which differ for $\theta \gtrsim 50°$; the cutoff due to nuclear absorption occurs only at angles larger than ~100°. It would be interesting to have experimental data which show evidence of such multiple-excitation effects in the elastic cross section. Hopefully, appropriate scattering experiments with sufficient resolution can be carried out in the near future.

We remark that rather different sets of α_n, β_n fit a given scattering function with equal accuracy. However, the corresponding potentials calculated by inversion *all coincide.*

For the application of the polarization potential in the calculation of scattering and absorption cross sections, or of the absorption along given trajectories, it would evidently be useful to devise a simple parametrization of the potential whose parameters would have to be determined by systematic studies. For the absorptive part, one might consider on LTS-type behavior with a leveling off at small distances.

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Coriolis-Distorted Bands of Common $g_{9/2}$ Parentage in Odd and Doubly Odd $N = 41$ Nuclei

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All features of a $\Delta I = 1$ band displaying Coriolis-like distortions based on a 4^+ isomeric state, recently discovered in ^{76}Br, are successfully described within the framework of a two-noninteracting-quasiparticle–plus–rotor calculation. Assuming the intrinsic state to be of $\tilde{\pi} g_{9/2} \otimes \tilde{\nu} g_{9/2}$ parentage it is possible to account in a natural way for the apparent relationship noted between this 4^+ state and the $\frac{5}{2}^+$ ground-state band of the neighboring isotone ^{77}Kr.

In recent years, the study[1-7] of high-spin states in transitional doubly odd nuclei has revealed the occurrence of certain interesting phenomena. One of these concerns Coriolis-distorted band structures found in the $N = 41$ doubly odd nuclei ^{76}Br (Ref. 2) and ^{78}Rb (Ref. 4) and their apparent relationship with the $\frac{5}{2}^+$ ground-state band[8] in the intermediate isotone ^{77}Kr. The first two excited states in these bands lie nearly at the same energy as the corresponding levels in the ^{77}Kr band, and while the higher levels in the doubly odd nuclei become depressed relative to those in ^{77}Kr, the phase of the level staggering remains the same. This observation[2,4,9] seems to imply that the coupling of a certain proton excitation to the ^{77}Kr ground-state band does not alter significantly the structure of this band's low-lying spectrum.

The theoretical investigation of this problem met with success only after the recent discovery[9,10] of a 4^+ isomer in ^{76}Br and the assignment of this state as the band head[9] (instead of the 1^- ground state as hitherto thought[2]). Earlier attempts in this direction showed that it was not possible to reproduce such a band if it was built on a low-spin, negative-parity state, a result which partially motivated the search[9] for an isomer in ^{76}Br.

In this Letter we wish to present an interpretation of these band structures, based on the two-noninteracting-quasiparticle–plus–rotor model,[6] which not only is successful in explaining their characteristic features but also provides a transparent physical picture of their related nature. We shall discuss specifically the case of ^{76}Br and ^{77}Kr as the parity of the ^{78}Rb band is still an open question.[11]

The present description is based on the assumption[9] that the intrinsic motion of the two valence quasiparticles involved in the 4^+ band of ^{76}Br takes place within the $\tilde{\pi}g_{9/2}\otimes\tilde{\nu}g_{9/2}$ configuration space; that is, both the proton and the neutron move in the five Nilsson states of $g_{9/2}$ parentage. This assumption is strongly suggested by the experimental information from neighboring odd-A nuclei. The $\Delta I=1$, $\frac{5}{2}^+$ ground-state band of ^{77}Kr corresponds to a predominantly $\Omega=\frac{5}{2}$ neutron of $g_{9/2}$ parentage which feels the strong influence of the Coriolis interaction giving rise to the observed level staggering.[8] On the other hand, a decoupled $\Delta I=2$ band[12] is known in ^{77}Br, which is developed on a proton $\frac{9}{2}^+$ ($g_{9/2}$) isomeric state at 106 keV. The different characters of the bands in these two nuclei are essentially determined by the position of the respective neutron and proton Fermi levels (in the latter case this lies nearest to the $\Omega=\frac{1}{2}$ state).

The calculations were carried out for different sets of parameters without attempting a precise least-squares fit. First, the neutron and core parameters were chosen so as to reproduce the spectrum of ^{77}Kr. The deformation was fixed as $\beta=0.3$ which corresponds to the root-mean-square value for the ^{76}Kr and ^{78}Kr ground bands (Nilsson parameters are as in Davidson[13]). The pairing strength for the neutron, $G_n=22/A$ MeV, was taken approximately equal to the value used in Sanderson.[14] (BCS space includes $N=3$ and 4 oscillator shells.) An inertia constant $\hbar^2/2\theta=65$ keV, representing a slightly lower value than that corresponding to the 2^+ state of the ^{76}Kr even-even core, was used. Finally the neutron Fermi level was adjusted to $\lambda_n=-0.710$ MeV relative to the $\Omega_n=\frac{5}{2}$ state energy. The results are shown on the left-hand side of Fig. 1 and are seen to describe the ground-state band of ^{77}Kr very well, accounting correctly for both level spacings and Coriolis staggering. The divergence of the theoretical spectrum as compared to the experimental one for high spins has to do with the fact, for simplicity, a rigid core was assumed.[6]

