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.

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The Neutron Subshell in the Region of the Transuranic Elements

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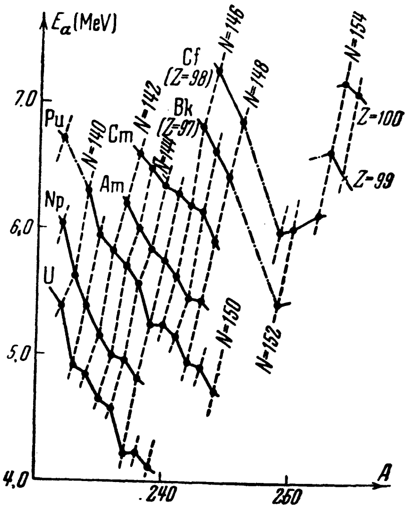
(Submitted to JETP editor September 30, 1954)

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 sequence of levels (for the neutrons) could correspond to such a subshell:

$$..7i_{13/2}|_{126}\, 6g_{9/2},\, 7i_{11/2},\, 4s\,|_{150}\cdots$$

or

$$\ldots 7i_{13/2}|_{126}\, 6g_{9/2},\, 4s,\, 5d_{5/2},\, 6g_{7/2}|_{152}\cdots$$

We express our gratitude to Prof. D. D. Ivanenko for valuable suggestions and discussions.

Note during proof reading: After this communication was sent to press, we learned of a paper[13], the authors of which, on the basis of α-decay energy values (among others also those of Cf ^{248} published for the first time) come to the conclusion that a subshell exists at $N = 152$. In view of this paper, the second of our level sequences above should be considered the more probable one.

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The Problem of Spontaneous Fission and Beta-Stability

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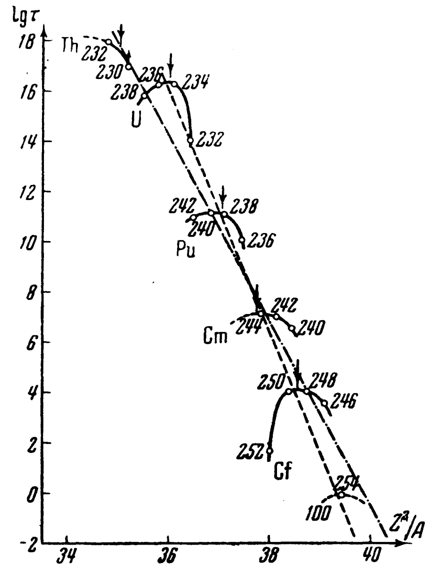
(Submitted to JETP editor September 30, 1954)
J. Exper. Theoret. Phys. USSR 28, 244-245
(February, 1955)

THE probability of fission of nuclei depends on the effective height of the potential barrier (that is, on the critical fission energy) and also on its width. Inasmuch as the critical fission energy, according to the theory of fission, is a function of the parameter $F = (Z^2/A)$, it can be expected that the probability of fission also will depend on this quantity. It was indicated by Seaborg[1] and others[2,3] that the relationship between the logarithm of the probability of spontaneous fission (or lg τ) and Z^2/A is nearly linear. However, further and more detailed investigation showed that such a relationship is at least not accurate. First, the uneven nuclei, which have a relatively low probability of spontaneous fission (in comparison with the even-even nuclei) do not fit into this general relationship. Second, and this is especially important, there is observed a maximum of stability with respect to spontaneous fission among the isotopes of a given element.



Dependence of lg τ (τ – in years) on Z^2/A

We wish to call attention to the fact that the maximum stability with respect to spontaneous fission fairly accurately coincides with the maximum of β-stability for the isotopes of a given element. We can convince ourselves of this, for instance, by examining the curve expressing lg τ as a function of Z^2/A (see accompanying figure). The experimental values for the lifetimes with respect to spontaneous fission τ are taken from the literature[4,5]. On the accompanying figure, points pertaining to isotopes of any one element are connected by solid lines. The curves obtained in this way sharply deviate from the linear relationship of Seaborg (the dash-dot line on the figure); they reach a maximum at some value of A and fall off both in the region of the lighter as well as of the heavier isotopes of the element. The latter fact is unexpected from the point of view of elementary fission theory.