bicentennial year

Newsletter

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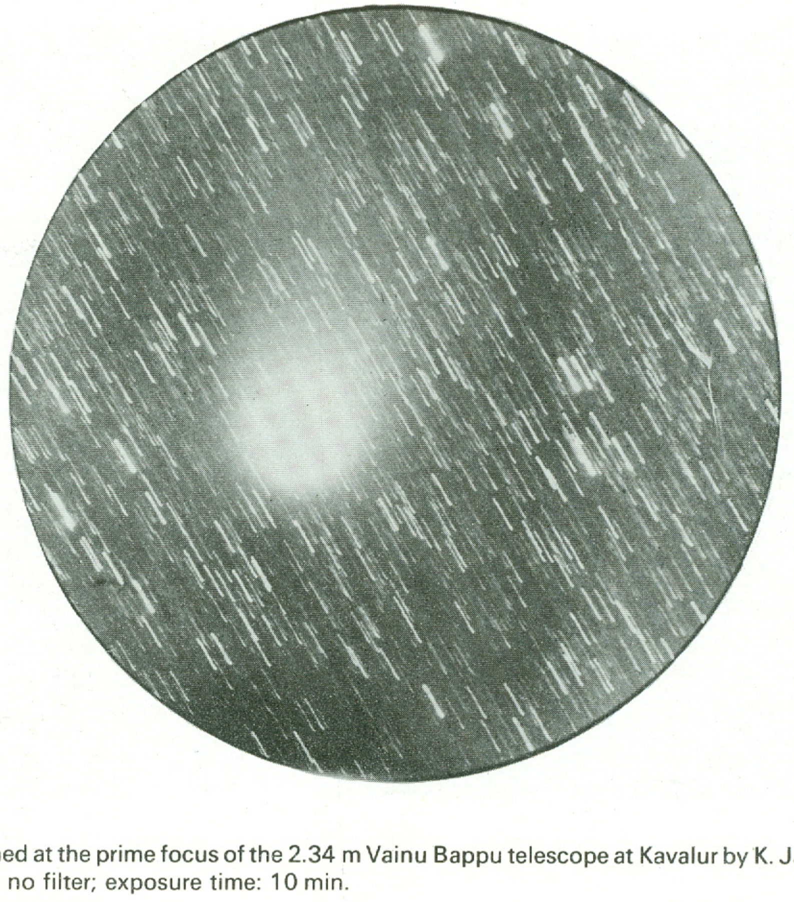


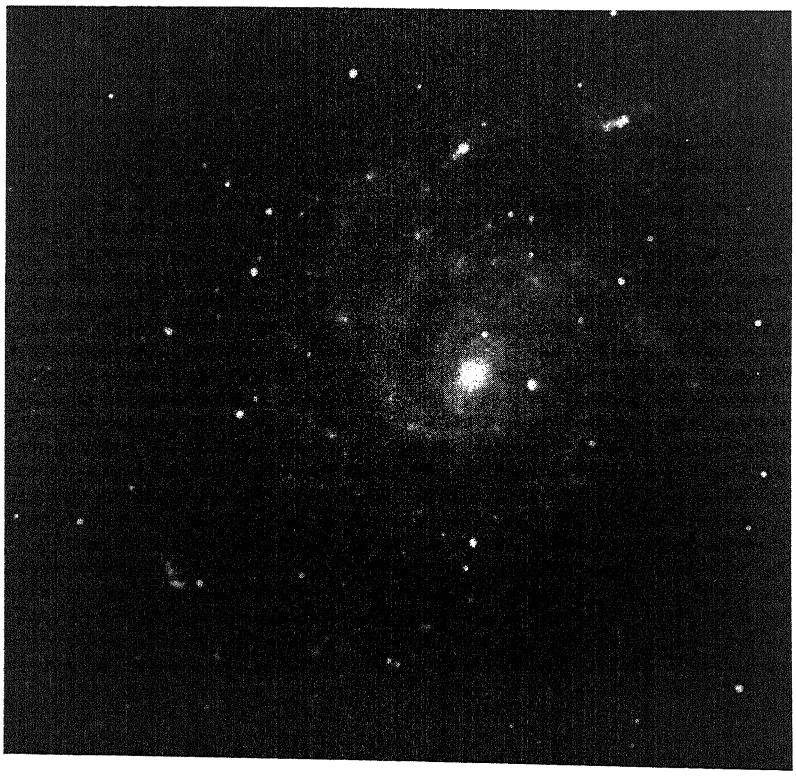
Comet Wilson photographed at the prime focus of the 2.34 m Vainu Bappu telescope at Kavalur by K. Jayakumar on 1987 May 17. Emulsion: Kodak 098-02; no filter; exposure time: 10 min.

