Dumand Note 80-22

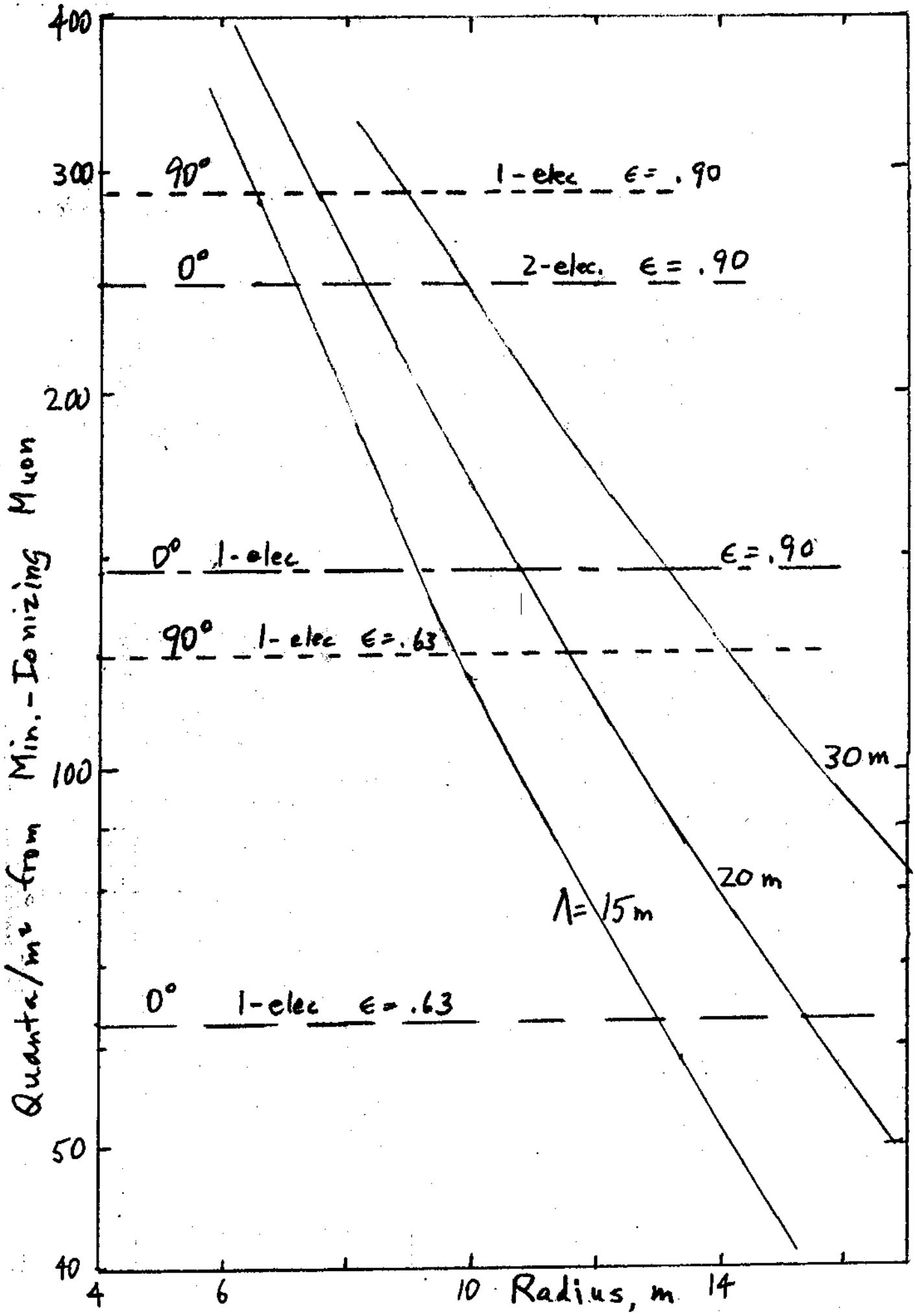
Note on Effective Area and Volume of the Five-String.

by
A. Roberts, Hawaii DUMAND Center

The accompanying figure shows the intensity of the Cerenkov light from a minimum-ionizing track, as a function of radial distance from the track, for three different values of the attenuation length of the Cerenkov light. I have also indicated on it several triggering conditions, taking into account an assumed variation of sensitivity with polar angle of the 13" PMT (of area 0.08 m^2). The assumption is that the 90^o sensitivity is only half that at 0^o. With a vertical spacing of 7.5m and an attenuation length of 25m or more, good detection efficiency should be obtained within a volume of radius 15m and height 30m for both vertically and horizontally incident muons. Detailed Monte Carlo calculations on that point are highly desirable.

Sept. 15, 1980

Fig. 1. The three curves show the intensity of the Cerenkov radiation as a function of radial distance from a minimum-ionizing muon, for water of attenuation length 15, 20, and 30m respectively.The horizontal lines show the triggering intensity levels for a single 13" PMT of cathode efficiency 20%, for several triggering conditions, and for angles of 0^o and 90^o with respect to the tube axis. (The effective photocathode area is only half as great at 90^o as at 0^o.) The efficiencies marked $\varepsilon = 0.63$ are for a threshold of one photoelectron; such a threshold is useful only for events in which at least threefold coincidences are required. The thresholds for 90% efficiencies are also shown. Effective volumes for a five-element string of 2×10^4 m^3, and sensitive areas for vertical muons of 800 m^2 appear to be feasible.


400
300
200
100
50
40
90°
1-elec ε = .90
0°
2-elec. ε = .90
0° 1-elec
ε = .90
90° 1-elec ε = .63
0° 1-elec ε = .63
30 m
20 m
Λ = 15 m
4
6
10
Radius, m
14
Quanta/m² from Min.-Ionizing Muon