Figure 1 shows the results obtained at the ESO 50-cm during sunrise on September 9, 1991 (B measurements carried out with an EMI 9789QB photomultiplier). The resulting value of the τ constant is 58 (± 4) 10^{-9} s; a less precise, though in excellent agreement, determination (the maximum rate was only 5 10^5 counts per second) was obtained on September 5, 1991: τ = 59 (± 19) 10^{-9} s. The measure was repeated with the same instrumentation during sunrise on April 24, 1992, and the value of 58 (± 6) 10^{-9} s was obtained.

These values are not much different from the value reported by the manufacturer (15 10^{-9} s): the 4:1 ratio causes deviations in limit cases only (0.005 mag between two stars with a luminosity ratio of 1:10 in the range 10^4–10^5 counts per second). However, we notice that much larger deviations are expected for higher values of τ: if its value is 600 10^{-9} s, an underestimation by a factor 4 will produce a difference of 0.05 mag for the same two stars. Hence, the possibility of applying a well-determined value should not be overlooked by an accurate observer. This procedure also allows us to measure the area ratios with great precision: for example, in the figure the intercept value is 58.6 ± 0.1 (diaphragms # 1 and # 6).

Radioactive Isotopes of Cobalt in SN 1987A

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The question of the main sources of energy input powering the late time (> 900 days) bolometric light curve of SN 1987A has continued to be debated up to the present time (> 1800 days). The nature of this energy input has been examined by determining by observational means the bolometric light curve and then comparing it with theoretical predictions. After day 530 when dust formed in the envelope most of the radioactive energy was released in the infrared region longward of 5 microns. This occurred because the optically thick dust proved very efficient at thermalizing the higher energy photons which emanated from the deposition in the envelope of γ-rays emitted as a result of β-decay of radioactive species.

Unfortunately, when the dust reaches a temperature of approximately 150° K, which it had by day 1316, the bulk of the radiation occurs at wavelengths longward of 20 microns, the longest infrared point measurable from ground-based observations. Thus astronomers using this technique are somewhat apprehensive about the accuracy of the derived bolometric light curve, for fear of course, that fitting theoretical black body temperatures and extrapolating into an inaccessible region may not account correctly for all the energy beyond observable reach.

The two groups studying this late-time behaviour, ESO and CTIO, have reported differences in 10 and 20 μ luminosities at approximately the same date (Bouchet et al. 1991; Suntzeff et al. 1991). In spite of these differences and the fact that they lead to somewhat different bolometric luminosities both groups agree that now there is radiation from SN 1987A in excess of what would be produced from the radioactive decay of ^{56}Co alone. Recently the CTIO group (Suntzeff et al. 1992) and others (Dwek et al. 1992) have ascribed this excess to the radioactive decay of ^{57}Co whose abundance would correspond to 4–6 times the amount expected on the basis of the solar values of the stable nuclides of mass 57 and 56. Other energy sources such as an embedded pulsar are also considered, but considerable weight is given to the fact that the observed light curves approximate in shape the decay curve of ^{57}Co with an e-folding decay time of 391 days.

The most direct method of determining the mass of ^{56}Co and ^{57}Co has been employed by the ESO group (Danziger et al. 1991; Bouchet and Danziger 1992) over the interval 200–600 days following the explosion. This involves the measurement of the Co II 10.52 μm line emitted in the nebular phase where the strength of this emission line is insensitive to temperature and comes from the predominant ion of cobalt during this time. This method allows the determination of ^{57}Co at much earlier epochs than the method based on the bolometric light curve, because at day 500 approximately half of the total mass of cobalt would be in the form of ^{57}Co even if the original 57/56 ratio were similar to that expected from the solar ratio of stable nuclides of the same mass. The detectable effect on the bolometric light curve occurs much later (> 1000 days) because ^{57}Co decays 3.5 times slower than ^{56}Co and also deposits lower-energy γ-rays in the envelope as a result of that decay.

At the Tenth Santa Cruz Workshop on Supernovae held in July 1989 (Woosley 1991), Danziger et al. (1991) announced that the ESO measurements pointed to an original ^{57}Co/^{56}Co ratio equivalent to 1.5 times the solar value of stable 57/56 nuclides. It was stated there and subsequently (Bouchet et al. 1991, 1992) that these results could not accommodate a value of this ratio as high as 4. In addition, this method also provided a determination of the original mass of $^{56}\mathrm{Co} = 0.070\ M_\odot$ consistent with the value determined from the bolometric light curve by Suntzeff et al. (1991) and Bouchet et al. (1991) and others. This determination of the ^{57}Co/^{56}Co ratio was subsequently supported by the results of Varani et al. (1991) who used a near-infrared line of Co II at 1.5 μ, the effects of the temperature sensitivity on which were considerably reduced by comparison with an Fe II line of similar excitation level.