Comet Wilson

No sooner than comet Halley disappeared from the scene, came the announcement of another comet. Christine Wilson, reported her discovery of a comet which appeared as a diffuse object with some condensation in the constellation of Pegasus on a plate exposed by her on 1986 August 5. Christine, a graduate student at Caltech had obtained this photograph with the 1.2 m Schmidt telescope at Palomar as part of the new Sky Survey programme. At the Oak Ridge Observatory, Schwartz, McCrosky and Shao had obtained photographs of the same region of the sky a day earlier as part of a patrol programme. A search for the comet in these prediscovery plates showed the diffuse condensation at the right place and this provided a confirmation of Christine's discovery of this 10th magnitude bright comet. The comet's best show was during April and May when it was circumpolar reaching a declination of $-77°$ around April 28. It passed through perihelion on April 20 when it was at 1.2 AU from the Sun. It was closest to the earth (0.62 AU) on May 2 when its integrated magnitude was 4.3 and when it was at declination of $-74°$. Soon after the perihelion passage, the comet passed south of the Small Magellanic Cloud and in early May it was close to the southern edge of the Large Magellanic Cloud. Like comet Halley, comet Wilson was too far south in the sky, thus not providing a good view to the northern hemisphere observers. But by mid-May and June of 1987, comet Wilson moved northward becoming accessible to northern hemisphere observers. For many comet viewers, the dark skies on the new moon night of May would have provided an advantage for viewing the comet in the evening skies through binoculars. Comet Wilson, unlike Comet Halley, approaching the Sun for the first time, did not brighten up as predicted. The comet never became bright enough to be a naked-eye object. The behaviour of all new comets is rather difficult to predict. Comet Kohoutek is another example where the predictions did not prove true.

Comet Wilson was photographed on more than a dozen occasions during May using the prime-focus camera (f/3) of the 2.34 m Vainu Bappu telescope at the Kavalur field station of the Indian Institute of Astrophysics.

K. R. Sivaraman



M101 (NGC 5457) photographed by K. K. Scaria and K. Jayakumar at the prime focus of the 2.34 Vainu Bappu telescope at Kavalur. Emulsion: Kodak 098-02; no filter; exposure time: 100 min.

