Newsletter

Quarterly Newsletter of the Indian Institute of Astrophysics

Volume 6 Number 1 January 1991

The Total Solar Eclipse of 1991 July 11

The total solar eclipse of 1991 July 11 with a maximum duration of totality of 6^m58^s belongs to the Saros cycle 136 and would be the longest eclipse until the year 2132. The last preceding eclipse in this series was the one of 1973 June 30; the next eclipse in the same series will occur on 2009 July 22 (18 years after the eclipse of 1991 July) with a maximum duration of 6 minutes 39 seconds.

The July 11 eclipse will be visible along a track extending from Hawaii across Baja California and the mainland of Mexico to Columbia and Brazil. The three main land masses in the path of the eclipse are:

1. Hawaii, soon after the beginning of the eclipse.
2. Baja California and Mexico, near the middle of the eclipse, and
3. Brazil, near the end of the eclipse.

The total eclipse would begin in the Pacific ocean west of Hawaii at sunrise. The moon's shadow sweeping eastward would encompass the big island of Hawaii at 7:30 am (MST) when the sun would be at an altitude of 21° in the north-eastern sky. At the central line of totality the duration would be 4^m 12^s. At Baja California, the total eclipse will occur around noon with the sun almost at the zenith and the totality will last 6^m 56^s. The maximum duration for this eclipse (6^m 58^s) will occur in the Gulf of California.

According to the satellite images, the two areas in the big island of Hawaii that would offer clear skies are: the Mauna Kea which lies above the inversion layer and the second is the Kohala-Kona coast which is on the leeward side of the island. But the eastern slopes of the island are likely to have clouding even in the mornings. Similarly, the west coast of Baja California may be free from clouds although getting closer to the east, towards the gulf can be risky.

The two experiments planned by the solar astronomers of the IIA are: (i) spectroscopy of the solar corona in the 5303 Å Fe [XIV] and 6374 Å Fe [X] lines using a multislit spectrograph, and (ii) imaging of the solar corona in five emission lines and in the electron-scattered continuum using narrowband filters. The prime detector will be a Peltier-cooled CCD.

The line profiles from the multislit spectra would be used to derive the temperature distribution and the turbulence in the corona. The multislit observations obtained during the past two eclipses in the coronal line 5303 Å have shown an evidence for the solar cycle dependence of the turbulence. Also important is the information on coronal rotation derived from two coronal lines simultaneously with the same instrumental set up. In addition there exist in the literature eclipse observations that reveal the presence of systematic downflow patterns which remain to be settled.

The second experiment would provide coronal images in the emission lines and the electron scattered continuum from which the temperature and density gradients would be derived. In particular, this data would enable mapping the density inhomogeneities in the coronal loops using the line intensity ratios.

Preparations are well under way. The multislit spectrograph and the coelostats fabricated under the direction of Mr. B.R. Madhava Rao are under tests. The optical flats were fabricated in the optical shops under the supervision of Dr. A.K. Saxena. Dr. R. Srinivasan is responsible for the CCD system and allied software development.

K.R. Sivaraman & Jagdev Singh

The Synthesis of ^{26}Al in Gamma-Ray Burst sources

The widely accepted model of γ-ray bursts involves accretion of matter onto a neutron star surface (Woosley & Taam 1976, *Nature*, **263**, 101). On reaching the neutron star surface where the density ranges from 10^5 to 10^7 g cm^{-3} and temperature from 10^8 to 8×10^8 K, the accreting material ignites explosively and a thermonuclear flash is generated . Such thermonuclear flashes can be sites of synthesis of various chemical elements.

