of μ-mesons is proportional to their energy in a wide range of energies of μ-mesons. Therefore, at recording μ-mesons the "detector mass" is considerably greater than in the case of recording electrons. Besides, it is difficult to determine the light direction of the produced electron.

That is why we have to assume that at the beginning in the underground experiment the neutrino reactions with the production of a μ-meson will be investigated.

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III-5-20. The Solution of the Kinetic Equation for μ-mesons Passing through the Great Depths of Substance*

G. T. ZATSEPIN and E. D. MIKHALCHI
P. N. Lebedev Institute of Physics, Moscow, U.S.S.R.

The kinetic equation for μ-mesons passing through the dense substance is:

$$\frac{\partial N}{\partial X'}-\beta(E)\frac{\partial N}{\partial E}=\int_0^1 W(v,E)\times\left\{N\left(\frac{E}{1-v},X'\right)-N(E,X')\right\}dv \quad (1)$$

where $N(E,X')$ number of μ-mesons at the depth X' with the energy more than E: $W(v,E)dv$ probability that a meson with energy E loses a part of its energy $v, v+dv$ per path unit, $\beta(E)$ the value of continuous energy losses per path unit. Supposing

$$\beta(E)=\beta_0+aE,$$
$$W(v,E)=\frac{W_0}{v}$$

and introducing dimensionless parameters

$$\varepsilon=\frac{aE}{\beta_0},\quad X=aX',\quad b=\frac{W_0}{a},$$

we have:

$$\frac{\partial N}{\partial X}-(\varepsilon+1)\frac{\partial N}{\partial\varepsilon}=b\int_0^1\frac{dv}{v}\left\{N\left(\frac{\varepsilon}{1-v},X\right)-N(\varepsilon,X)\right\}. \quad (2)$$

The boundary condition is:

$$N(\varepsilon,0)=B\varepsilon^{-\gamma}.$$

If we neglect the fluctuations, the right part of the equation (2) will be:

$$b\cdot\varepsilon\cdot\frac{\partial N_m}{\partial\varepsilon}.$$

The solution of such differential equation is known to be as follows:

$$N_m(\varepsilon,X)=B\exp\left[-\gamma(1+b)X\right]\times\{\varepsilon+(1+b)^{-1}\cdot[1-\exp\{-(1+b)X\}]\}^{-\gamma}. \quad (3)$$

By the analogy with expression (3), we take the solution of the exact equation (2) in the form:

$$N(\varepsilon,X)=B\exp\left[-A(\gamma)X\right]\times\{\varepsilon+\kappa^{-1}[1-\exp(-\kappa X)]\}^{-\gamma}\cdot\exp\varphi(\varepsilon,X). \quad (4)$$

This expression provides

$$\varphi(\varepsilon,0)\equiv 0.$$

The constant $A(\gamma)$ is determined from the condition that $\varphi(\infty,X)\equiv 0$, this gives

$$A(\gamma)=\gamma+b\int_0^1\frac{u^\gamma-1}{u-1}du.$$

For the determination of the constant κ we order $\varphi(0,\infty)=0$. This condition gives the equation for κ:

* This paper was combined with III-5-19 and presented by G. T. Zatsepin.

$$\gamma \ln \kappa = b\int_0^\infty \frac{y_\gamma(z)dz}{z+\kappa},$$

where

$$y_\gamma(z)=\int_0^1 \frac{(1-v)^\gamma}{v}\left\{\left(1-\frac{v}{z+1}\right)^{-1}-1\right\}dv\,.$$

For $\varphi(\varepsilon, X)$ we obtain an approximate expression:

$$\varphi(\varepsilon, X)=\int_0^X dt\left\{-\frac{\gamma(\kappa-1)}{p+1}+by_\gamma(p)\right\},$$

where

$$p=\frac{\kappa[(\varepsilon+1)\exp(X-t)-1]}{1-\exp(-\kappa t)}\,.$$

For the different parameters b and γ $\varphi(\varepsilon, X)$ was found with computer "Strela." The magnitudes of φ are small and they do not exceed 0.1. The Fig. 1 shows plot $\varphi(\varepsilon, X)$ (b=2, γ=2) on X for different values of μ-meson energy ε.

The Fig. 2 shows ratio N (formula 4) to N_m (formula 3) versus X for three values of ε for the case b=2, γ=2. The tables of the values κ is given below.

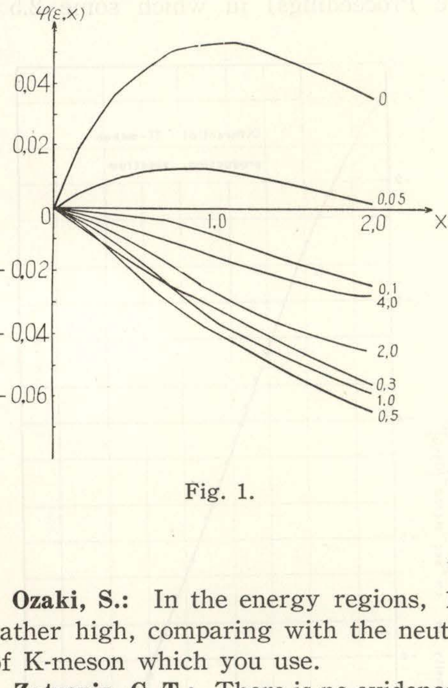

Fig. 1.

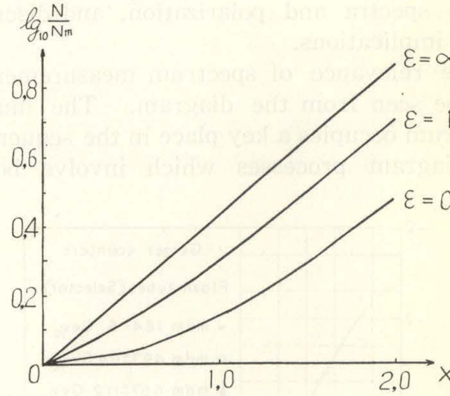

Fig. 2.

Table I.

γ \ b	1,0	1,0	2,0
2,00	1,4381	1,6519	1,8637
2,25	1,4077	1,6069	1,8037
2,50	1,3814	1,5678	1,7525
2,75	1,3584	1,5337	1,7072
4,00	1,2762	1,4116	1,5456

Discussion

Ozaki, S.: In the energy regions, 10^{12} ev, the neutrino from the K-meson decay is rather high, comparing with the neutrino from π-meson. Let me know the intensity of K-meson which you use.

Zatzepin, G. T.: There is no evidence of a big contribution of μ-mesons from K-mesons in the total flux of μ-mesons in the atmosphere. Probably this contribution is about few percent. So the uncertainty of the total flux of neutrino is about some decades of %. I hope that future experiments on μ-mesons, also π and κ productions in jets will give more precise information on K-contribution.

Wolfendale, A. W.: What do you estimate to be the cost of such an experiment?

Zatzepin: One million dollars.

Wolfendale: Perhaps I can answer Prof. Menon's question. A very approximate calculation shows that if the neutrino cross-section is angumented by virtue of the existence of the intermediate boson, there is a contribution of a few percent to the underground intensity at 10,000 mwe. This might be detectable with a big array.