As a consequence of these observations the ESO group has always sought a different explanation for the excess in the bolometric luminosity at late times.

The other direct method to determine the mass of ^{57}Co (and also independently ^{56}Co) is to measure the flux of γ-rays produced by the radioactive decay. Because some γ-rays escape the envelope and some are absorbed to support the conventionally determined bolometric luminosity, the interpretation of any such measurement is somewhat model dependent. Nevertheless, the opacity of such an envelope to γ-ray penetration is thought to be well understood.

Therefore, it is of particular interest that recently, new results from the Oriented Scintillation Spectrometer Experiment on the Compton Gamma Ray Observatory have been announced by Kurfess et al. (1992) from observations made during the intervals days 1617 to 1628 and days 1767 to 1781. They report a detection of γ-ray emission from ^{57}Co in SN 1987A consistent with an original amount equal to 1.5 times the solar value of the ratio of stable 57/56 nuclides and inconsistent at greater than a 3σ level with a value of 5 times solar.

X-ray observations searching for comptonized γ-ray radiation (Sunyaev et al. 1991) from the KVANT-MIR Observatory had previously pointed to an upper limit of 1.5 solar.

One should note also that the most preferred values of the ^{57}Co/^{56}Co ratio from the theory (Woosley and Hoffmann (1991) are in the region of 1.5 times the solar value of the ratio for stable nuclides. This deserves some weight because the theoretical models involving nucleosynthesis have been remarkably accurate in their predictions for SN 1987A, and nucleosynthesis results are not very model dependent.

Thus we have gained more confidence that the correct value of ^{57}Co/^{56}Co has been determined. Consequently, the excess in the bolometric light curve remains unexplained. A pulsar, an accretion disk surrounding a collapsed object, other radioactive species such as ^{22}Na and ^{44}Ti remain candidates, and further observations may in time either confirm or eliminate each or all of them.

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ESO FELLOWSHIPS 1993–1994

The European Southern Observatory (ESO) intends to award up to six post-doctoral fellowships tenable in the ESO Headquarters, located in Garching near Munich.

The main areas of activity are:

- to do research in observational and theoretical astrophysics;
- to carry out a programme of development of instrumentation for the La Silla telescopes and for the VLT;
- to develop future telescopes involving new technology;
- to provide data reduction facilities for users of the ESO instruments;
- to provide photographic facilities for atlases of the southern sky;
- to foster cooperation in astronomy and astrophysics in Europe.

Fellows normally participate in one or more of the above. In addition there is the possibility of participating in the activities of the European Coordinating Facility of the Space Telescope (ST-ECF) which has been established at ESO.

Fellows will normally be required to spend up to 25 % of their time in supporting activities such as the introduction of users to data reduction facilities, remote control operations and testing new instrumentation.

Fellowships are to be taken up between January and October 1993.

Most of the scientists in the Centre come from the Member States of ESO, but several are from other countries. The Member States of ESO are: Belgium, Denmark, Germany, France, Italy, the Netherlands, Sweden, and Switzerland. In addition to regular staff members, the Centre comprises visiting scientists, post-doctoral fellows, and graduate students.

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Applicants normally should have a doctorate awarded in recent years. The basic monthly salary will be not less than DM 4827 to which is added an expatriation allowance of 9–12 % if applicable. The fellowship are granted for one year, with normally a renewal for a second year and occasionally a third year. Applications should be submitted to ESO not later than 15 October 1992. Applicants will be notified in December 1992. The ESO Fellowship Application form should be used. Three letters of recommendation from persons familiar with the scientific work of the applicant should be sent to ESO directly. These letters should reach ESO not later than 15 October 1992.

Enquiries, requests for application forms and applications should be addressed to:

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An Intermediate Age Component in a Bulge Field

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Much can be learned about the galactic stellar populations and structure from studies of background fields. As yet, bulge field studies have been carried out along its minor axis. These studies show a dominant old metal-rich population (e.g., Terndrup, 1988).

It would be important to observe also fields along the major axis in the hope of learning more about the transition halo-disk.

Recently we have studied NGC 6603,