



Meson Structure

It is customary to assume that electrons, neutrinos, nucleons, π and μ mesons are "elementary," i.e., structureless, an assumption that is questioned in this paper where it is pointed out that the present experimental information might perhaps be explained equally well with other models for the structure of these particles. In particular, the possibility is discussed that a π meson might be a composite particle consisting of a nucleon and an antinucleon revolving around each other at a distance of the order of the Compton wavelength of the nucleon. From an extremely crude calculation it appears that such a meson would have in most respects properties similar to those of the meson of the Yukawa theory. For example, Yukawa's explanation of nuclear forces would remain valid even when the meson has a structure and is a composite particle. Appreciable deviations from the Yukawa theory would occur only at energies of the order of one billion electron volts, or higher. Another feature of the theory is that in principle the strength of nuclear forces is determined by the masses of the nucleon and the π meson. A rough estimate of the strength shows that it is not in violent disagreement with experiments. It is emphasized, however, that a rigorous mathematical treatment is very difficult and that the crude attempt made in the paper should be regarded as an illustration of a possible program, rather than a proposal of a definite model. C.N.Y.

Are Mesons Elementary Particles? By E. Fermi and C. N. Yang. *Phys. Rev.* 76: 1739, December 15, 1949.

Total Reflection Filter

Until recently prisms or gratings were customarily used for isolating a narrow band of wavelengths, but during the last few years a series of interference filters have been developed, the commonest of which is analogous to the Fabry-Perot interferometer and consists of a layer of dielectric about one wavelength thick, sandwiched between two layers of silver. The higher the reflectivity of the silver, the narrower the band width; but the reflectivity depends on the thickness of the layers, which absorb a larger amount of light as they are made thicker, so that as the filter band width is decreased the transmission is also cut down. The band width which can be achieved without reducing the transmission below a useful quantity is about one hundred and fifty Å. Unfortunately, it is not possible to achieve high reflectivity and low absorption from metal layers except in the visible spectrum.

Recently Dr. Turner at Bausch & Lomb announced the invention of his frustrated total reflection filter, which operates in the same fashion as the solid Fabry-Perot filter but replaces the silver layers by a system which gives any desired degree of reflectivity with no absorption. This is accomplished by using the total internal reflection which occurs at the hypotenuse of a right angle prism.

By putting two right angle prisms together so as to make a rhomb, the reflection at the interface is cut down, depending on the thickness of the air film between the two prisms. The light which is not reflected is transmitted. By adjusting the thickness of this film it is possible to make a semitransparent mirror with any desired ratio of reflection to transmission and with no absorption.

The frustrated total reflection filter combines two such lossless reflections with high and low index layers suitably disposed. Since the behavior of this filter depends only on index differences, it can be made to operate wherever there are transparent materials. A filter was made to operate in the rock salt infrared region. The high index layer in this filter was silver chloride; the low index layers, sodium fluoride. The prisms were of rock salt. The pass bands of this filter were at 4.5 and 5 microns, and were 1/10 of a micron wide. By tilting the filter it is possible to shift the pass bands easily over a range of approximately one-half a micron.

The bands are oppositely polarized and thus the filter can be used by itself as a particularly simple gas analyzer. One band can be placed on an absorption band of the gas to be detected. The other band can be made to fall at a wavelength which is free of absorption. If a polarizer is spun in front of the filter, light passing through the filter will be modulated by a percentage which will be proportional to the quantity of gas present.

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A Frustrated Total Reflection Filter for the Infrared. By B. H. Billings and M. A. Pittman. *J. Opt. Soc. Am.* 39: 978, December, 1949.

Accelerator Shielding

Shielding for high energy nuclear particle accelerators should contain elements of rather high atomic weight for inelastic scattering of fast neutrons, as well as an appreciable amount of hydrogen to slow down low energy neutrons. High density is desirable to conserve floor space, which in large accelerator buildings is unusually expensive because of special facilities requiring high head room. Concrete consisting of five parts by weight of dry magnetite ore concentrate to one part by weight of cement was found to have good strength and handling properties and a density of more than 200 pounds per cubic foot. Because of the small particle size of the magnetite, considerable water (up to ten percent by weight of the concrete) is retained after setting. To study loss of moisture by diffusion, spheres of various sizes were placed in a desiccator and weighed frequently over a period of several weeks. From the loss of weight data, the diffusivity could be calculated and was found to be about 10^{-2} cm² per hour. This information may be applied to estimate the rate of loss of moisture from a thick wall such as is used for the Carnegie Institute of Technology shield. This shield, which is 8 feet thick, will lose half its moisture in about 30 years.

Although no very high energy particles were available, some radiation attenuation measurements were made in the magnetite concrete. Spheres were provided with central cavities for gamma ray and photo neutron sources, thus making it possible to estimate the thickness of con-