# SHORT COMMUNICATIONS

## SEARCH FOR A POSSIBLE NEW NEUTRAL COSMIC RAY

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THE experiments of Cowan *et al.*[1-6], if true, suggest the existence of a new electrically neutral cosmic radiation[7] capable of producing a muon in a local absorber. We have carried out an experiment similar to that of Cowan *et al.*[1-3] to verify whether such a radiation exists. Following Cowan *et al.* we have looked for decaying muons in a liquid scintillator tank covered by a shield of plastic scintillators in anticoincidence (figure 1). A concrete shielding provided an aperture or slit of ±15° in the east-west direction. The absorption of the radiation in the concrete of thickness 400 g/cm² is thought to provide a collimating effect to the radiation and depending on the sources in the sky contributing to this radiation there would appear a sidereal time variation in the counting rates.

The experimental arrangement, shown in figure 1, has been set up in the premises of the Tata Institute of Fundamental Research (sea level). It consists of a liquid scintillator tank 100 × 50 × 30 cm filled with 125 l of aviation turbine fuel (kerosene) with dissolved DPO (3 g/l) and wavelength shifter POPOP (5 mg/l). The liquid scintillator is watched by two (denoted as A and B) 12.5 cm photomultiplier tubes (Philips XP2050) in coincidence. The liquid scintillator tank has an anticoincidence cover of plastic scintillators (C) on all sides except the bottom. The plastic scintillators are in modules of 50 × 50 × 5 cm each viewed by a 5 cm photomultiplier (Philips 2212 B) in contact at the middle of the module. This detector system is housed inside a 12.5 cm thick (400 g/cm²) concrete enclosure having an opening of ±15° in the zenith in the east-west direction. The shielding acts as a collimator for the cosmic rays.