The ^{76}Br levels were calculated using the same deformation, inertia constant, and neutron parameters as for ^{77}Kr guided by the experimentally suggested parentage between the ^{77}Kr and ^{76}Br

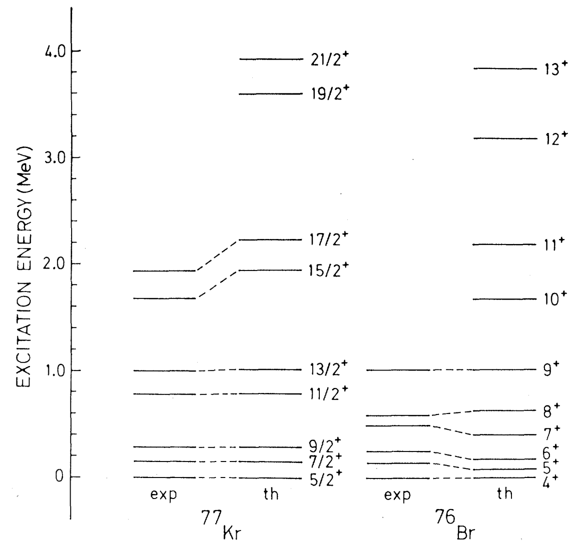

FIG. 1. Experimental and calculated $\frac{5}{2}^+$ and 4^+ bands in ^{77}Kr and ^{76}Br.

positive-parity bands. The proton Fermi level $\lambda_p=0.573$ MeV above the $\Omega_p=\frac{1}{2}$ state and the pairing strength $G_p=24/A$ MeV were used. In addition a scaling factor $k=1.4$ was introduced to allow for a different (actually larger) splitting of the proton $g_{9/2}$ Nilsson multiplet from that corresponding to the neutrons, and its main effect is to expand the spectrum, while the neutron parameters used for ^{77}Kr are fixed. However, it is worthwhile to point out that equivalent results (within ~10 keV) can be obtained for $k=1$ by increasing the deformation for both protons and neutrons (to $\beta=0.33$) and lowering λ_n slightly to -0.877 MeV. The results for ^{76}Br are shown at the right-hand side of Fig. 1. They are seen to reproduce all qualitative characteristics present in the data. It should be pointed out that similar or even better agreement might be obtained with a least-squares fitting program. However, varying the parameters around the chosen values, within a relatively wide range, has shown that the basic features remain unchanged: (a) The 4^+ state becomes the lowest and the calculated spin sequence of the yrast states is the correct one. (b) The phase of the staggering in both ^{77}Kr and ^{76}Br is the same, in agreement with experiment for $I\leq\frac{15}{2}$ and $I\leq 9$, respectively, but a change of phase is predicted for the upper states of ^{76}Br. This represents an unforeseen result of the model which makes an investigation of the states with $I^\pi\leq 10^+$ indeed very attractive.

In order to understand these results it is convenient to display the behavior of the main physical quantities[6] determining both band structures. In Fig. 2(a) we show the proton (dot-dashed line) and neutron (solid line) occupation probabilities of the different Ω components for some states of the 4^+ band. The dashed line indicates the same quantity for the unpaired neutron in ^{77}Kr. The neutron configuration in both ^{77}Kr and ^{76}Br remains essentially the same (mainly $\Omega_n = \frac{5}{2}$) for the first three states as earlier suggested.[2,4,9] On the other hand, the proton is not found to be totally decoupled, being, nevertheless, predominantly in a state of mixed $\Omega_p = \frac{1}{2}$ and $\frac{3}{2}$. Hence, from the point of view of the intrinsic energy, the states with $K = |\Omega_n \pm \Omega_p| = 1$, 2, 3, and 4 and $I = K$ lie lowest. However, the attractive Coriolis