The detection of γ-ray line at $E_\gamma = 1.809$ MeV due to decay of ^{26}Al (half life $\tau_{26} = 7.4 \times 10^5$ yr) in the interstellar matter (*cf.*, Shore *et al.* 1985, *Astrophys. J.*, **292**, L61) gives a direct evidence of ongoing nucleosynthesis in the Galaxy. Synthesis of ^{26}Al can occur in two distinct modes. (1) The quiet mode in which ^{26}Al is synthesized in a slow stellar nuclear process: this can take place in massive main sequence stars and red giants. (2) The explosive mode can occur when temperature and density reach high values in explosive or shortlived astrophysical situations.

Under usual circumstances hydrogen and helium burning occur in separate mass layers. On the other hand, if hydrogen burns at sufficiently high densities ($\rho = 10^6$ g cm^{-3}) helium must eventually burn in the same mass layer. It is proposed that this combined hydrogen and helium burning reactions, starting with ^{12}C on the neutron star surface can initiate new chains of reactions, (A) and (B) leading to the production of ^{26}Al.

$$^{12}\mathrm{C}(\alpha,\gamma)^{16}\mathrm{O}(\alpha,\gamma)^{20}\mathrm{Ne}(p,\gamma)^{21}\mathrm{Na}(\alpha,\gamma)^{25}\mathrm{Al}(\beta^+)$$

$$^{25}\mathrm{Mg}(p,\gamma)^{26}\mathrm{Al}(p,\gamma)^{27}\mathrm{Si} \begin{cases} \nearrow (\beta^+)^{27}\mathrm{Al} & \text{(A)} \\ \searrow (p,\gamma)^{28}\mathrm{P} & \text{(B)} \end{cases}$$

The occurrence of these chains at the temperature-density condition relevant to the γ-ray burst sources is certainly possible. Wallace & Woosely (1981, *Astrophys. J.*, **45**, 389) have studied these combined hydrogen and helium burning reactions at temperatures in excess of 4×10^8 K. However, at lower temperatures but in excess of 10^8 K an important product may be ^{26}Al.

The rise time of γ-ray burst events on a neutron star surface is of the order of a few milliseconds. The hydrodynamic timescale in this case ranges from 0.14 seconds to 0.63 seconds as dictated by the density range considered here. Once the reaction chain (A) is initiated it leads to the production of ^{26}Al in a time t which is of the order of or less than the hydrodynamic timescale for free fall or free expansion.

A detailed calculation of the abundances of ^{26}Al and ^{27}Al isotopes shows that a finite amount of ^{26}Al is produced at temperature density condition $T = 2 \times 10^8$ K and $\rho = 10^6$ g cm^{-3}. The amount of material processed in the burst sources is very little compared to the amount of material processed in novae or supernovae. Hence for the enrichment of the general interstellar medium throughout the galaxy the contribution from γ-ray burst sources seems negligible. But in the neighbourhood of burst sources the average abundance of ^{26}Al will be substantially higher than in the interstellar medium. Thus rather than contributing to the overall amount of ^{26}Al, γ-ray bursts are likely to contribute to the inhomogeneity of ^{26}Al distribution in the interstellar medium.

Aruna Goswami

Augmenting the Computing Facilities at IIA

A PC based on Intel 80486 chip has been recently acquired from Advanced Micronic Devices. In this system, the CPU chip itself contains the math coprocessor and 8K cache memory which accelerates the calculation of mathematical functions. This has 4 MB RAM, 155 MB SCSI drive, a UNIX operating system with DOS MERGE. MS DOS version 4.0, LPI UNIX FORTRAN, and MS WINDOWS version 2.0 are available on this system. Various types of programs have been executed on this machine to do some benchmarking. The programs which do not require a lot of memory, but contain the calculation of the trigonometric and algebraic functions, run 30 to 40 times faster on this machine compared to the MF II. The programs which require a lot of memory and matrix manipulations are executed 7 to 9 times faster.

K.E. Rangarajan, D. Mohan Rao & B.A. Varghese.