Rapid Scan Fourier Transform Spectrometer

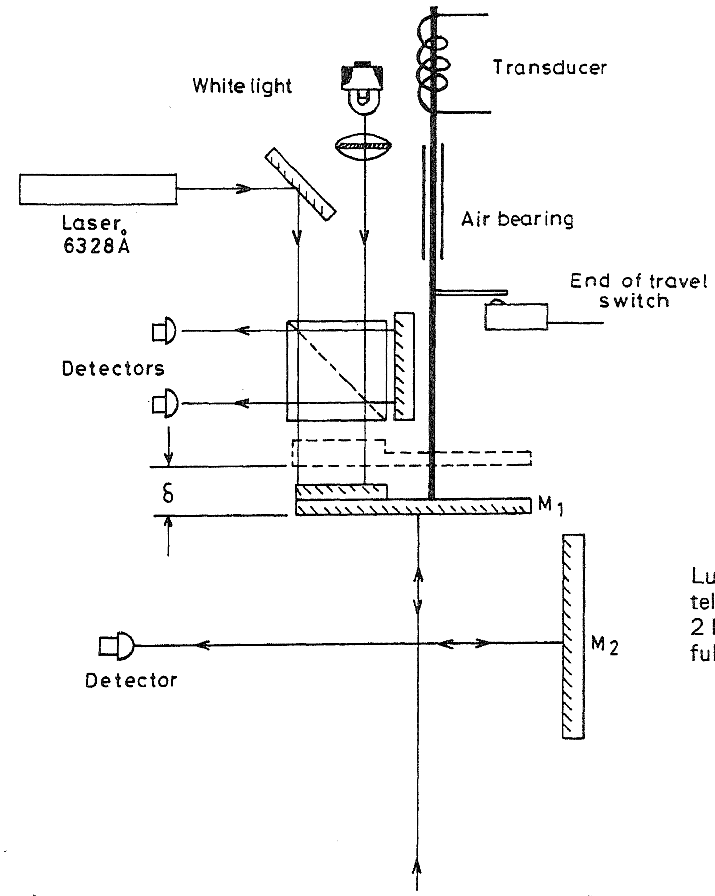
Recently an infrared Fourier transform spectrometer (IR-FTS) was installed at the Cassegrain focus of the 102 cm telescope at VBO, Kavalur for infrared spectroscopic observations. This program has been started in collaboration with the Royal Observatory, Edinburgh (ROE). A commercial Michelson interferometer of classical design, supplied by the Royal Observatory, constitutes the main component of the spectrometer.

A schematic lay-out of the interferometer is shown below. It consists of two interferometers—the main interferometer for the main signal, and an auxilliary one for the white light reference and laser monochromatic reference signals. One mirror of the main interferometer is mounted on an air bearing and it is moved by an electro-mechanical transducer similar to that of a loudspeaker. The mirror motion is controlled by a constant velocity servo. The auxilliary interferometer has two detectors which look at a laser and a white light source. The resulting interferograms are used to generate the velocity error for the servo and the sampling information to sample the main interferometer signal. The laser is a He-Ne unit which produces a line at 6328 Å. The interferometer is controlled through a control unit which contains the electronic circuits which generate the signals required by the interferometer drive and the signals for interfacing with data processing systems.

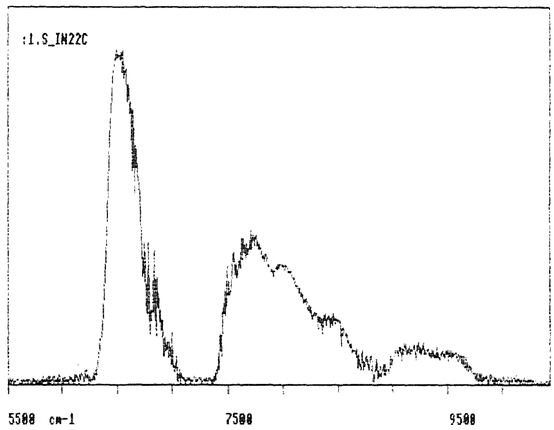
The synchronization and reference signals act as follows. The monochromatic reference signal goes through a Schmitt trigger which detects the zero crossings and generates a square wave. A digital frequency doubler generates a train of pulses whose average area is proportional to the frequency of the monochromatic interferogram and provides the velocity information to the servo loop.

The white light signal goes through a peak detector which determines the point of zero retardation in the reference interferometer. This point is the start of the 'synchronization' signal. The synchronization signal is a square wave whose period can be selected to be $\frac{1}{2}$, 1, 2, 4, 8 and 16 times the period of the monochromatic interferogram and which is gated 'ON' by the peak detector signal, and is gated 'OFF' at the end of the scan.

