of a white hole explosion have been studied to some extent. White hole explosions would in general be anisotropic, may take place in a tenuous medium and the expansion may quite likely be nonhomogeneous. Kapoor has hypothosized the ejection of matter (particles/blobs of gas) from a white hole and has studied the problem of its visibility while still inside the Schwarzschild barrier. He finds that photons, radial as well as nonradial, emitted by a mass ejected from the white whole surface can leak through the barrier and be received by detectors far away. The frequency blue shifts are more severe compared to those in the radial/ non-radial photons from the white hole surface itself. When an ejection is not violent or the ejectum carries an insignificant fraction of the white

hole mass, its emergence from the white hole would appear as a flare phenomenon. For larger etjecta masses, the white hole may quite likely appear as a multicomponent object with components showing different frequency shifts and separating from each other at enormous speeds. Using a simple geometry, the separation speeds can be shown to be superluminal too, if energy of an ejectum per unit rest mass as measured at infinity $\gamma \gtrsim 1$. In the case of mass ejection from a white hole in the phase of expansion, this condition is easily met. This leads to the possibility of describing the superluminal separation of component seen in a number of radio sources by invoking white holes.

RADIO ASTRONOMY

Vinod Krishan has investigated the problem of interaction of a high intensity and low frequency electromagnetic beam with a plasma. The objective of this work is to study the particle motion in the presence of such intense fields which forbid the use of the usual perturbation procedures and look for the collective competence of these particles in radio emission. Such a collective mechanism which may be comparable to the multiphoton excitation process seems to furnish a fairly good estimate of the energy content of extragalactic radio sources.

Vinod Krishan has also suggested a possible mechanism for the direct generation of electromagnetic modes of frequencies near the electron plasma frequency. She finds the spatial variation of the interplanetary magnetic field play an essential role for the excitation of the type III radio bursts. The values of the frequency drift rate and the rise time of the bursts compare well with the observations.

The decameter wave Radio Telescope at Gauribidanur, set up in collaboration with Raman Research Institute has been provided with diode phase shifters in the NS array enabling it to point the beam instantaneously to any declination in the range $-30°$ to $+60°$. A software technique has been provided for the elimination of phase errors in the data collected by the telescope.

The telescope is being used for mapping selected regions of the galaxy like the Cygnus loop, Monoceros Nebula etc. and also ionized hydrogen regions. Daily scans of the sun are obtained to determine the angular extent of the quiet sun and also to detect the variations due to the slowly varying component. Radio bursts are recorded with high time and frequency resolutions of the order of 10 milliseconds and 50 KHz

respectively to study the frequency structure of weak solar radio bursts.

SOLAR TERRESTRIAL RELATIONSHIPS

Vinod Krishan has extended the previous work on the excitation of radio frequency emissions near $(n+\frac{1}{2})\omega_e$ (n is an integer and ω_e is the electron cyclotron frequency) in the earth's magnetosphere to include the nonlinear effects, which enable the calculation of amplitudes of various modes. The dominance of 3/2 mode is seen. This may be the source of the observed 3/2 emissions at auroral latitudes.

Sastri *et al* have inferred the absence of any particular threshold height for the bottom of the F-region at the time of the postsunset onset of equatorial spread-F, from a study of Kodaikanal ionogram date pertaining to low sunspot activity conditions. This feature which is essentially similar to the one noticed earlier for high sunspot activity conditions revealed that the postsunset onset of equatorial spread-F does not unequelly depend on the F-region height.

Sastri has conducted case studies of nights with a sudden upostmid nights onset of spread-F on Kodaikanal ionograms. He finds that the sudden postmidnight onset of spread F is closely associated, quite consistently, with a significant increase in F-region height, the onset occuring either before or after the time of reversal of the vertical uplift. There is no particular threshold height for the sudden postmidnight onset of spread-F as it occurred, on individual occasions, at heights ranging from 270 to 500 Km. Sastri has made a further study of this new and interesting aspect of equatorial spread-F to gain some insight into the physical mechanisms involved. The results suggest that the sudden presunrise onset of equatorial spread-F could not be due to 'Travelling Ionospheric Disturbances' (TID's) of polar origin but due to anomalous night time reversals in F-region vertical drift (reversals in the E-region eastwest electric field) in the equatorial region. Sastri and Sasidharan have found from a study of the mean diurnal variation of foF2 at Kodaikanal on normal quiet days and days with CEJ that the prominent evening peak in the diurnal variation of foF2 at equatorial latitudes during low sunspot activity conditions is not entirely due to the frequent occurance of afternoon counter-electrojet (CEJ) events.

