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Expedition

Expedition to Mauritius for observing supernova 1987A

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Abstract. A two-member expedition to the island country of Mauritius was organised in February/March 1988 to observe the supernova 1987A photometrically. A portable 35-cm (Celestron) telescope alongwith a photon counting photometer (Starlight-1) was used for this purpose. Three broad-band filters of *B*, *V* and *R* were employed in addition to the narrowband filters for H-alpha and [*OI*] regions. But, due to the exceptionally bad weather conditions in Mauritius during that period, the only occasion when one complete set of observations of SN 1987A could be obtained was on 1988 March 4.89 (UT). In that one observation the brightest part of the supernova was found to be in the H-alpha region followed by [*OI*] and the *R* band. The transformation coefficients obtained for this set up are also presented.

Key words: SN 1987A—expedition to Mauritius

1. Introduction

Though considerable amount of spectroscopic observations of supernova 1987A were obtained from the Vainu Bappu Observatory (Ashoka *et al.* 1987), observing it photometrically was rather difficult, because as seen from this observatory, the altitude of supernova was very low at $<9°$ above horizon. So, in order to obtain better photometric observations, it was decided to establish a temporary observing station in Mauritius, in the southern hemisphere. From this place (longitude = 57° 30′ E; latitude = 20° 19′ S), the LMC and its supernova 1987A could be conveniently observed at the meridional altitude of about 40°. However, due to exceptionally bad weather conditions in Maritius in February/March 1988 and the related instrumentational problems during the month-long expedition, there was only one occasion (March 4/5, 1988) when a complete set of observations of SN 1987A could be obtained by the two member team. A brief description of the expedition and the experiment are presented.

2. The expedition

By the time the program for the expedition to Mauritius was finalized, 7 or 8 months had already elapsed since the discovery of the supernova and by then its brightness also had decreased by several magnitudes. After a country-wide search for a suitable instrument, a 14-inch (35 cm) Schmidt-Cassegrain (f/11) telescope (Celestron-14), belonging to the Positional Astronomy Centre, Calcutta, was chosen for the purposes of this expedition, alongwith the accessories for photography and photometry.

The equipment for photometry consisted of a Starlight-1 photometer mounted at the Cassegrain focal plane. This was a compact unit having an S-20 photocathode (EMI 9798A) alongwith a set of broad-band *B*, *V*, *R* filters. Two narrow band filters for H-alpha at 6563Å and for [*OI*] at 6300Å were also added in an extra filter bar. The red leak in the *B* filter was separately measured through another filter provided for this purpose. A photon counter was attached to the photometer.

The telescope and the accessories were transported to the Indian Institute of Astrophysics, Bangalore, from Calcutta in January 1988 for making test observations, after which the entire equipment was airlifted to Mauritius. One of us (GSDB), along with the equipment, arrived in Mauritius on February 14, 1988 and the second member (AKB) joined after a few days.

The installation of the telescope was done on the roof of the building belonging to the Mauritius Meteorological Services headquarters, which is located almost at the centre of the island in a town called Vacoas. During the installation, a rather unusual arrangement had to be adopted for the mounting of the telescope's polar axis system, because the drive of the telescope was suitable only for northern hemisphere stations. In this set up, the entire fork assembly of the telescope, through which the polar axis passes, was tilted in such a way that it continued to point towards the north pole, which for Mauritius, is below the horizon. This rendered the Cassegrain focal plane of the telescope too close to the ground, which necessitated the raising up of the entire set up. This was accomplished by using heavy concrete blocks under the legs of the tripod, which gave a lift of about 60 cm. The finer adjustments of the polar axis were then carried out in a standard manner using stars at near-zenith and near-horizon regions. By 1988 February 22, the telescope was ready for observations. From then on, attempts to observe SN 1987A were made on every night until March 15. And on March 16 the telescope was dismantled for packing and subsequent transportation to India, thus ending the expedition to Mauritius.

3. Sky conditions

The months of February and March are generally cyclone months in Mauritius. Each cyclone normally shows its effects for about 5 to 7 days. In approximately every ten days, at least 3 or 4 are expected to be cloudless and fairly clear. However, this year the gaps between the successive cyclones were too small to be of any utility for astronomical observations. This has later on been traced by the meteorologists to a global phenomenon originating from the Antarctic region. All this led to an unfortunate situation of bad sky conditions during the month-long expedition, giving only occasional short clear spells lasting an hour or so at best. It was so unpredictable that one clear evening turned overcast in a matter of minutes and there was more than 200 mm of rain

in just about 6 hours during that night! Nevertheless, it may well be conceded that the transparency of the sky was very good whenever there were no clouds, which was mainly because of the almost dustless and smokeless atmosphere of this small island country.

4. The experiment

Under such depressing and discouraging circumstances, there was just one night, 1988 March 4/5, when the sky was continuously clear for about 5 hours. During that time one complete set of observations of the supernova 1987A could be obtained. However the clouds and rain arrived rather rapidly leaving no chance of observing any comparison stars or standard stars. After that, till the very last night of the expedition, the weather conditions were never favourable for any reasonable length of time. Even during the short clear spells, no observations could be obtained due to the high humidity which caused fogging of the optical surfaces of the telescope. Hot air blowing on the corrector plate improved the situation for very short durations of a few minutes only. Then, the conventional method of fixing a heating coil around the top end of telescope tube was resorted to. That too turned out to be a futile exercise because the sky conditions deteriorated more rapidly as the days passed on.

