A LARGE-AREA GAS-ČERENKOV DETECTOR FOR HIGH-ENERGY GAMMA-RAY ASTRONOMY

J. DELVAILLE, K. GREISEN, D. KOCH and B. McBREEN
Cornell University, Ithaca, N.Y., U.S.A.

and

G. FAZIO, D. HEARN, and H. HELMKEN
Smithsonian Astrophysical Observatory, Cambridge, Mass., U.S.A.

Experimental upper limits of the high-energy gamma-ray flux (above 100 MeV) from point sources are about 10^{-5} cm^{-2} s^{-1}, and realistic theoretical predictions for the strongest sources are an order of magnitude lower than this, while the diffuse background flux is about 4×10^{-5} cm^{-2} s^{-1} sr^{-1} in space, and 100 times higher at balloon altitudes. To meet the need for instrumental sensitivity and angular resolution adequate to measure the small but important gamma-ray source strengths, a telescope of large area (5 m^2) and fine angular discrimination (0.5 deg at 300 MeV, 0.3 deg at energies above 1 GeV) has been developed.

These features have been attained in an instrument based on Čerenkov radiation produced in a low-density gas by the electron-positron pair created by gamma-ray absorption. These narrow cones of Čerenkov light are focussed by a parabolic mirror onto a nest of photomultiplier tubes. The total weight of the detector is approximately 2000 pound and of cylindrical shape, 9 ft in diameter and 20 ft in length.

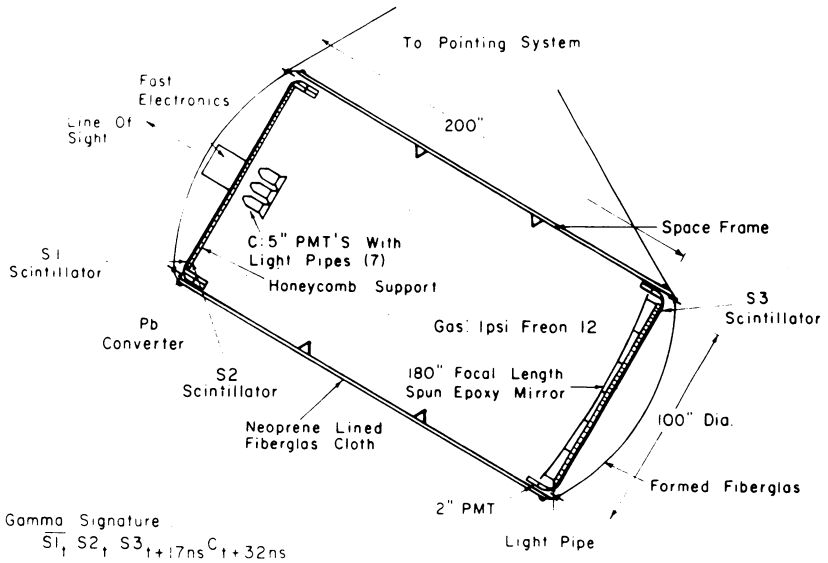

Fig. 1. Schematic diagram of the gas-Čerenkov detector built at Cornell University.

Labuhn and Lüst (eds.), New Techniques in Space Astronomy, 75–76.

The telescope will be pointed within 2° of each source by an automatic orientation system. The minimum flux detectable at 5 mb pressure in the atmosphere will be 5×10^{-7} cm^{-2} s^{-1} above 300 MeV, and 1.5×10^{-7} above 1 GeV. Much lower intensities can be detected in space.

DISCUSSION

B. N. Swanenburg: What is the effective observation time on HEAO for a point source?

H. Helmken: The HEAO A and B missions will have a 1-month spin in the galactic plane. Thus with the 10.8° angular acceptance cone this becomes 4×10^4 s.

K. Pinkau: Would you rather like to operate your experiment in the pointing mode?

H. Helmken: Either mode is suitable. The experiment has an angular acceptance cone of 2.5° and a resolution up to 0.3°. Therefore only a 'post-mortem' pointing knowledge to 0.1° to 0.2° is required.