The events recorded are those having a pair

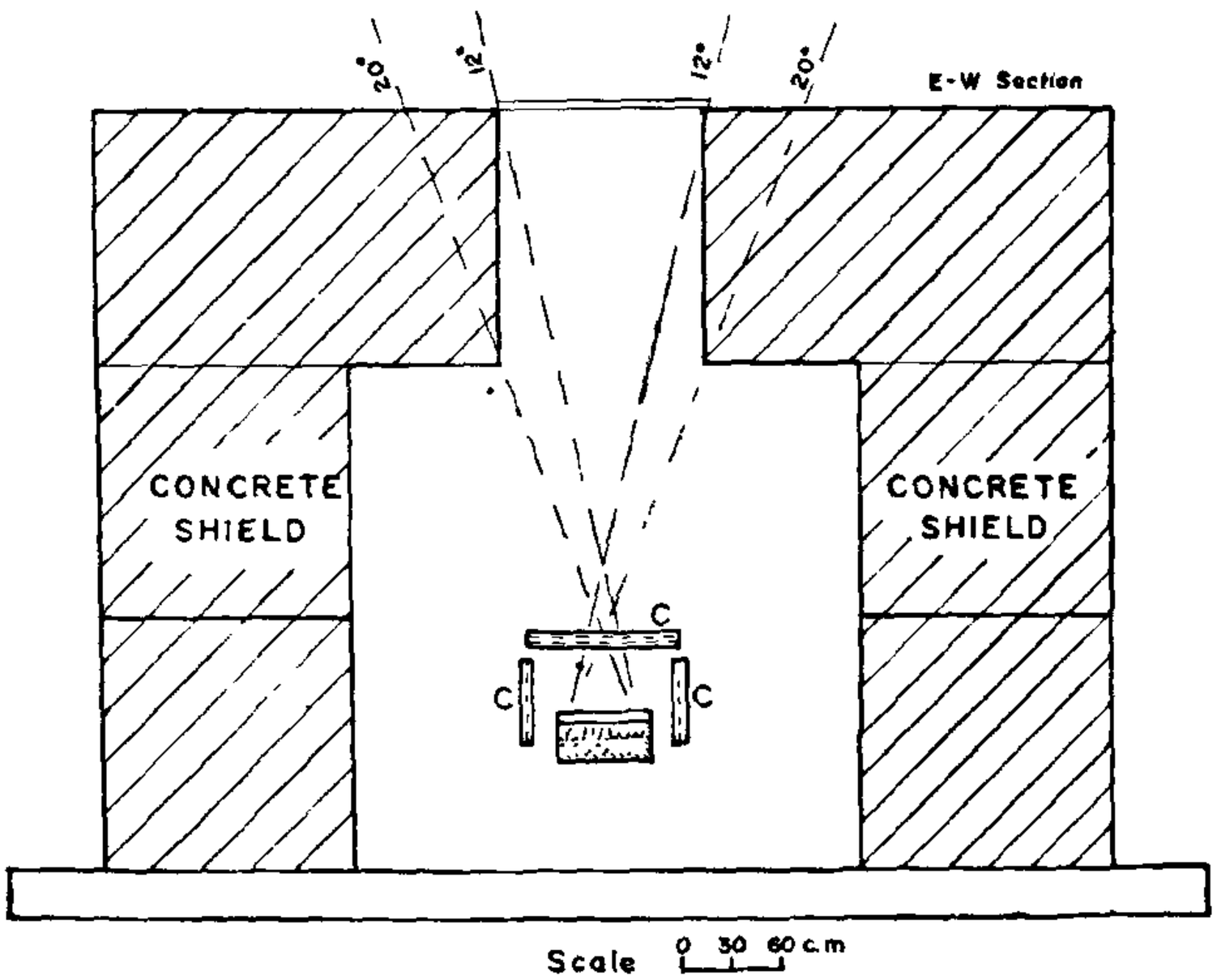


**Figure 1.** An east-west section of the detector assembly and shielding. C is the anticoincidence plastic scintillator shield for the central liquid scintillator shown dotted.

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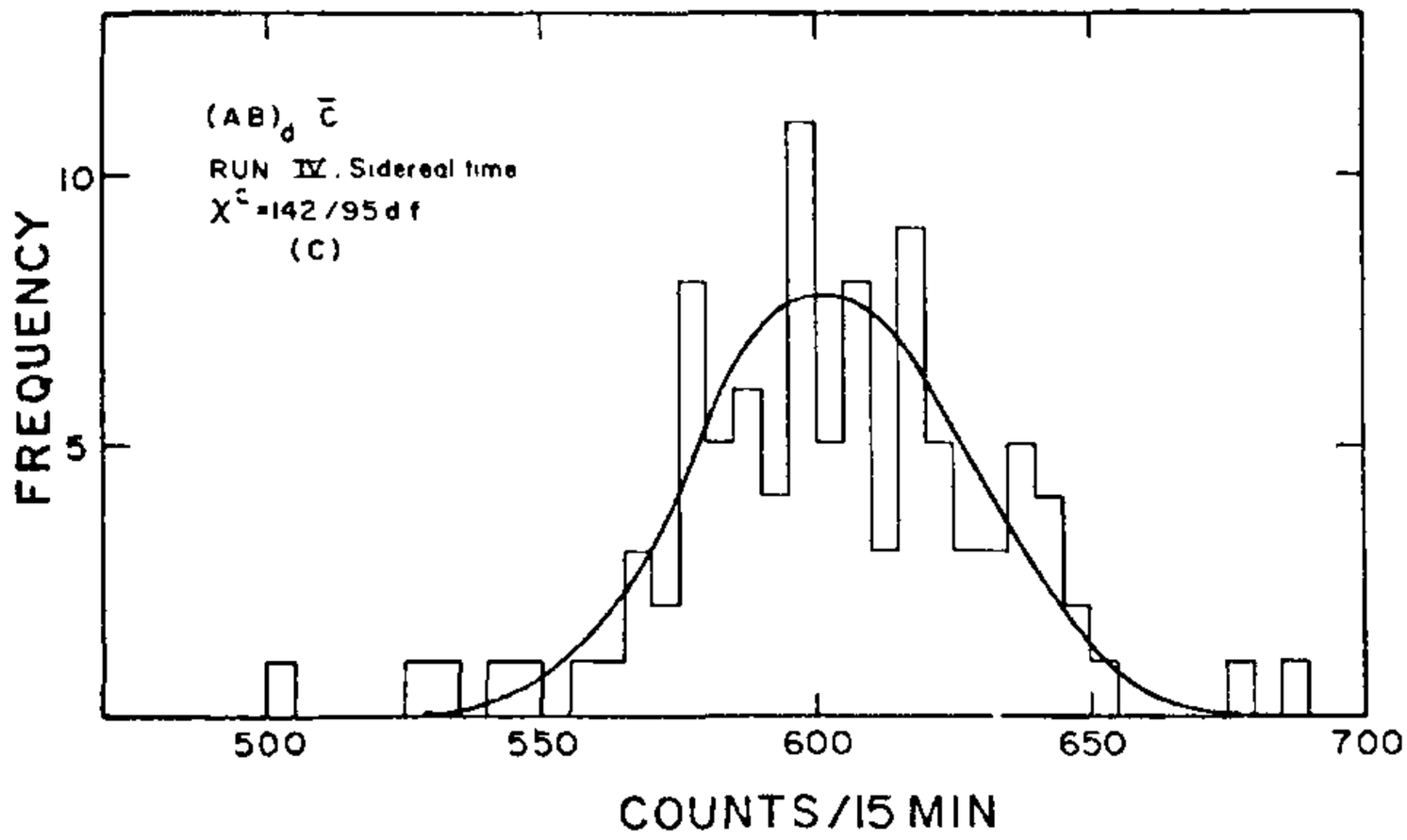


