DISCUSSION

GALBRAITH: Can you say something about the operational experience of the differential Cherenkov counter using FC 75? For example, do you have difficulty in keeping the optical properties constant with time?

DEUTSCH: In fact, I did not have time to point to the way in which this has been monitored. In fact the counter ran for I think of the order of two weeks without any appreciable change in the optical properties. We did not monitor the optical properties as such. What was monitored was the dielectric constant and it was hoped that the optics would stay constant. This was found to be true over periods of even a couple of weeks. The dielectric constant was monitored by immersing a condenser into the counter gas and then monitoring its capacity. In principle, this could be fed back to the heating coil on the liquid but we found this not necessary. It was constant enough.

KOECHLIN: Is the particle beam very focused in this gas Cherenkov counter?

DEUTSCH: The particle beam had an angular spread of 1° which was the thing that limited the resolution. The beam filled almost the entire aperture of the counter radially and as a result there were marginal particles. If particles pass near the wall of the counter it is quite probable that the efficiency for detecting them was significantly less. All we know is that the efficiency over this entire area under the conditions shown was better than about 70%. We do not know how much better because of the particular conditions of the determination.

HOW MUCH DO WAVELENGTH SHIFTERS USED FOR CHERENKOV COUNTERS SCINTILLATE?

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(presented by L. Mezzetti)

The remarks I am going to present to you very briefly are somewhat marginal with respect to the main subject of this session, the detection of very high energy particles. They refer rather to the routine work of an experimentalist using Cherenkov counters, and it may be useful to someone, preventing him from wasting time in unsuccessful trials to improve the performance of his counters.

In the past few years several authors have used, or suggested using, wave shifters dissolved in typical liquid Cherenkov radiators to increase the light output and thereby the resolution of liquid Cherenkov counters of the non-focusing type. In particular, it has been reported that dissolution of small quantities of betha-methyl-umbelliferone in water and of POPOP in carbon tetrachloride increases the light output by a factor of two; increases by even greater factors have been found by using amino-G-acid. This technique would appear to be very appropriate because the wave shifting action would take place near the point where the ultraviolet light is produced, before it has had a chance to get lost by absorption in the medium or at the walls of the counter.

Scintillation of the solution would, of course, destroy the dependence of the light output from the energy, which is characteristic of a Cherenkov counter, in particular the useful threshold property. To show that this is not the case, the light output obtained with particles well below the Cherenkov threshold was measured. This, however, seemed to us not to be a direct and clear cut test for two reasons:

1. The optical efficiency is not the same as in the case of particles above Cherenkov threshold, because the geometry of the light source is different.

2. The energy of the particles being not the same, possible saturation effects of the scintillation process at low energies may lead to underestimation of the scintillation light produced at higher energies.

The experimental difficulty lies in the separation of the light produced by direct scintillation from that coming from frequency conversion of Cherenkov light. The obvious thing to do would be, of course, to check the dependence of the light output from the energy of the particles. As we did not have at hand, until very recently, a beam of particles of suitable and variable energy we achieved the separation of the two effects by constructing a small cell, containing a β-source at the bottom, filled with water and which could be tightly sealed with a thin quartz window. This Cherenkov light source was immersed in a vessel with white diffusing walls, filled with the solution under study and viewed by a photomultiplier. We measured the photomultiplier current as a function of the concentration of the solution, once with the Cherenkov light source sealed, and once with the quartz window removed, so that the cell was filled by the solution itself and the β rays did penetrate it. The results for one of the solutions are shown in Fig. 1. The two curves are normalised at zero concentration, to correct for the somewhat different optics. The increase observed in case (a) (as well as the dependence on concentration) is in substantial agreement with previous results; but curve (b) shows that it is reduced to a much smaller amount when only the Cherenkov light, and not the ionizing particles producing it, is allowed to penetrate the wave shifting solution. Similar results are obtained for the case of the POPOP in CCl_4 solution.

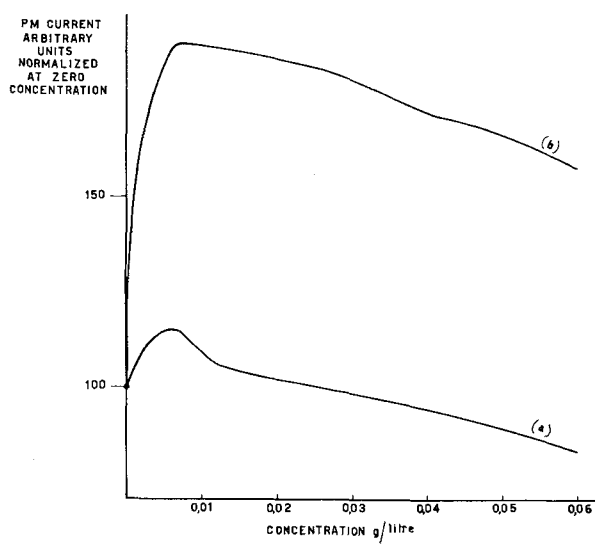

Fig. 1 β-methyl umbelliferone in H_2O.
(a) = Solution shielded from β-source.
(b) = Solution in contact with β-source.

As a conclusion, we believe that in general one must be very cautious in applying this ~~type of wave shifting~~ technique to Cherenkov counters.

DISCUSSION

WETHERELL : I would like to ask Mezzetti if he knows anything about the possibility of using wave shifters in lead glass Cherenkov counters?

MEZZETTI : I think they would be very useful but I think they are subject to the same criticism. If the particles do go through the wave shifting layer or material quite a lot of scintillation is probably emitted.

WETHERELL : What I had in mind was the possibility of putting something in the glass to shift the wavelength.

MEZZETTI : We have not considered this.

VON DARDEL : Would it be the correct way to use a wave shifter to put it for example along the face of the photomultiplier at the exit-window of a Cherenkov counter so as not to have the particles traversing it?

MEZZETTI : This is certainly a correct way to use a wave shifter but the increment ratios found in the literature for this case are smaller by a factor 2 or 3 than for the wave shifters in solution.