High-spin Isomer in ^{183}Ir and Shape Evolution of the K=9/2$^-$ and 11/2$^-$ Configurations from the $h_{11/2}$ Orbital

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Abstract. The level scheme of ^{183}Ir have been investigated with the ^{150}Nd(^{37}Cl,4n)^{183}Ir reaction. High spin isomer ($I \geq 17/2$) with a halflife of $T_{1/2}$=21(1) ns has been found. It decays mainly to two rotational bands, tentatively identified as built upon 11/2$^-$[505] and 9/2$^-$[514] Nilsson configurations. The bands are mixed by Coriolis interaction. Theoretical PES calculations indicate different quadrupole deformations for these configurations in agreement with different moments of inertia in both rotational bands deduced from Coriolis interaction calculations for these bands.

Keywords: Nuclear reaction ^{150}Nd(^{37}Cl,4n)^{183}Ir, E=170 MeV, measured γγ(t), γ(t), ^{183}Ir deduced levels, isomers, configurations, rotational bands.
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The high spin states of the ^{183}Ir nucleus have been investigated with the use of the Argonne-Notre Dame Gamma-ray Facility at ANL, Argonne. An analysis of the prompt and delayed γ-γ matrices allowed to identify, for the first time in ^{183}Ir, a high spin isomer at an excitation energy of ∃1647 keV and with spin I∃17/2. A halflife of $T_{1/2}$= 21(1) ns was established for the isomer. Although the isomer is quite weakly populated, an analysis of delayed γ-γ matrices permitted for very sensitive identification of weak γ-transitions which are nearly fully obliterated by stronger transitions and γ-background in the prompt spectra. Several new levels populated by the isomeric decay have been identified in this way (Fig. 1).