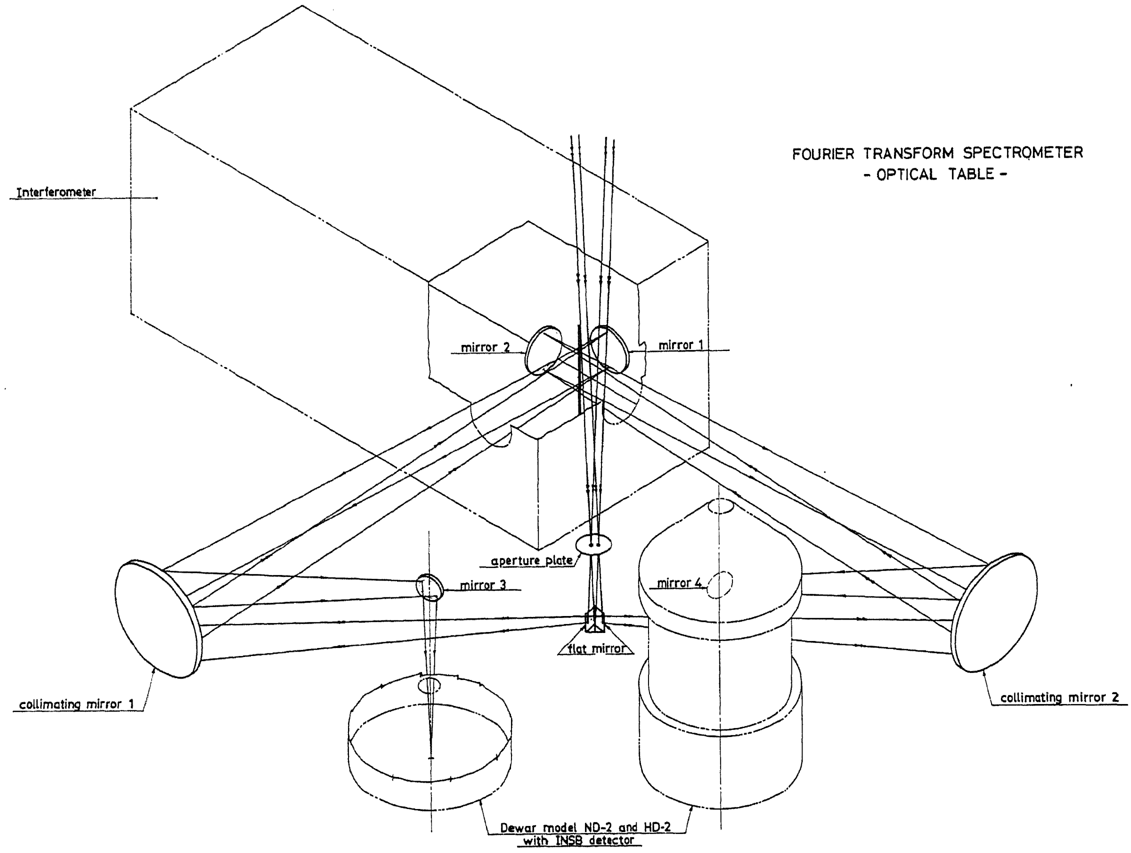
The end of scan is determined by a pre-set binary counter that starts with the synchronization signal and



Optical layout of the interferometer. B: Beam splitter; M_1, M_2: Flat mirrors.



Lunar spectrum, in combined JH band, recorded on 40" telescope with the FTS; 64 interferograms co-added, and only 2 K data points Fourier transformed; wave number scale not fully calibrated.



counts fringes of the monochromatic interferogram. When the counter reaches the pre-set number, the active scan ends, the synchronization and clock signals are turned off and the moving mirror flies back to start another scan.

Some of the important characteristics of the interferometer are given below.

Spectral range	0.64–2.5 μm	1–5 μm
Beam splitter	Fe_2O_3	Fe_2O_3
Beam splitter substrate	Quartz	CaF_2
Optical retardations	0.0625, 0.125, 0.25, 0.5, 1.0, 2.0 cm	
Corresponding resolutions	16, 8, 4, 2, 1, 0.5 cm^{-1}	
No. of samples (1 λ)	1 K, 2 K, 4 K, 8 K, 16 K, 32 K	
Wavelength precision	0.1 cm^{-1}	
Scan velocity	6.3 mm s^{-1}, 1.27 mm s^{-1}	
Velocity precision	Better than 5%	
Sampling interval	6328 Å $\times \frac{1}{2}$, 1, 2, 4	
Sampling precision	< 100 Å	
Aperture stop area	> 20 cm^2	
Field of view	6° maximum full angle	
Air pressure required	Between 30 and 55 PSI	