The young Star Cluster NGC 2214 in the LMC

NGC 2214 ($\alpha_{1950} = 06^h13^m11^s; \delta_{1950} = -68^\circ 14'36''$) is a young star cluster situated to the far east of the Large Magellanic Cloud (LMC). It shows a large ellipticity on a deep UK Schmidt IIIa-J plate but two clumps on a short exposure IIIa-F plate. These features led Bhatia & MacGillivray (1988, *Astr. Astrophys.*, **203**, L5) to argue that it is a binary star cluster in an advanced stage of merging and that it will merge completely in a time of $\sim 10^7$ yr.

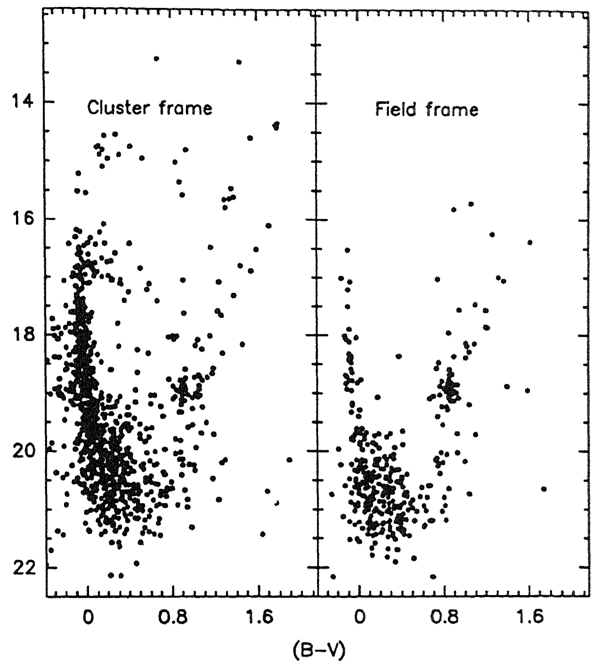

Fig. 1. V, $(B\text{–}V)$ diagrams for the NGC 2214 cluster and field frames.

The *BV* CCD data were obtained on 1988 November 6/7 using the 1.54-m Danish telescope at the European Southern Observatory, La Silla, Chile. The night was of good photometric quality with seeing of $\sim$ 1 arcsec. A pixel of the 320 x 512 size CCD chip corresponds to 0.47 arcsec and the entire chip covers a field of $\sim 2.5 \times 4.0$ arcmin^2 on the sky. In order to estimate the field star contamination in the cluster region, we also imaged an area located $\sim$ 4 arcmin south to the cluster frame. After initial image processing in MIDAS, the DAOPHOT's crowded stellar photometry routine was used for the photometry. The magnitudes were calibrated using photoelectric standards covering a range in brightness ($12.4 \leq V \leq 17.3$) as well as in colour ($-0.17 \leq (B - V) \leq 1.68$). We have been able to calibrate the photometric data with a zero-point accuracy of $\sim$ 0.04 mag in both B and V.

Fig. 1 shows the V, $(B - V)$ diagram for the cluster and the field frame. Before discussing the features of the V, $(B - V)$ diagram of the cluster frame, we discuss the presence of field stars in the cluster sample. The angular distance ($\sim$ 4 arcmin) between the two frames is such that the stars of the field frame can be safely used to estimate the field star contamination in the colour-magnitude diagram (CMD) of the cluster frame. Also, NGC 2214 lies so far to the east of the main body of the LMC that the distribution of stars in the field is even.

The field star subtraction is done in the following manner. For each star of the field frame, the nearest star located within a box of size ± 1 mag in V and ± 0.2 mag in $(B - V)$ from the $V, (B - V)$ position of the field star in the CMD of the cluster frame is deleted from the sample. Since the field frame has about 20 % overlap with the cluster frame, our field CMD actually gives only the stars of the southern 80 %. We therefore took a relevant fraction of extra stars out of the cluster CMD. The cluster CMD suffers from incompleteness at the fainter end due to crowding effects. However, the data is almost complete for $V < 17.5$ mag.