The effect of geomagnetic activity on the occurrence of the two basic forms of equatorial spread-F i.e., range and frequency types, has been

examined using ionogram data of Kodaikanal for the period 1957-1963. The correlogram analysis shows that the occurrence of both range and frequency types of spread-F bears a significant negative correlation with geomagnetic activity, but only during periods of high sunspot activity.

Sastri has also studied the influence of the interplanetary magnetic field (IMF) on the characteristics of equatorial geomagnetic bays using Kodaikanal magnetogram data. He finds that not only the nocturnal and seasonal occurrence but also the relationship between the amplitude and rise time of equatorial geomagnetic bays show a significant dependence on the polarity of the interplanetary magnetic field.

A detailed study of the seasonal and sunspot cycle variations in the nocturnal occurrence of range and frequency type of spread-F configurations at Kodaikanal, using ionogram data for the period 1957-63 is complete. The results not only confirm some of the important findings of the earlier analysis by the Kodaikanal group but also brings to light some new features. The prominent premidnight peak in the occurrence of range spread-F gets shifted to the postmidnight period during local summer months of low sunspot activity revealing thereby that the postmidnight peak in spread-F activity in summer months of low sunspot activity reported earlier by several workers is representative of the range type of spread-F. Also there is a significant correlation in the occurrence patterns of range and frequency types of spread-F which suggests that the origin of these two basic forms of spread-F on equatorial ionograms cannot be due to entirely unrelated causative mechanisms. These and other results of the study are discussed in the light of the recent theoretical work on equatorial spread-F.

Sastri and Murthy, in collaboration with Prof. Rastogi's group at PRL, have examined in detail the nature of ionospheric scintillations associated with the various characteristic feature of equatorial ionosphere, using ionogram data at Kodaikanal and amplitude recordings of ATS-6 transmissions (40, 140 and 360 MHz) at Ootacamund. They find that intense day-time scintillations occur in association with various types of spradic-E other than Esq. Scintillations are found to occur during night Es conditions also. Further, while the occurrence range type of spread-F is noticed to be associated with strong scintillations on all frequencies, that of the frequency type of spread-F is associated with only weak scintillations and that too only on 40 MHz transmissions.

A study has been made of the ionospheric storm of 4–6 Dec. 1958 in the Indian sector using published data from ten ionospheric stations distributed from high latitudes to the dip equator. This ionospheric storm is characterised by not only the well known positive effect in foF2 due to a weakening of the electrojet, but also negative effect in foF2 which occurred in association with a prominent increase in F2-layer height during day time. The study suggests that changes in atmospheric neutral composition (i.e. enhanced N_2/Q and O_2/O ratios) are the primary cause of the negative effect in foF2 at equatorial latitudes noticed for this ionospheric storm.

Murthy has studied the response of the equatorial geomagnetic field to passage of Interplanetary magnetic field (IMF) sector boundary using the Kodaikanal magnetograms during the period 1962–1972. A distinct seasonal variation has been noticed in the range of daily variation of the equatorial geomagnetic field due to the passage of IMF sector boundary of positive to negative polarity. The range of mean daily variation shows a significant increase following the passage of sector boundary only during Winter and Summer but not during Equinox. No such difference in the response of the range of mean daily variation with respect to season has been noticed during the passage of sector boundary from negative to positive polarity.

The response of the equatorial geomagnetic field in the vicinity of over 170 spacecraft observed and well established IMF sector boundaries during the period 1962–1972 has been studied by Murthy. He finds from superposed epoch analysis of the daily range of equatorial magnetic field at Kodaikanal in a time interval from 10 days before to 10 days after sector boundary crossings that the significant aspect of the association is not mainly the increase in the daily range following the boundary crossing, but also the minimum of the daily range before crossing. A distinct difference is noticed in the response of the range of daily variation with respect to the type of boundary passage, namely a transition from positive to negative polarity and negative to positive polarity. Murthy has determined the characteristics of Travelling ionospheric disturbances (TID's) in the lower F region using a few phase path records taken at Waltair (17°48'N, 83°18'E) from an altitude of around 170 km. and on a frequency of 5.6 MHz. The time period has been found to be in the range of 4 to 8 minutes and the vertical amplitude in the range of 2–4.

INSTRUMENTATION

Several new developments in the field of detection and registration of astronomical information were achieved during this period. Chandramohan completed an automatic system incorporating a teleprinter machine for logging time and photometer readings at precisely controlled rates. A similar system incorporating a faster matrix printer was developed by Sadasivam and is awaiting final refinements before field trial. Sundareswaran has made good progress in developing an imaging system with a CCD detector array. For extension of our activities in the near infra-red region, a photometer incorporating a liquid nitrogen cooled PbS detector was finalised by Muraleedharan.