Since it was not possible to the standard stars during the period of the expedition in Mauritius, the entire equipment, after its return to India, was reinstalled in the campus of the Indian Institute of Astrophysics in Kodaikanal (longitude = 77°28′ E; latitude = 10°14′ N) during the month of May 1988. From this location, several standard stars were observed with exactly the same instrumentational set up as that used for the supernova observations. From these observations, using the standard graphical procedures, the atmospheric extinction coefficients as well as the instrumental constants were derived. The extinction coefficients are listed in table 1 and the equations with the instrumental constants are given below:

$$(B-V)_{std} = 1.37\ (B-V)_{obs} + 0.68 \quad \ldots(1)$$

$$(V)_{std} - (V)_{obs} = 8.99\ (B-V)_{std} + 16.03 \quad \ldots(2)$$

$$([OI])_{std} = 1.36\ ([OI])_{obs} + 14.10 \quad \ldots(3)$$

$$(\text{H-alpha})_{std} = 1.35\ (\text{H-alpha})_{obs} + 15.42 \quad \ldots(4)$$

$$(R)_{std} = 1.22\ (R)_{obs} + 18.13 \quad \ldots(5)$$

Table 1. Standardized magnitudes of the supernova SN 1987A on 1988 March 4.89 along with the values of k in each filter band

Filter band	Extinction coefficient (k)	Standardized magnitudes of supernova
B	0.285	7.6
V	0.080	7.3
[*OI*]	0.038	3.1
H-alpha	0.038	0.9
R	0.035	3.3

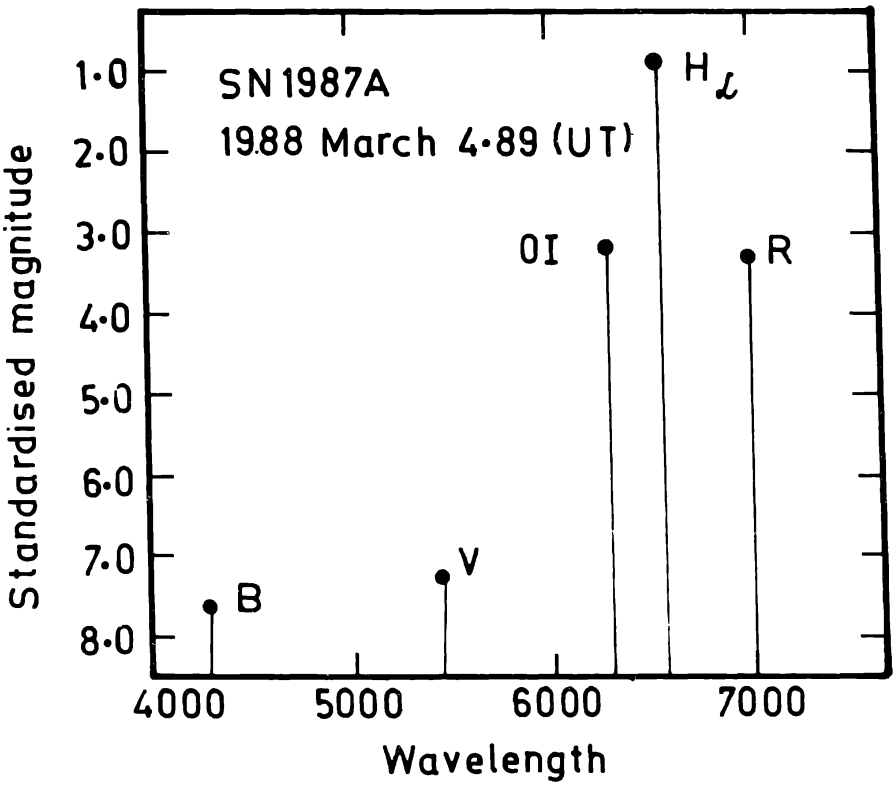

Figure 1. Standardized magnitudes of supernova 1987A in *B*, *V* and $\hat{R}$ bands as well as in the narrowbands of H-alpha and [*OI*] on 1988 March 4.89 UT

This is the first time that these transformation coefficients have been evaluated for this particular instrument. The standardized magnitudes of the supernova in *B*, *V* and *R* bands as well as in the narrow bands of H-alpha and [*OI*], obtained using the extinction coefficients and transformations listed above, are given in table 1 and shown in figure 1. These results are of only a qualitative nature since they are based on a single set of observations and are reduced using observations of standard stars observed at a different site.

It is evident that the supernova was the brightest in H-alpha filter, and fainter by about 2 mag in [*OI*] filter. In the broad bands, the *R* region was the brightest while the *V* and *B* regions were much fainter. The *V* magnitude of 7.3 fits fairly well into the general trend of the light curve of SN 1987A (Beresford 1988), though the differences seen when compared with the values obtained by Whitelock *et al.* (1988), indicates the effects of bad weather and the possible differences between the extinction in Mauritius and Kodaikanal.

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