Fig. 2 shows the CMD of NGC 2214 cleaned from field stars. It cannot be excluded that a few foreground galactic G-K stars are still present and that some cluster stars have been deleted. However, the cleaned CMD establishes beyond any doubt the existence of two supergiant branches of cluster stars.

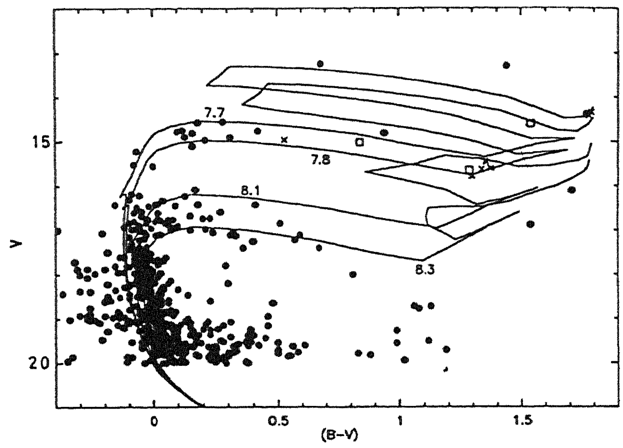

Fig. 2. The cleaned V, $(B\text{–}V)$ diagram shows that NGC 2214 has two supergiant branches of different age. The diagram represents the stars of the cluster frame after taking out a number representative of field frame (see text). Radial velocity members (×) and galactic foreground stars (□) are marked. The curves are isochrones from Maeder labelled with the logarithm of age (year). The density of data points on the lower main sequence has not been corrected for incompleteness. Data were cut off at $V = 20$ mag.

The more luminous of the two branches has V in the range of 14–16 mag while the other is located in a region bounded by $16 \leq V \leq 17.5$ and $0.0 \leq (B - V) \leq 0.8$. The mean brightness difference between the two branches, *e.g.*, near $(B - V) = 0.2$, is 2 mag. We have used three theoretical stellar evolutionary models for the age estimate. They are from Bertelli *et al.* (1990, *Astr. Astrophys., Suppl. Ser.*, **85**, 845) from Maeder (1990, in *Stellar Evolution and Dynamics in the Outer Halo of the Galaxy*, eds. Azzopardi & Matteuci, p.489), and from Castellani *et al.* (1990, *Astrophys. J., Suppl. Ser.*, **74**, 463). Bertelli *et al.* give isochrones for various metallicities while the others only for solar metallicity. To fit isochrones to the V, $(B-V)$ diagram, we used $E(B-V) = 0.07$ mag, a value of 3.1 for the ratio of total to selective absorption in V, and 18.6 mag as a value for the distance modulus of the LMC. Amongst the isochrones for $Z = 0.02$, 0.004 and 0.001 given by Bertelli *et al.* the one with $Z = 0.02$ fits the overall shape of the CMD best. Consequently, we estimate the cluster age for $Z = 0.02$. The best fitted Maeder's isochrones are shown in Fig. 2. Ages estimated for both branches by fitting the different isochrones are given in Table 1. The age derived depends strongly on the theoretical models used. Isochrones given by Bertelli *et al.* make the object oldest while those by Castellani *et al.* make it the youngest. For further discussion, we take the value of ages derived from Maeder's (1990) isochrones, as they happen to lie in between the values given by the other two models.

Table 1. Ages in Myr of the two supergiant branches.