The design of the foreoptics which serves as an optical interface to the telescope is shown above. Here two beams are used—one for the astronomical source and one for an adjacent patch of sky. This permits simultaneous cancellations of sky background. A dichroic filter (not shown in the figure) between the aperture plate and the telescope transmits the infrared and reflects the optical component of light for use in guiding. The two beams after being rendered horizontal by two small mirrors fall on two almost identical spherical mirrors which are used here in the Ebert-Fastie mode. The collimated beams enter the interferometer 2° off-axis. Returning from the interferometer, the two beams again encounter the spherical mirrors which now re-image the focal plane onto the detectors. Presently only one InSb (Infrared Laboratories, USA) detector is being used.

A UNICORN microcomputer, with an additional 128 K SRAM operating through its 1 MHz bus, controls the operation of the interferometer through the latter's control unit, acquires the data, does the FFT of 4 K data points for a quick look at the spectrum, and prints/plots the results on a high-speed dot matrix printer. Before the Fourier transformation, the electrical signal (the interferogram), after passing through a set of sharp cut-off passband electrical filters, is digitized using a 12-bit ADC.

A 'protocol' has been established between the microcomputer and the VAX 11/780 computer via a software package. Thus, larger data sets recorded on the floppy disks of the microcomputer can be easily processed on the main frame computer.

Some modifications/alterations in the design of the fore-optics are envisaged in view of the limitations of counter-weighting on the declination axis of the 1-m telescope. This limitation will, however, disappear on the Cassegrain focus of the 2.34 m Vainu Bappu telescope.

S. K. Jain (IIA) & M. J. Smyth (ROE)

from the director

Mr. S. C. Tapde, after successful completion of the 2.3-m Vainu Bappu telescope, has left us to join the Giant Metre-Wave Radio Telescope project of the Tata Institute of Fundamental Research. We wish him all success in his new endeavour.

The instrumentation cell has been reorganized; Mr. A. P. Jayarajan has joined as a consultant to this unit. Several projects of design of instrumentation for special astronomical observations—such as the speckle camera, infrared occultation photometer—have been taken up by the cell.

A workshop to review the present state of instrumentation in ground-based astronomy, and to formulate the best course of development in near future, will be held at Kodaikanal on August 10–12. One hopes that an optimum course of action would emerge at the end of the workshop leading our scientists to the forefront of astronomy, at least in some selected areas.

The project Kalki has made remarkable progress: four new solar-system objects have been spotted, as a result of a month's vigil of the Schmidt telescope at Kavalur. The priority for discovery, however, cannot be claimed, as other observatories abroad have reported their identifications a week or two earlier than us.

Two groups of students are being exposed to our research and development programmes during the months of June and July. The first group consists of fifteen students of instrumentation science from Birla Institute of Science and Technology, Pilani, who came for an attachment to our laboratory projects for a period of two months. The second group consisted of thirty students attending the summer school in astronomy and astrophysics, organized under the Joint Astronomy Programme, Indian Institute of Science; these students spent a day in our laboratories in Bangalore, and two nights at the telescopes at Vainu Bappu observatory, Kavalur.

J. C. Bhattacharyya

Project Kalki

The new facility at VBO, Kavalur, the 45-cm Schmidt telescope has been pressed into regular use for sky survey, with a special aim of discovering new asteroids and comets. The general scheme of observational programme was discussed with Professor Tom Gehrels of the University of Arizona, who was with us in December 1986 during the bicentennial celebrations of the Institute. According to his estimate such a project would yield about one or two earth-approaching asteroids, two Mars crossers and one comet per year. These estimates were based on the assumption that about 600 dark and clear observing hours per year are available and that we will be able to cover about 8100 square degrees with pairs of plates of 9 square degrees. A limiting magnitude of $V=17.0$ was assumed for these calculations. These values are probably over-estimated by a factor of three since the present exposures are of the order of one hour instead of 20 minutes that was used in these calculations.