Viswanath completed a system for direct computation of intensities from photographic spectrograms utilizing a microcomputer system. Venugopal completed a fast photoelectric system with facilities for direct digitizing and storing photometric data. Chinnappan developed several software modifications for the on-line computer system with the 40-inch telescope at Kavalur.

Shylaja developed a digital system for direct display of telescope pointing and other parametric data ; her design of the system is for the 30-inch telescope built in our laboratories and which is under installation at Kavalur. A new arrangement for precise speed control of small telescopes was finalised by Ramamurthy.

A folded Bouwer-type spectrograph camera for use with an image tube has been completed in the optics laboratory. An all-reflecting system for dividing and reorienting the circular slit image of the solar corona during the eclipse has been made. Saxena has developed a new quantitative test using the Babinet compensator for the evaluation of surface figures of concave aspheric surfaces of mirrors during their fabrication. He has also finalised a computer programme to obtain the thickness of thin films from experimental data of the ellipsometer based on measurement of Stokes parameters.

OBSERVING CONDITIONS AT KAVALUR

There were 1490 hours of observing at Kavalur. Photometry could have been done on 608 hours. On 89 nights spectroscopic work was carried out for a duration of 9 hours or greater. Average seeing better than 1.5 seconds of arc was available on 74 nights. The table below shows the monthwise distribution of these features.

Month	Hours of Spectro-scopic work	Hours of possible photometry	Number of nights when spectroscopic work 9 hours or greater was done	Number of nights with average seeing better than 1.5″
1978 Apr	199.5	69	16	11
May	165	50	7	5
June	28	0	1	0
July	17	2	0	3
Aug	33	1	0	1
Sep	52.5	12	0	0
Oct	47.5	33	7	8
Nov	224	139	20	18
Dec	60	14	2	0
1979 Jan	275.5	138	21	6
Feb	140.5	62	4	11
Mar	248	88	11	11
Total	1490.5	608	89	74

THE 234 CM TELESCOPE PROJECT

The tower and dome for the 234 cm Telescope have progressed well. Work on the tower is now complete and the installation of the dome at site has commenced. The fabrication of the main ring girders and wheel bogies has progressed satisfactorily at the contractor's works at Bombay. The mirror grinding machine for the primary mirror has been successfully tested in the works of the contractor at Ahmedabad and has been shipped to Bangalore. Steps have been taken to install the stand-by Diesel Generator set in the new power house building while the HT Transformers have been received at site. Work on the 2.8 meter aluminising tank has progressed well at the Bhabha Atomic Research Centre. The design of telescope mount has been completed and tenders have been invited for its fabrication, installation and commissioning. The design of the drive and control system is in progress and certain essential components to be imported have been acquired.

LIBRARY

During the year 1978–79, 324 books and 93 reports were added to the Library. The library subscribed to 130 journals and continued to receive publications from other institutions on an exchange basis.

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Sastri, J. H.	Ionospheric storm of 4-6 December 1958 in the Indian sector. J. of Geomag. and Geoelect. (Communicated)
Sastri, J. H. Sasidharan, K.	Diurnal variation of F2 at equatorial latitudes and counter electrojet — Current Science, 47, 714.
Sastri, J. H. Sasidharan, K. Subrahmayam, V. Srirama Rao, M.	Equatorial spread-F configurations and geomagnetic activity. IJRSP. 7, 314.
Sastri, J. H. Sasidharan, K. Subrahmanyam, V. Srirama Rao, M.	Range and frequency spread-F at Kodaikanal.—Ann. Geophys. (in press).
Sastry, Ch. V., Shivgonkar, R. K. Jones, B. B.	A feeder system which minimizes mutual interaction between elements in a large array.—IEEE Trans. Antenna Propag. (in press).
Saxena, A. K.	A qualitative test for concave aspheric surfaces using Bauinet Compensator—Appl. Opt. (in press)
Sethia, G., Chandra, H, Rastogi, R. G. Murthy, B. S. Shah, G. A. Krishna Swami, K. S.	Daily variation of total electron content near magnetic equator—Current Science, 48, 377.
Sivaraman, K. R. Babu, G. S. D. Bappu, M. K. V. Parthasarathy, M.	Emission band and continuum photometry of Comet West (1975n) I. Heliocentric dependence of the flux in the emission bands and the continuum.—Mon. Not. of R.astr. (in press),
Venkatakrishnan, P.	Frequency response of magnetic flux sheaths—Sol. Phys (in press)

STAFF

Academic Staff in position during the year were as follows :