Isochrones	Supergiant branch Bright	Faint
Bertelli *et al.*	90	250
Maeder	60	170
Castellani *et al.*	35	110

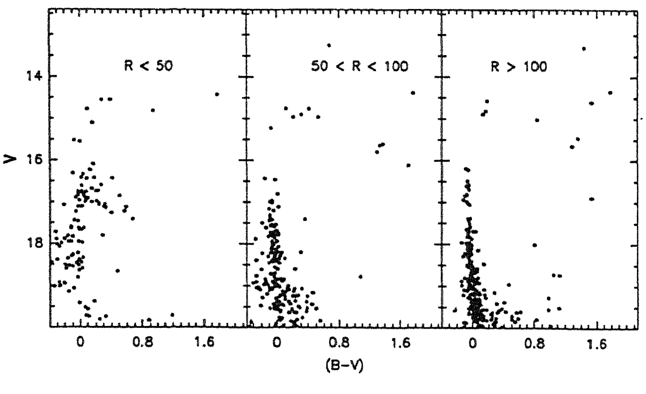

Fig. 3. The V, $(B-V)$ diagrams of stars located in 3 rings around the cluster centre show the different spatial distribution of the two supergiant age groups. R is radius in pixel. Data were cut off at $V = 20$ mag. Note that these diagrams are derived directly from Fig. 2.

In order to study the structure of the V, $(B-V)$ diagram with respect to radial distance, we divide the cluster sample in three regions, namely ring 1 ($R < 50$), ring 2 ($50 \leq R < 100$) and ring 3 ($R \geq 100$), where R is in pixels. Fig. 3 shows the V, $(B-V)$ diagram for these rings. The older branch is not present in the CMD of rings 2 and 3. In the range of V = 17–18 mag an almost vertical main sequence is clearly visible in the CMD of rings 2 and 3. In the CMD of ring 1, instead, a tilted stellar sequence merging smoothly with the older supergiant branch can be clearly seen. One expects such a shape on stellar evolutionary grounds. This indicates that most of the stars in ring 1 belong to the older population. This, as well as the presence of the younger supergiant stars in the CMD of all the rings, led us to conclude that the western component, containing the older sequence stars is compact in nature, the eastern one has a more amorphous and extended structure.

The presented CCD data clearly demonstrate the presence of two stellar populations in the young star cluster NGC 2214, differing significantly in age. The deduced age difference is model-dependent ranging from 75–150 Myr. Bhatia & MacGillivray argued that NGC 2214 is a binary cluster, the two parts being coeval. However, we have demonstrated that the two parts are not coeval. Two different age groups at the same location would mean two epochs of star formation. The first would have been ~ 170 Myr ago, the second ~ 60 Myr ago.

A detailed description of this work will be presented elsewhere (Sagar, Richtler & de Boer 1991, *Astr. Astrophys., Letters*, submitted). Most of the work was done at the Astronomical Institute of the University of Bonn while Ram Sagar visited the Institute as an Alexander von Humboldt Fellow from October 1989 to December 1990.

Ram Sagar

IIA Library linked to Databases

Recently IIA library became a member of the Easynet through the help of Videsh Sanchar Nigam Ltd., Bombay. Easynet is a gateway by which one can access hundreds of databases all over the world. It analyses our request, selects the database, enters the correct term and then presents the results. There are nearly 900 databases we can search including *Science Citation Index, Physics Abstracts,* and the *Biographies of Men and Women in Science* to name a few, and the information is acquired in a matter of minutes. The system allows us to opt for either a menu search or a command search. Menu search is for beginners, where Easynet makes all the decisions and presents the results, whereas the command search is a little more complicated and the user needs to get acquainted with various commands and acquire some knowlege of the database features. The latter method is less expensive. The main advantage of Easynet is that it accepts rupee payment. IIA library has already made a few searches using this facility.

Since the *Astronomy and Astrophysics Abstracts* are a part of a database host called STN (Scientific and Technical Information Network) and STN is not included in Easynet a separate subscription has been made for this. STN has a Physics database where *Astronomy and Astrophysics Abstracts* from 1968 are included. This database is very useful to us especially since the printed version usually lags behind by one year, whereas STN gives us access to information as recent as one month. IIA library has also acquired a password for SIMBAD of the Stellar Data Centre at Strasbourgh. SIMBAD (Set of Identifications, Measurements and Bibliography for the the Astronomical Data) was created by merging the CSI (*Catalog of Stellar Identification*) and BSI (*Bibliographic Star Index*). Later the database was expanded by the addition of source data from many catalogues connected to CSI and by new literature references. Today SIMBAD has data on 600,000 stars, 100,000 nonstellar objects. For each object it gives the basic data, cross-identifications, observational data and general bibliography, including full references. The bibliography is complete since 1950 for the stars and since 1983 for all nonstellar objects.

