In conclusion, we note the advantage of the non-diffraction processes for the study of the production of heavy resonances at large values of s by the missing-mass method. This follows from the fact that, as demonstrated above, at large values of s the ratio σ(resonances)/σ(backgr.) is small in the diffraction reactions and is not small in non-diffraction reactions.

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SUBBARRIER ALPHA PARTICLES EMITTED BY NUCLEI WITH LARGE ANGULAR MOMENTA

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The interaction of heavy ions with nuclei is of considerable interest from the point of view of the influence of the large angular momentum of the compound nucleus on the process of the relaxation of the excitation by emission of various types of particles and γ quanta.

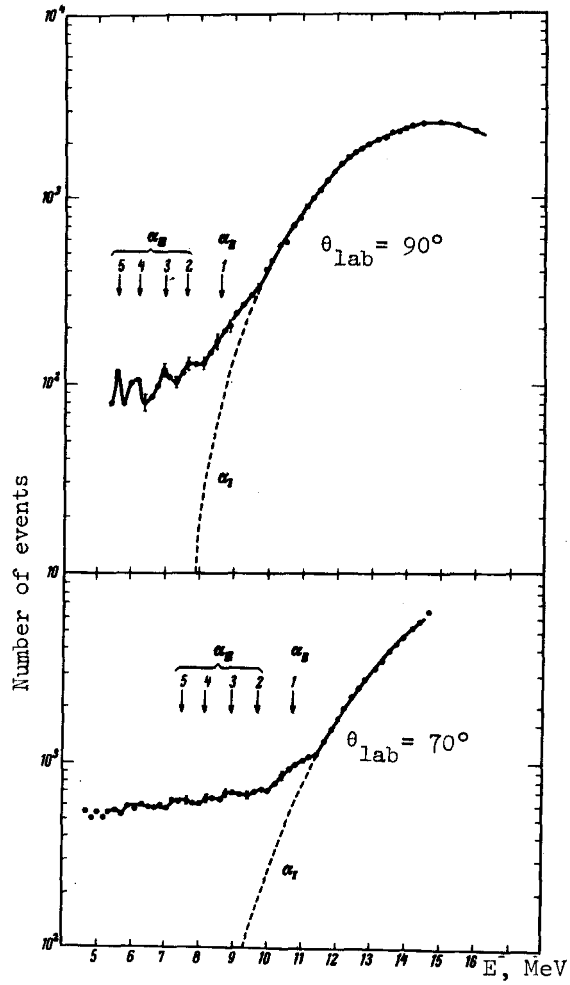
A description of the behavior of highly-excited systems is possible on the basis of the statistical theory. Using the classical cascade approach developed in [1, 2], the authors of [3 - 5] calculated the emission of particles from nuclei with large angular momenta with allowance for the consecutive change of the characteristics of the excited nucleus during the evaporation process. These calculations, in general, can be reconciled with the experimental data, with the possible exception of the excessively large fraction of α particles with energies below the Coulomb barrier in the experimental distributions.

In all the calculations, however, either no account or very approximate account was taken at all of the γ-quantum emission, whereas the competition between the emission of α particles and γ quanta plays the decisive role at the final stage of the process of excitation relaxation, as shown by Grover and Gilart [6]. Their calculation scheme was based on the statistical model of successive evaporation of the particles with allowance of dipole and quadrupole γ emission. The calculation shows a large yield of subbarrier α particles, revealing thereby a complicated structure of a subbarrier α spectrum consisting of three components. An experimental verification of the form of the spectrum would be the best confirmation of the applicability of the evaporation model and of the calculation scheme itself. With this in mind, we have performed an experiment with Ag nuclei on the U-300 heavy-ion cyclotron[1)] with energy 175.4 MeV. The target, 1.2 mg/cm^2 thick, consisted of a natural mixture of Ag isotopes and 99.99% pure. The reaction products were identified with the aid of a telescope consisting of one thin (ΔE) and one thick (E) silicon detector measuring the ionization losses of the particles and the residual energy. The thickness of the thin detector was 13.3 μ, and the energy resolution of the quantity E + ΔE

[1)]We investigated the characteristics of the α particles (differential spectra at various angles) from the interaction of Ne^{22} ions.

in the α-spectrum region of interest to us was 100 - 120 keV. The energy resolution of the E detector was ≲40 keV. The pulses from the detectors were fed either to the system for the identification of the nuclear reaction products [7], or to an AI-4096 analyzer operating in the two-dimensional mode (64 × 64 channels). The systems identified the α particles reliably against the background of the other products of the nuclear reactions.