M. K. V. Bappu, Ph. D.	— Director
J. C. Bhattacharyya, D. Phil.	— Associate Professor
M. H. Gokhale, Ph. D.	— Reader
A. P. Jayarajan, M. A.	— Reader
A. Peraiah, D. Phil.	— Reader
P. K. Raju, Ph. D.	— Reader
Ch. V. Sastry Ph. D.	— Reader
J. Hanumath Sastry, Ph. D.	— Reader
G. A. Shah, Ph. D.	— Reader
K. R. Sivaraman, Ph. D.	— Reader
P. K. Das, Ph. D.	— Fellow
S. Sirajul Hasan, Ph. D.	— Fellow
R. C. Kapoor, M. Sc.	— Fellow
R. K. Kochhar. Ph. D.	— Fellow
Vinod Krishan, Ph. D.	— Fellow
D. C. V. Mallik, Ph. D.	— Fellow
B. S. Murthy, Ph. D.	— Fellow
M. Parthasarathy, M. Sc.	— Fellow
R. Rajamohan, Ph. D.	— Fellow
N. Kameswara Rao Ph. D.	— Fellow
M. Singh, D. Phil.	— Fellow
G. S. D. Babu, M. Sc.	— Research Associate
R. Chandramohan, M. Sc.	— Research Associate
A. K. Pati, M. Sc.	— Research Associate
T. P. Prabhu, M. Sc.	— Research Associate
K. C. A. Raheem, B. Sc.	— Research Associate
A. K. Saxena, Ph. D.	— Research Associate
K. K. Scaria, M. Sc.	— Research Associate
Jagdev Singh, M. Sc.	— Research Associate
K. R. Subramanian, M. Sc.	— Research Associate
A. Sundareswaran, B. E.	— Research Associate
P. Venkatakrishnan, M. Sc.	— Research Associate

The Technical, Administrative and Non-Technical Maintenance Staff numbered 158.

COUNCIL MEETINGS

The Governing Council had one meeting during the year at New Delhi. The Finance Committee also met once at New Delhi.

BUILDINGS AND GROUNDS

Construction of the extension of the Optics Laboratory and Tool Annexe for the Optics Laboratory at Bangalore was started during the year. Plans for the construction of Mechanical Laboratories at Kavalur and Bangalore were drawn up. The Department of Space, Engineering Division was requested to take these up as Deposit Works and funds placed at their disposal. Similar action was taken in respect of an extension to the Main Laboratory at Bangalore.

As in the previous years, the fire lines at Kodaikanal and Kavalur were kept in good condition.

SCIENTIFIC MEETINGS

Dr. M. K. V. Bappu, continued as President of Commission 12 on the Solar Atmosphere of the International Astronomical Union. Dr. J. C. Bhattacharyya was appointed as a member of the Indian National Committee for Astronomy and as National Co-ordinator for the Total Solar Eclipse of February 16, 1980.

Drs. Bhattacharyya, P. K. Raju, J. H. Sastry and B. S. Murthy participated in the Fifth Annual Radio and Space Sciences Symposium in January at New Delhi. Drs. Bappu, Bhattacharyya and Sivaraman, attended the Seminar on "Total Solar Eclipse of February 16, 1980" held at the Centre of Advanced Study in Austronomy. Osmania University, Hyderabad in March 1979.

Dr. Ch. V. Sastry spent two months at the Clark Lake Observatory in California.

Drs. Gokhale and Hasan attended the International Astronomical Union Colloquium on the "Physics of Solar Prominences" held at Oslo in August. Dr. Bappu attended the ESO Symposium at Geneva on "Modern techniques in astronomical photography". He also participated in an IAU Colloquium on "Variable Stars" at Auckland and was Chairman of the section on Stellar Astronomy of the Regional Meeting of the IAU held at Wellington, New Zealand. Dr. Hasan visited the Astronomical Institute at Oslo, the Royal Institute of Technology, Sweden, the Astronomical Institute at Bonn and spent a month at the Institute for Plasma Research, Stanford University, California.

Dr. Vinod Krishan attended the Indo–Soviet workshop on "Plasma Astrophysics" and also a symposium on 'Plasma Physics' held at Ahmedabad.

VISITING SCIENTISTS

Scientists who visited the Institute and its field stations and who lectured at the Institute, during the year, include Dr. N. Viswanathan, Mt. Stromlo and Siding Spring Observatory, Canberra, Australia, Dr. K. V. Subbaram, Physics Department, M. D. University, Rohtak, Prof. L. H. Aller, University of California, Los Angeles, Prof. D. Ter Haar, Magdalen College, Oxford, Prof. T. Gehrels, University of Arizona, Prof. P. Morrison, Massachusetts Institute of Technology, Prof. R. K. Varma, Physical Research Laboratory, Ahmedabad, Shri D. R. Kaprekar, Deolali and Dr. J. O. Koppen, Institute of Theoretical Astrophysics, Heidelberg.