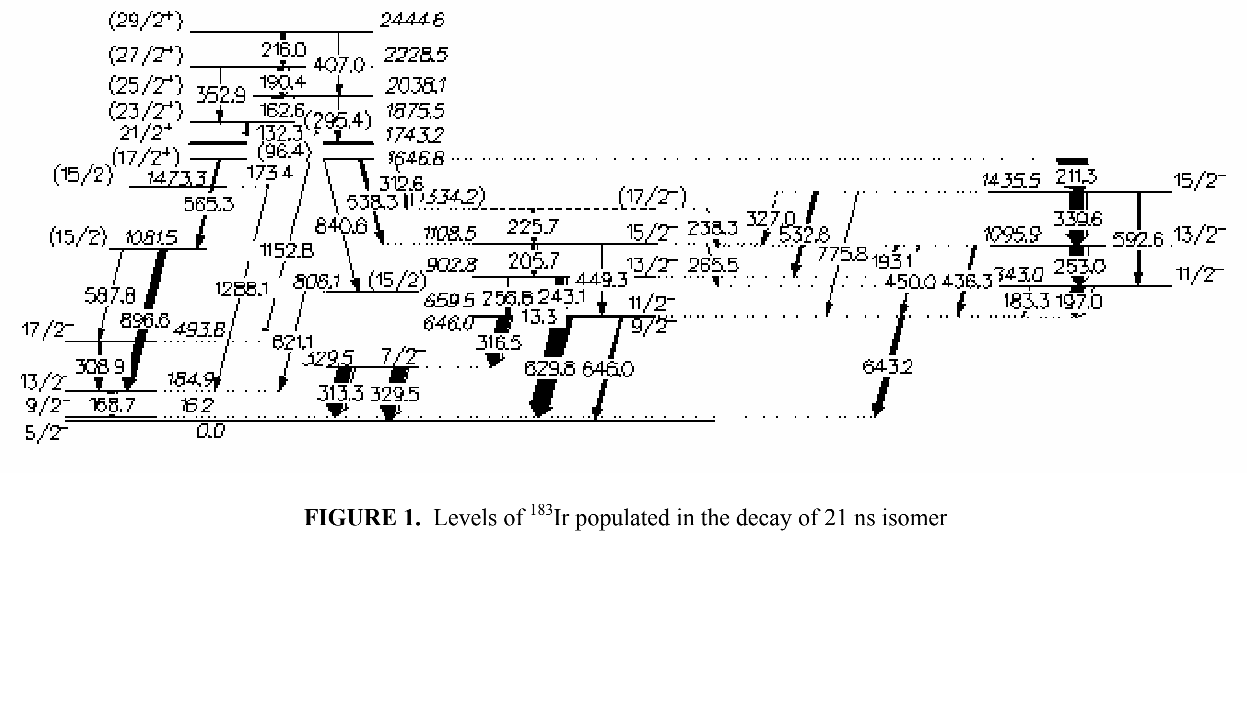

FIGURE 1. Levels of ^{183}Ir populated in the decay of 21 ns isomer

The isomer populates primarily the level structure above the already known K,I^{π}=9/2$^-$ level at 646 keV. Weak decay branches into low-K bands have been also found despite of high K-forbiddenness of the respective γ-transitions. The main decay path goes by a strong cascade of 211, 339, 253 and 197 keV transitions to the 9/2$^-$[514] band head at 646 keV. Another, much weaker path, goes via 538, 306, 243 and, unseen, 13 keV transitions to the same level. For the most intensive, 211 keV γ-transition an E1 multipolarity was assumed. This is the most probably choice consistent with intensity balance considering that the 9/2$^-$ level at 646 keV decays by the mixed M1/E2 transitions. A predominant M1 multipolarity has been deduced for three remaining strongest transitions, 339, 253 and 197 keV, from total intensity balance for the respective levels. This, together with the coincidence relations, allowed for consistent spin/parity assignments for the level structure built on the 9/2$^-$ state. This structure can be understood in the terms of two rotational bands, strongly mixed by Coriolis interaction, built on the 9/2$^-$[514] and 11/2$^-$[505] Nilsson orbitals. The latter one is for the first time identified in the light Ir isotopes with A<185. The theoretical calculations with the use of the CORIOLIS program [1] support this interpretation. The calculated undisturbed moment of inertia for the rotational band built on the 11/2$^-$[505] state is about 45% lower than the respective moment for the 9/2$^-$[514].]. Considering that moment of inertia is roughly proportional to squared quadrupole deformation parameter, β_2^2, it indicates about 22% lower quadrupole deformation for the former orbital. This result is in a reasonable agreement with theoretical calculations of potential energy minima. Energies of local minima in the potential energy surface and corresponding deformation parameters were obtained by performing a multi-parameter minimization of the total energy with respect to β_2, β_4 and β_6 parameters. For more detailed description of the model see ref. [2,3]. The considerable different quadrupole deformation parameters, β_2=0.19 and 0.23 were found for the discussed above [505]11/2$^-$ and [514]9/2$^-$ orbitals, respectively. However, the difference of calculated β_2 values is about two times lower than inferred from experimental data and Coriolis calculations. The calculated Woods-Saxon deformation energy, defined as $E_{def} = E(\beta_2,\beta_4,\beta_6) - E(\beta_2,\beta_4,\beta_6=0)$, as a function of quadrupole deformation β_2 is shown in the figure below for two orbitals of interest. The values of β_4 and β_6 parameters were calculated independently for each β_2 value and correspond to the respective energy minimum in the β_4 - β_6 plane.

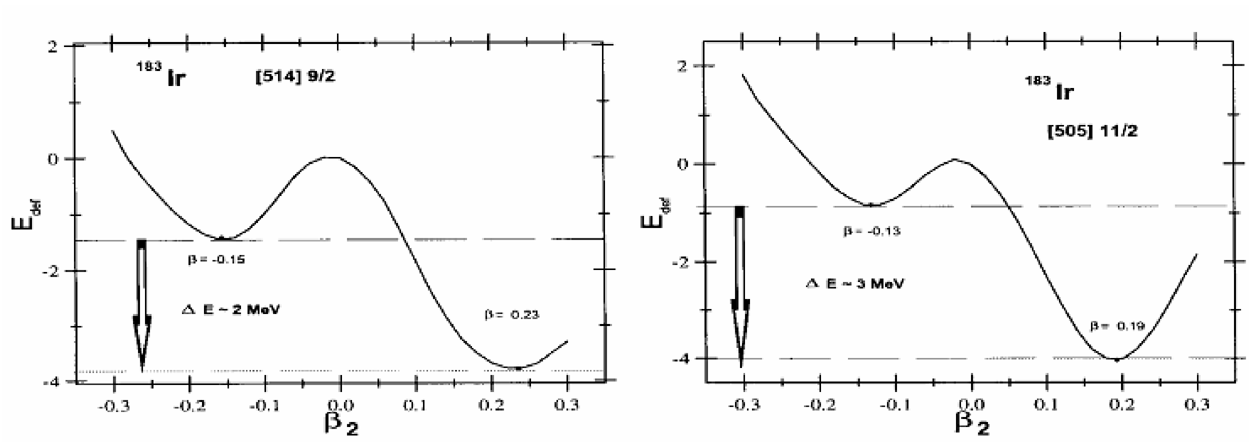

FIGURE 2. Deformation energy minima for the 9/2$^-$[514] and 11/2$^-$[505] configurations.

The systematics of the [514]9/2$^-$ and [505]11/2$^-$ orbitals in the odd Ir isotopes with A = 181(tentative) to A=191 suggest gradual shape change of the latter orbital from (nearly) prolate in light Ir isotopes to triaxial shape in the heavier ones.

EFERENCES

1. R. Kaczarowski, *Comp.Phys.Comm* **13**, 63 (1977)
2. S. Ćwiok et al., *Comp. Phys. Comm.* **46**, 379 (1987)
3. P.Möller and J.R. Nix, *ADNDT* **39**, 213 (1988)