This survey is initially geared for discovery of new asteroids from India. So far five asteroids have been discovered from India, all by N. R. Pogson, the Government Astronomer at Madras from 1861–1891. Pogson, famous for his introduction of the mathematical basis of the magnitude scale, discovered five new minor planets from Madras: 67 Asia (1861), 80 Sappho (1864), 87 Sylvia (1866), 107 Camilla (1868), 245 Vera (1885).

The present project has been named as KALKI in the fond hope that we are likely to stumble on to the discovery of a new planet beyond the orbit of Pluto, whose existence has been a subject of speculation from several indirect ways. The 27-33 million year periodicity found in mass extinction of biological species is believed to be caused by either, (a) a planet beyond Pluto, (b) a solar companion star—Nemesis, (c) encounter of the solar system with interstellar molecular clouds. The transplutonian planet, if found, may be named as Kalki. In Hindu mythology, Lord Vishnu's incarnations suggest the steps of evolution of life on our planet. Kalki is supposed to be the next expected incarnation, hence the choice.

For the trial run of the project during 1987 February–May, we have chosen areas in opposition to the Sun, centred on the ecliptic. The field of view of the Schmidt is $3^\circ \times 4^\circ$ with a plate scale of 150 arcsec per millimetre. The regions were chosen with half a degree overlaps with suitable BD stars in the centre to facilitate guiding. A six inch Zeiss objective with 90-inch focal length was installed on top of the Schmidt as a guide telescope. Most of the observations at the telescope were carried out by Mr K. Kuppuswamy and Mr V. Moorthy and the measurements of positions of the asteroids by Mr Arvind Paranjpye.

One novel feature of this project is the participation by the amateur astronomers of the Bangalore Amateur Astronomy Association. In this process, the president of the association Dr P. N. Shankar has already become an expert in blinking the plates.

In the February–March dark moon period, we observed a total of about 15 asteroids out of which four had not yet been numbered. We have learnt that these four were already discovered, two of them a month earlier and the other two a few days earlier than our observations. The present experience indicates that if we continue with the pace we have set up, it will take only a couple of years for us to add some new objects to Pogson's list after a lapse of more than 100 years.

R. Rajamohan

Of human elements

A causal dance

Heisenberg once told me a charming story of this ocean voyage. Dirac would often sit at a table in a corner, sipping water or a soft drink, while Heisenberg would take part in the entertainment offered by the boat, including dancing. Once, at the end of a dance, Heisenberg returned to their table, and Dirac asked him, 'Heisenberg, why do you dance?' Heisenberg said, 'Well, if a girl is nice, I like to dance with her', and he moved on to another dance. When he returned again after some time, Dirac said, 'How do you know that a girl is "nice" before you have danced with her?'

Aspects of Quantum Theory (1972)
Eds Abdus Salam & E. P. Wigner
Cambridge University Press, P. 57.

Out of context

The observations reported in this paper were carried out at the 6-m telescope owing to an agreement between the USSR Academy of Science and the French Ministère des Relations Extèrieures. We would like to express our thanks to both these organisms . . .

Astr. Astrophys. (1987) **174**, 36.

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We thank . . . and . . . for details of their bursts

Nature (1980) **283**, 551.

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. . . I believe that a discrete event, as far as possible, should be treated as a discrete event, and I have shown that if done so, it gives better results.

Astrophys. J. (1977) **215**, 883.

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The **Second National Workshop on Solar Physics** will be held at Kodaikanal during September 24–29, 1987. It is planned to arrange introductory lectures, reviews of latest developments and brief presentations of research work.

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National Symposium on Comet Halley will be held at Indian Institute of Astrophysics, Bangalore, between October 27–29, 1987. The symposium aims to bring together all the investigators involved with the ground-based observations and theoretical work on Comet Halley. Discussions on other comets relevant on this occasion are also welcome.

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