**Figure 2.** A projection of the sidereal time rate plot of a data set covering 21 days running time. The curve is the Gaussian expected for purely random variation.

(doublet) of coincidence pulses from the photomultipliers A, B from the liquid scintillator within a time separation in the interval of 0.6 to 8 $\mu$s with no pulse in the scintillator C. These signals we denote as $(AB)_a\bar{C}$. These events can be construed as having been caused by electrically neutral particles incident on the liquid scintillator and producing a muon decay event in it. The doublet pair spacing distribution shows an exponential with a mean value consistent with 2.2 $\mu$s which is the characteristic lifetime of muon.

The $(AB)_a\bar{C}$ events occurring at the rate of a few/minute as well as $(AB)_aC$ which corresponds to slow cosmic ray muons stopping and decaying in the tank have been recorded for one or more full days. The data show largely statistical fluctuations when plotted as a 15-minute rate vs local time. The aim of the experiment was to see whether there are fluctuations beyond the statistical when the rate plots are made against sidereal time obtained by shifting the local time by $\pm 4$ min a day, the minus sign for following days with respect to a fixed day and the plus sign for preceding days with respect to the same fixed day (chosen as May 15, 1987).

Counting rate distribution obtained in sidereal time (figure 2) is compared with the Gaussian or normal distribution expected from the mean of the distribution. The deviations from the expected curve are barely significant. There are two or three rates occurring outside the Gaussian distribution.

From the results obtained it is difficult to conclude that there is evidence for a new type of neutral cosmic radiation as envisaged. The sidereal effect is marginal though it is at a $3\sigma$ level of deviation in significance (figure 2). The level of flux times cross-section per nucleon of the signal if any can be set at $3.8 \times 10^{-29}$ s$^{-1}$ st$^{-1}$. This level is much higher than the level of $3 \times 10^{-33}$ s$^{-1}$ st$^{-1}$ per target nucleon for the signal claimed by Cowan *et al.*[5] An attempt is being made to improve the signal to noise in our detection system.

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