

Cosmic Schools Group

Detector Design

The detector units for the Cosmic Schools project must be robust, cheap, safe to use and sensitive to the particles to be detected. We propose to use a scintillator based detector with wavelength shifter and photodiode or photomultiplier readout. That detectors of this ilk can be operated within schools has been demonstrated by one of the members of our Group¹. In order to be useful as an element of a large array, the detector should cover an area of at least 1 m². To fulfil the requirement that it can be used for local tracking it must also be able to provide directional information; here a “cosmic ray telescope” using two scintillators of dimensions perhaps 30 x 30 cm², separated by a distance of about two metres, is appropriate. The required detector, illustrated schematically in figure 1, could be built of 10 identical elements, each composed of a sheet of scintillator, to one edge of which is attached a strip of wavelength shifter (WLS). The photodiode or photomultiplier which converts the detected light to an electronic signal would be affixed to the end of the WLS. The elements could be supported in a “Meccano” frame, allowing the whole detector to be provided as a “flat-pack”.

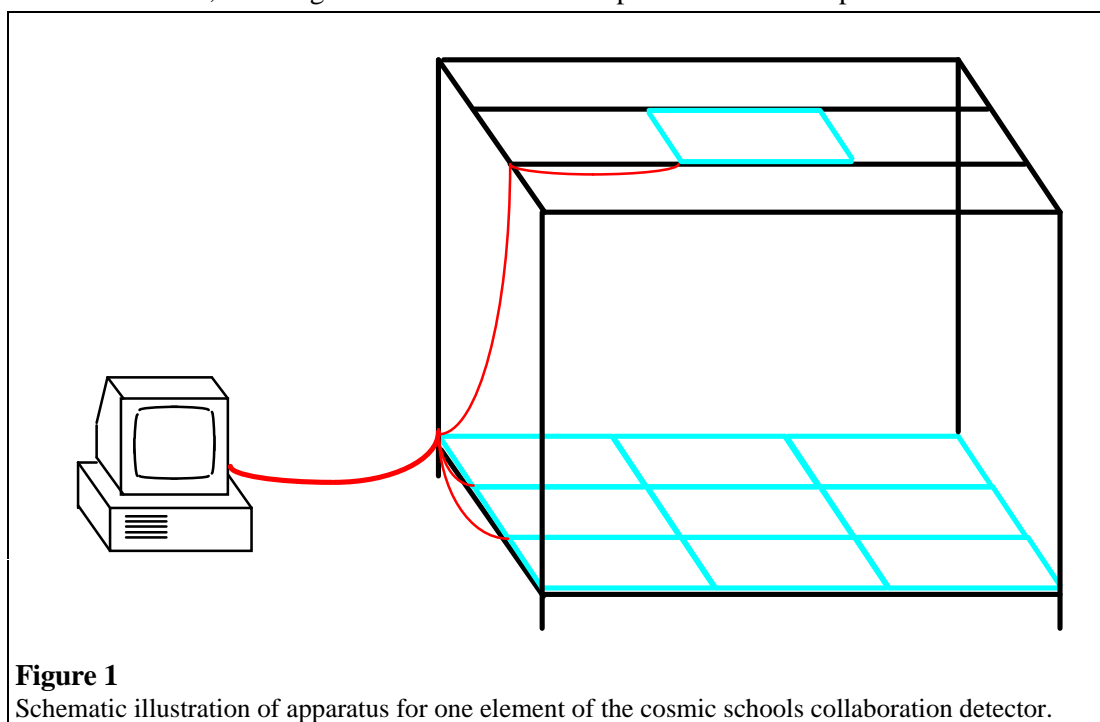


Figure 1

Schematic illustration of apparatus for one element of the cosmic schools collaboration detector.

In order to keep the cost of the associated electronics as low as possible, while providing a high degree of flexibility, we propose to put the electronics on a card that can be inserted into a PC. To remove the need for separate power supplies, again cutting costs, the card should provide the power for the photodiodes or photomultipliers, in the latter case the necessary HV being produced using a diode cascade at the photomultiplier. The electronics should, as a minimum requirement, allow “local” and “global” operation. In local mode, it should be possible to display the singles counts and rates in the individual scintillators, and also allow various coincidence conditions to be required and the resulting count rates displayed. In global mode, the apparatus must be able to record information about the signals observed in the scintillators together with an accurate time-stamp, obtained either from the Global Positioning Satellite

¹ “Measurement of the mean lifetime of cosmic ray muons in the A-level laboratory”, Peter Dunne, Davis Costich and Sean O’Sullivan, Phys. Educ. **33**(5) 296 (1998).

(GPS) system, or from the Greenwich clock. This data must be stored in such a way that it can be easily down-loaded to the Group's central data acquisition system over the internet.

The central data acquisition system must be able to accept data from the array elements as and when they make it available. It should be located at a university, with perhaps several sites keeping copies of the data to ease access and for safety reasons. These central systems should make the data available to schools in a way that allows analysis using the packages commonly found on PCs in schools, such as Microsoft's Excel. In addition, analysis should be done at the central sites and the results made available over the world wide web.

Future Programme

The above outlines some initial ideas on what we feel to be an exciting project for all involved. Many problems must be solved before we can realise our objective of placing a Cosmic Ray detector in all of the UK's schools. Some of the issues are technical:

- Can we use photodiodes for the readout, or must we go for the more expensive option of using photomultipliers?
- What is the optimal combination of scintillator, wavelength shifter and photodiode or photomultiplier?
- Can we put the necessary electronics on a card which can slot into a PC?

We hope to address these issues in the next year, so that at the start of the year 2000 we have a preliminary design for the detector units. We will then apply for further funding, perhaps again through the Small Awards scheme or perhaps for a larger amount through the PPARC National Awards Scheme, to enable us to build several detectors and install them in Preston College and schools around Merseyside. This will allow us to iron out the inevitable teething problems with the detectors and to study the possibility of linking the detectors to form an Extensive Air Shower array. Simultaneously, we will investigate sponsorship possibilities and start to publicise the pilot project in schools throughout the UK. Once all problems have been solved we would then hope to extend the project to cover as many schools as possible.