one nucleon. More precisely, it is sufficient that

$$q_{\|}(1/\mu) \ll 1. \qquad (3)$$

Furthermore, if $$q_{\|}(A^{1/3}/\mu) \ll 1, \qquad (4)$$

then this effective region elongates to a distance greater than the dimension of the entire nucleus. In these cases one cannot consider the collision of the incident nucleon and the generation of products as a collision with one nucleon in the nucleus It is necessary to treat it as a process of simultaneous interaction within a "tube" or "channel" which has a cross section of π/μ^2 and which is cut out in the nucleus by the incident nucleon.

From Eqs. (1) - (4) one can easily obtain the conditions for the existence of such a collective interaction. Two cases are possible: 1) $\nu\epsilon \ll E$ and 2) $\nu\epsilon \sim E \sim E - \nu\epsilon$. For both cases, condition (3) has the form, after substitution of Eq. (2) into Eq. (1) and then Eq. (1) into Eq. (3):

$$\frac{M^2}{2E}\frac{1}{\mu} \ll 1, \quad E \gg M\frac{M}{2\mu} \sim 5 \cdot 10^9 \,\text{eV} \qquad (3')$$

[here one requires].
For condition (4), the threshold energy is multiplied by $A^{1/3}$. If the emergent angles are smaller than M/E, then the picture of successive collisions becomes inapplicable even earlier. If

b) the nucleons scatter with angles greater than $\theta_M \sim \sqrt{M/E}$ (isotropic in the center of mass system of both nucleons) then one finds

$$q_{\|} \sim M, \quad q_{\|}(A^{1/3}/\mu) \gg 1, \qquad (5)$$

and the picture of successive collisions can be retained.

c) To the degree to which the impact parameter equals, in the mean, $1/\mu$ and $q_{\perp} \sim \mu$, then there is greater probability that the scattering angle of the nucleon is $\theta_M \sim \mu/M$. Then the decisive role is played by the emergent angle of the meson, θ_μ. If it equals $\sqrt{M/E}$ (this occurs, for example, in the case of isotropic emission of mesons in the center of mass system), then, as is plausible, the main role is played by the last term in Eq. (1):

$$q_{\|} \sim {}^1\!/_2(M\nu\varepsilon/E).$$

The picture of successive collisions is useful if the meson energy is not very small, that is, if

$$\nu\varepsilon > 2(\mu/M)E. \qquad (6)$$

If the mesons are emitted isotropically in the system of rest of the incident nucleon then $\theta_\mu \sim M/E$ and we again revert to case (a) and condition (3).

In this sense, only with a special mechanism of meson emission can we say that, in the realm of energies $E > 5 \times 10^9$ ev, successive collisions of a nucleon with different nucleons occur. The preceding considerations lose their force when $E \gtrsim 10^{12} \div 10^{13}$ ev[3], where the Fermi-Landau process[2] becomes operative.

Translated by A. Skumanich
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Improvement of the Quality of a Cavity Resonator By Means of Regeneration

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(Submitted to JETP editor November 4, 1954)
J. Exper. Theoret. Phys. USSR 28, 242 (February, 1955)

N connection with the possibility of constructing a molecular oscillator[1,2] there arises the question of substantially improving the quality of cavity resonators. One possibility which can be utilized for this purpose is the construction of a superconducting type of cavity resonator[3]. Another is the adoption of the well known low frequency radio method of regeneration[4].

In experiments performed by us, a cavity resonator with a Q value of 4×10^4 was employed. This resonator was connected in a positive feedback loop with a microwave amplifier. By gradually increasing the gain modulus, the effective Q of the resonator increased and reached the value 3×10^6. This value was maintained for several hours; while a Q of 5×10^6 could be maintained for only 10 - 20 minutes. The Q values were measured with the help of a quartz frequency standard.

Further increase in the quality is restricted by the lack of stability in the amplifier system, which results from fluctuations in the gain modulus and, in particular, the phase shift.

The apparatus could have been changed so that with such periodic influences on the gain modulus one could employ the method of interrupted generation - - a scheme analogous to classical superregeneration.

A substantial improvement of the quality, without the utilization of superregeneration, can be obtained with the employment of negative feedback coupling. As is well known, the gain modulus and phase shift of the amplifier is determined by the fundamental parameters of the feedback loop. Thus a superimposed negative feedback can provide the necessary stable scheme.

Translated by A. Skumanich
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The Neutron Subshell in the Region of the Transuranic Elements

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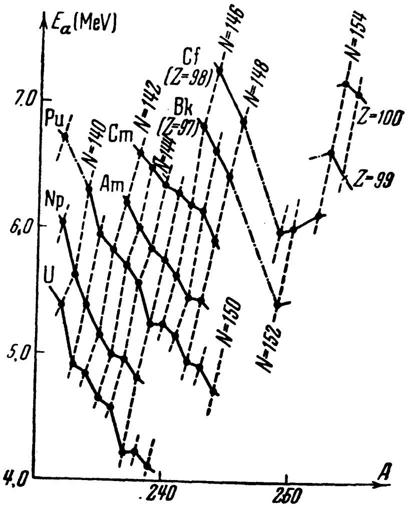
(Submitted to JETP editor September 30, 1954)
J. Exper. Theoret. Phys. USSR 28, 243
(February, 1955)

At present the existence of neutron or proton shells or subshells in the region $N > 126$ and $Z > 82$ is not reliably established. There have been only a few scattered indications of the possibility of existence of weak subshells at $Z = 96$[1], $N = 148$[2] and $Z = 92$[3].

New data on the properties of isotopes of the transuranic elements, including the recently discovered elements 99 and 100 allows us to look into this question anew. The greatest interest in this respect is provided by the data on energies of α-decay. Using the experimental results of very recent papers[4-8] as well as of earlier papers[9,10], we constructed a diagram showing the dependence of the energy of the α-decay on the mass number A in the manner of the diagram of Seaborg et al[10]. Using the known β-decay energies of the nuclei 99^{254} [4] and Bk^{250} [5] and the α-decay energy of the nucleus 100^{254}, we calculated from the energy of the α-decay energy of 99^{254}, which is also indicated on the accompanying diagram. Points pertaining to the same element are connected by solid lines; points corresponding to nuclei with an equal number of neutrons are connected by dotted lines.



Dependence of α-decay energy E_α upon the Mass Number A

An examination of the diagram shows that for the element curium ($Z = 96$) a very slight decrease of α-decay energy takes place only for the lightweight isotopes; for the heavier isotopes (Cm^{242}, Cm^{243} and Cm^{244}) such is not observed. At the same time near $N = 150$ to 152 there is clearly visible a lowering of the α-decay energy with a subsequent increase; analogous to this, although on a smaller scale, are the jumps observed on a similar diagram near $N = 126$[10]. This is demonstrated most clearly by the considerable increase of α-decay energy of the nuclei with $N = 154$, especially for Cf^{252}, and also for 99^{253} and 100^{254}.

In connection with this we note that, according to the latest data[6,11], the nucleus Cf^{252}, proved to have a considerably lessened stability with respect to spontaneous fission, along with the above mentioned reduced stability with respect to α- decay.

Examination of lg τ as a function of the α-decay energy (the diagram of which is not shown here) indicates that the α-decays of nuclei Cf^{252}, 99^{253}, and 100^{254} are relatively more probable than for other neighboring nuclei; it is natural to connect this behavior with some increase of the radii of these nuclei after the subshell has been filled at $N = 150$ (or 152)[10,12].

The above facts point to the existence of a neutron subshell at $N = 150$ (or 152). According to the usual scheme of Mayer-Jensen, the following