ORBITING CLUSTER PHENOMENA AND HEAVY IONS THRESHOLD STATES

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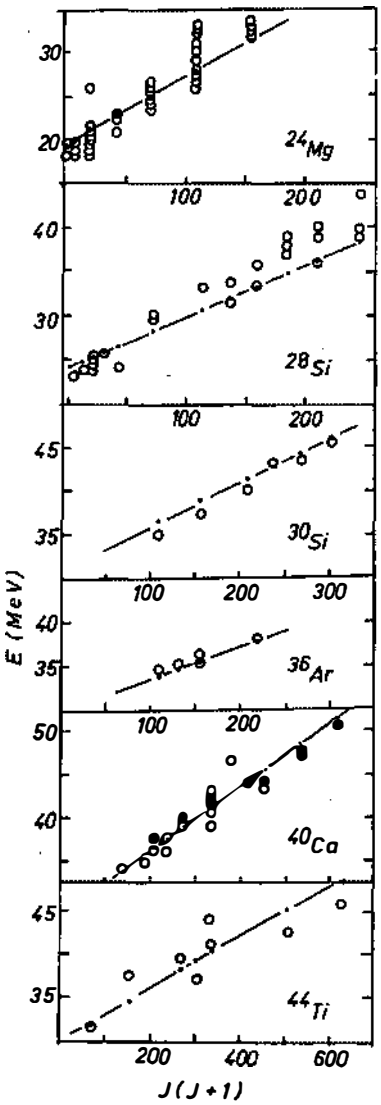

The threshold states (TS) have the following characteristic features : i) they are connected with the effective threshold for the two-body disintegration of the nucleus $B \rightarrow a_i + X_i$; ii) they have an anomalous large radius; iii) they have large reduced width for the decay in the threshold channel (almost the Wigner limit) and very low reduced widths for the decay in other channels.

The TS have been observed in light and heavy ions induced reactions and a qualitative theory of such states has been done by Baz' and Man'ko/1/.

Rotational bands of TS can exist.

A treatment of TS within the framework of R matrix theory was proposed /2/. It is based on the use of the compression factor β /3/, that defines the extension of the TS wave function outside the channel radius. The position of the TS was defined by the energy E_{min} at which $\beta(E)$ has its minimum.

In this contributed paper the relationship between the TS in heavy ions induced reactions and the orbiting cluster phenomena /4/ was studied.

The numerical calculation of the E_{min} for all the resonance states given in the work of Cindro and Pocanic was made and a diagram E_{min} vs $J(J+1)$ was drawn. A remarcable agreement can be seen (fig.1). Furthermore, the rule $E_{min} \sim J(J+1)$ was analitically established.

The damping width in our model is proportional to the strength function of the threshold channel, and consequently to the level density.

The molecular resonance-window concept is formally found again.

References

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INVESTIGATION OF α-CLUSTER STRUCTURE BY THE STRIPPING REACTION

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The (^{6}Li,d) reaction has been used by Kurchatov Institute- I.N.P group to study the properties of highly excited states of light nuclei: ^{16}O, ^{17}O, ^{20}Ne, ^{28}Si.[1-3] Lithium beam with energy from 24.5 to 60 MeV was provided by Cyclotron of Kurchatov Atomic Energy Institute.

The deutrons were recorded at the angles (8°-10°), close to the direction of the primary beam. Target + α particle systems were formed with excitation energies well above thresholds for particle emission. Investigated systems relax their excitation energies & transfered angular momenta predominantly by α particle decays leading to ground and low lying excited levels of target nuclei. Coincidence (d,α) spectra were obtained, and angular correlations of the decays corresponding to target ground states transitions were measured. The data enable to determine spins, parities, partial widths, reduced widths of several states or groups of states.

The α-cluster structure of nuclei at high excitation energy is demonstrated by existence of set of states which are selectivly populated in direct α transfer reaction, reduced α particle widths of these states are close to Wigner limit, they can be selected into quasirotational systematics, At higher excitation energy and /or heavier target (^{24}Mg) reduced widths are distributed among few close lying states which have the same characteristic. In case of ^{13}C(^{6}Li,d) ^{17}O reaction a weak coupling of single particle α cluster levels to ^{13}C core was observed[3].

Stripping of weakly bound particle followed by reemission of the transfered particle can be treated as the off-energy shell particle scattering. In terms of model out-