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ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

Лаборатория теоретической физики

P.S.Isaev

D- 824

# NOTE ON THE MASS SPECTRUM OF ELEMENTARY PARTICLES

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*P.S.Isaev*

*D- 824*

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...единенный и...
...ядерных исследов...
БИБЛИОТЕКА

Some regularity observed in decays of unstable particles has been indicated in paper /1/. Namely, the kinetic energy released in all decays of unstable particles turnes out to be multiple to the quantity

$Q = 35.3$ MeV ( or to the energy corresponding to $\approx 69$ electronic masses ).

The same paper shows that if there are other unstable particles, then the valnes of their masses should be songht among numbers which satisfy the law ( in units of electronic masses ):

for leptons and mesens $\mu = (1 + n.\,69)\, m_e$

for baryons $M = (1836 + m.\,69)\, m_e$

where n and m are the integer number, and $m_e$ is the electron mass.

At present there is a nnmber of recently discovered resonances in the interaction of $\pi$ and K mesons with baryons which are sometimes interpreted as new unstable particles. It is interesting to see how the aforementioned regularity is kept in the unstable particles discovered in such a way.

The Table gives the values of masses and numbers n and m for all known unstable particles and resonances.

| N | Name of particle or resonance | Mass ( in MeV ) | n | m | Resonance width $\Gamma/2$ |
|---|---|---|---|---|---|
| 1 | $\mu$ - mesons | 106 | 3 | – | – |
| 2 | $\pi$ - mesons* | 141 | 4 | – | – |
| 3 | K - mesons | 493 | 14 | – | – |
| 4 | $\Lambda$ - particles | 1114 | – | 5 | – |
| 5 | $\Sigma$ - particles | 1185 | – | 7 | – |
| 6 | $\Xi$ - particles | 1322 | – | 11 | – |
| 7 | $K\pi$ - resonance | 885±3 | 25 | – | 16 MeV |
| 8 | $\Lambda\pi$ - resonance | 1325± 15 | – | 13 | 20 MeV |
| 9 | $\Sigma\pi$ - resonance | 1415 ± 3 | – | 13.5 | 20 MeV |
| 10 | $2\pi$ - resonance | 750±50 | 21 | – | 150 - 200 MeV |
| 11 | $3\pi$ - resonance | 787 | 22 | – | < 15 MeV |
| 12 | $\omega^{\circ}$ - resonance | 320 | 9 | – | – |

As to the $\pi N$ resonances /7/, they are rarely related to the unstable particles. However, to give a complete picture we list here these resonances:

13. The first maximum lies for the kinetic energy of $\pi$-meson $T_{\pi}$ equal to 179 MeV /8/ (n = 5) .

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* Small difference in masses of charged and neutral particles corresponding to isotopic douplet or triplet can be caused by the electromagnetic interactions.

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As to the $\pi$N resonances /7/, they are rarely related to the unstable particles. However, to give a complete picture we list here these resonances:

13. The first maximum lies for the kinetic energy of $\pi$-meson $T_\pi$ equal to 179 MeV /8/ (n=5).

* Small difference in masses of charged and neutral particles corresponding to isotopic doublet or triplet can be caused by the electromagnetic interactions.

14. The second maximum in $\pi^- + p$ and $\pi^0 + p$ interaction lies for the energy $T_\pi = (605 \pm 5)$ MeV (n=17)

15. The third maximum in the $\pi^- + p$ interaction lies for $T_\pi = (890 \pm 9)$ MeV, n = 25, and in $\pi^0 + p$ interaction for $T_\pi \approx 860$ MeV, n = 24 ( kinetic energy in the lab. sys. of coordinates ).

So, almost in all the cases, within the experimental errors, the old regularity is conserved. The divergence is observed only in the position of the $\Sigma\pi$ resonance. However, $\Sigma\pi$ resonance is obtained from the analysis of a small number of cases, but with a sufficient accumulation of statisticol material its position can be removed in any side.

It is interesting to clear up condition under which the kinetic energy is transformed into the inert mass by certain quanta. Since in strong interactions the collisions proceed in the nuclear time intervals then the intertainty relation suggests an idea that the appearance of energy quanta is possible only in the case when the action reaches the value multiple to the Plank constant $\hbar$ .

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