The figure shows the subbarrier sections of the energy spectra of the α particles at angles 90 and 70° in the lab. The main parts of the α-particle spectra at all angles have a Maxwellian form with the most probable energy near a Coulomb barrier corresponding to the compound nucleus $_{57}La^{130}$. It is possible to separate in the obtained spectra three component regions or subspectra, in accordance with the definition of Grover and Gilart. The subspectrum designated α_I in the figure owed its form, especially at high energy, to the dependence of the level density of the α-emitting nuclei on the excitation energy. It would be possible also to calculate the form of this subspectrum by ignoring the γ emission of the residual nuclei and the effects connected with the conservation of the angular momentum. The most probable energy (E_{exp} = 15.6 MeV) lies near the Coulomb barrier, in agreement with the calculated value (15 - 16 MeV).



Spectra of subbarrier α particles at angles θ_{lab} = 90 and 70° in the reaction Ne^{22} + Ag.

The subspectra designated α_{II} and α_{III}, which were not observed earlier because of the insufficient energy resolution [8, 9] or because of the small angular momenta of the compound system [10], are due to the competition of the dipole γ radiation with the α emission (α_{II}) and of the quadrupole γ radiation with the α emission (α_{III}) (the α-particle binding energy ε_α is negative) at the final stage of the process of the relaxation of the excitation. It is possible to ascertain from the figures that the average angular momentum carried away by the α_{II} particle is (1 - 2)ħ. The subspectrum of type α_{III} releals apparently a complex structure and contains four weakly separated lines. The calculation does not distinguish between these lines, but presupposes their possible existence. The table shows a comparison of the experimental energies obtained by us for each of the subspectra in the c.m.s., and the results of calculations in accord with [6].

The results of the calculation agree well with the experimental data for all the subspectra. The arrows in the figure indicate the positions of the subspectra α_I and α_{II} for the angles θ_{lab} = 90 and 70°, recalculated from the c.m.s. in accord with the translational momentum of the compound system. The subspectrum of type α_{III} is an almost continuous distribution of the α particles,

Type of subspectrum	Experimental energy, MeV	Calculated energy, MeV
Most probable α_I	15.6	15 - 16
α_{II}	9.9	~10
α_{III}	9.0 8.3 7.6 7.1	7 - 8

and its occurrence may be attributed to the large probability of emission of α particles ($\varepsilon_\alpha < 0$) from the levels of cold nuclei with large angular momenta with subsequent transition of the levels of thermal excitation, or else to the existence of an intermediate mechanism [11]. These α particles are emitted with sharp anisotropy, and a ratio $\sigma(50°)/\sigma(100°) \approx 15/1$. We have started investigations of the subbarrier regions of the α spectra in the reactions $Ne^{22} + Nb^{93}$ and $Ne^{22} + Au^{197}$. The measurements have shown, just as in the case of the reaction Ne^{22} + Ag considered here, the existence of α particles with low energies ($E_\alpha < V$) and with practically continuous spectrum up to energies ~3.5 MeV (the limiting energy of α-particle identification). Background experiments performed by us (without a target) and experiments on the α spectra in reactions of light nuclei ($Ne^{22} + C^{12}$, $Ne^{22} + Al^{27}$) have shown that the discussed low-energy sections of the α spectra are produced in reactions on heavy target nuclei, i.e., they represent an effect of subbarrier emission of α particles, the interpretation of which is possible within the framework of the notions indicated above.

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STRUCTURE OF DOMAIN WALL IN WEAK FERROMAGNETS

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Several years ago we called attention [1] to the fact that the magnetization vector $\vec{M}$ in uniaxial ferromagnets near the Curie point T_c should not rotate (as is the case far from T_c) but only change in magnitude. In a direction