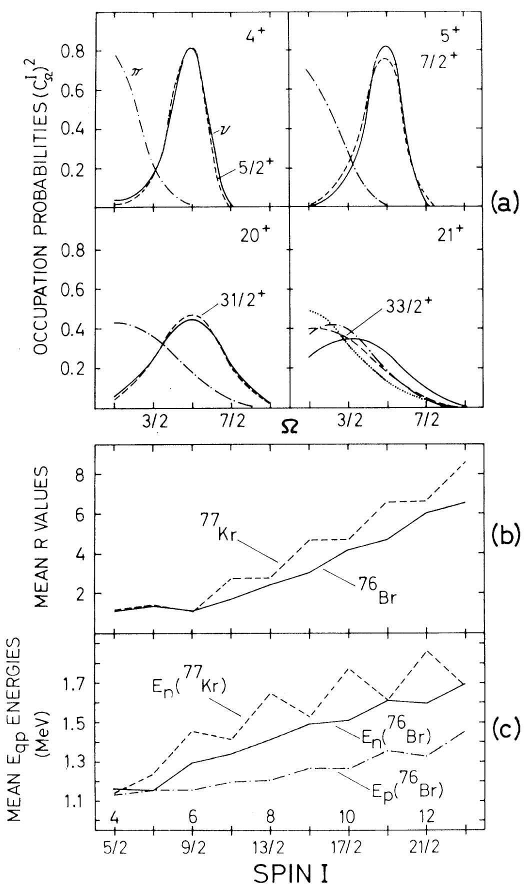

FIG. 2. Occupation probabilities for the valence proton (dot-dashed line) and neutron (solid line) in ^{76}Br and neutron (dashed line) in ^{77}Kr are plotted in (a) for the first two states and two high-spin states. The dotted line indicates the decoupled limit. In the lower half, mean values of the core angular momentum R in (b) and mean quasiparticle energies in (c) are shown as functions of spin I.

interaction is most effective for the 4^+ state because the number of contributing $\Delta K = \pm 1$ matrix elements is largest. It is, nevertheless, worth noting that the 3^+ is close to the 4^+ state.

In Fig. 2(c) the mean quasiparticle energies are displayed as functions of total angular momentum. It is seen that the proton is significantly more inert than the neutron. Its intrinsic energy remains relatively constant at the beginning of the band, particularly for the first three states. The neutron in ^{76}Br is seen to exhibit a staggering of the same phase as that in ^{77}Kr for the first states, beyond which there is a transition region until a phase change sets in for $I^\pi > 9^+$. This staggering is of similar magnitude and phase as for the proton for high angular momenta.

The amount of collective angular momentum R for each state of ^{76}Br (solid line) is given in Fig. 2(b) and it is compared with that of ^{77}Kr (dashed line). It becomes apparent from this plot that the first three states in ^{77}Kr and ^{76}Br have essentially the same R parentage. However, while the $I^\pi = \frac{11}{2}^+$ and $\frac{13}{2}^+$ states in ^{77}Kr are seen to carry approximately two additional units of core angular momentum and the sequence continues in similar steps for the upper states, the R values for ^{76}Br do not increase as fast (providing a natural explanation for the observed deviation between the ^{76}Br and ^{77}Kr spectra above the first three states) and a Coriolis-distorted rotational sequence is developed only from the 9^+ state onwards. This has to do with the fact that the maximum spin obtainable from the intrinsic motion for the doubly odd system is 9 while for the odd nucleus it is $\frac{9}{2}$. In such a situation the R values for the $I = 7$, 8, and 9 states represent the minimum-energy compromise between rotation and realignment of the intrinsic spin as means of increasing the total angular momentum. From this point of view the $I^\pi = 9^+$ state is a favored state (as is the $\frac{9}{2}^+$ state in ^{77}Kr) and ultimately a band resembling that of ^{77}Kr should develop on top of this state. In the present case this circumstance produces a change of 180° in the phase of the staggering above the 9^+ state. It would therefore be highly desirable to test this definite prediction by measuring the band in ^{76}Br to higher spins. To complete the picture at high spins, Fig. 2(a) shows the wave functions at $I = 20$ ($\frac{31}{2}$) and 21 ($\frac{33}{2}$) where the identification of states in the odd and doubly odd systems has been made by requiring same core rotation asymptotically. Unfavored neutron distributions are very similar ($I = 20$ and $I = \frac{31}{2}$), while favored distributions of both proton ($I = 20$) and neutron ($I = 21$ and

$I=\frac{33}{2}$) approach the totally decoupled limit[15] (shown in dotted line).

In summary, the present description is shown to be successful in explaining, first, the observed parallelism among the lowest three states of positive-parity bands in the doubly odd nucleus ^{76}Br and its odd neighbor ^{77}Kr, and, secondly, the deviations which occur for the higher-spin states in these bands. In addition a striking change of phase is predicted to take place above the 9^+ state in ^{76}Br, providing a stringent test for the model's validity.

Despite the fact that both quasiparticles occupy the same orbital and therefore the residual p-n interaction may be expected to play a stronger role than in other cases,[16] a "free" Hamiltonian seems adequate. These results entail the idea of a semidecoupled structure in the doubly odd system. Such a situation is reported here for the first time for medium-A nuclei and resembles to some extent the semidecoupling phenomena described in the Tl region.[1,6] In this case, however, distinct features are imprinted by the relatively large deformation which splits the quasidegenerate multiplet associated with vanishing core rotation.[6] A large variety of similar phenomena throughout the nuclidic chart may be envisaged yielding specific features which depend on the actual value of the deformation and the positions of the Fermi surfaces with respect to the relevant high-j Nilsson multiplets representing the very ingredients of the model.

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