IIA library is also making use of E-mail to get the IAU telegrams from *Central Bureau of Astronomical Telegrams*. The *National Extragalactic Data Base* (Caltech) has also recently been requested for membership.

A. Vagiswari & Christina Louis

newsline

M. Parthasarthy visited the Department of Astronomy, Astronomical Observatory of Trieste and Kapteyn Astronomical Institute, Groningen for collaborative work, during 1990 September–November.

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S.S. Hasan, V. Krishan, A. Satyanaraynan, R.T. Gangadhara participated in the *National Seminar on Plasma Science* and *Fifth National Symposium on Plasma Science and Technology* organized by the Departments of Mathematics and Physics, Jadavpur University , in collaboration with Plasma Science Society of India, held between 1990, December 4–8. The following talks were delivered: MHD waves in the solar atmosphere (S.S. Hasan); Self-organization in MHD systems (V. Krishan); What is common between solar granulation and clustering of galaxies? (V. Krishan & A. Satyanarayanan); Stimulated Raman scattering *vs.* Compton scattering in quasars (R.T. Gangadhara). Teaching of plasma physics (V. Krishan).

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Mr.P.K. Sahu (Institute of Physics, Bhubaneswar) visited IIA from 5–20 December 1990 for discussions relating to his thesis work with B. Datta.

B. Datta visited the Institute of Physics, Bhubaneswar from 24–26 December 1990 and gave a talk on "Equation of State of Dense Nucleon Matter".

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R.K. Kochhar gave a talk on "Science as a Tool of British Imperialism in India." at Panjab University, Chandigarh, in December 1990.

IIA Colloquia

The following lectures were given at IIA between1990 October–December:

1. Symmetries of Liouville's equation (Y. Subouti, Shiraz University, Iran).
2. A Langrangian formulation of non-equilibrium ensemble theories (Y. Subouti, Shiraz University, Iran).
3. Time-dependent radiative transfer (D. Mohan Rao, IIA, Bangalore).
4. Dark matter (M. Valtonen, University of Turku, Finland).
5. Black holes in the centres of galaxies (M. Valtonen, University of Turku, Finland).
6. Vertical distribution of stars above the galactic plane (S. Chatterjee, IIA, Bangalore).
7. Cometary impacts and stress on terrestrial life (N. Bhandari, PRL, Ahmedabad).
8. Spatio-temporal fluctuations of He 10830 Å line: evidence for protospicules (P. Venkatakrishnan, IIA, Bangalore).
9. Raman scattering *vs.* Compton scattering in quasar plasmas (R.T. Gangadhara, IIA, Bangalore).
10. IR imaging of high-z radio galaxies (A. Chokshi, Princeton University, USA).
11. Ultra-high-energy γ-ray production in Cyg X-3 and associated high energy processes (A.K. Mitra, BARC, Bombay).
12. Modulation of nonthermal Alfvén waves (P.K. Shukla, Rühr University, Germany).

out of context

We present a list of 105 newly misclassified planetary nebulae...

Astr. Astrophys., Suppl. Ser., **86**, 219 (1990).

Editors: T.P. Prabhu & A.K. Pati
Editorial Assistant: Sandra Rajiva
Published by the editors on behalf of the Director, Indian Institute of Astrophysics, Bangalore 560034.

Newsletter
Quarterly Newsletter of the Indian Institute of Astrophysics

Vol. 6, No. 1, January 1991

To:

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Bangalore 560034