

Note on False Track Synthesis by Smart and Dumb PMT's.

A. Roberts, Hawaii DUMAND Center

This note is intended to clarify the confusion that seems to exist concerning previous statements about our ability to distinguish events in the presence of K^4_0 background. I would like to point out that before the 1982 Signal Processing Workshop, it had always been assumed - certainly by me - that we would require smart tubes that discriminate against K^4_0 , in order to eliminate background. That is the reason I have written so many papers and propagandized the PMT manufacturers on the subject. Statements about the ability to operate in the presence of K^4_0 noise made up to the time of the 1982 workshop must all be interpreted in that light; they are still correct, and I stand by them.

At the 1982 workshop, a considerable body of well-informed opinion warned against relying on PMT manufacturers to produce smart tubes. This well-intentioned warning is based on much experience on requirements for special tubes, and the difficulties of obtaining them. I happen to be particularly well acquainted with these difficulties, having spent much time over a ten-year period trying to get tube manufacturers to produce high-gain image intensifier tubes suitable for use in HEP. That effort obtained only meager results, and was thankfully terminated when the advent of the spark chamber gave us an alternative electronic visual device which did not require tube manufacturers' cooperation.

Having said all that, the question remains as to whether dumb tubes can be made to work in the K^4_0 background. We now have made considerable advances over our status before the workshop, and it is still possible that means for making dumb tubes usable can be found. If we are willing to spend large amounts of money, we certainly can make them work. To achieve the best performance/cost ratio may require smart tubes, even if they cost appreciably more than dumb ones. None of these statements can yet be quantified, since we know neither costs, nor exactly how to best use dumb tubes.

The warning against getting involved in new PMT development is well-meant; but it is really irrelevant. We already are, and have been from the beginning of the project. When we first discussed DUMAND, the largest PMT's available were 5" flat-faced. The existence of the present large tubes is due to development work undertaken by manufacturers for DUMAND (and, fortunately for us, facilitated by developments of similar, though not identical, tubes for proton decay.) The adaptation to smart tubes represents not a new venture, but a change in the requirement of tubes already under development for us.

Until the Monte Carlo simulations reach the stage where we can say exactly how dumb tubes can be used in DUMAND and meet our requirements, I think we have no choice but to continue pushing for the development of smart

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ones. The Philips development is a particularly significant one, in that it requires no new technology. It should be encouraged, even if the PMT's are somewhat more expensive. (If they are absurdly expensive - \$10K apiece - then of course all bets are off.) Our cost estimates are not yet so accurate that we can claim that another \$1K per tube will put us above our self-imposed upper limit of \$10M.