Studies of ^{193}Os and ^{113}Cd with Single Neutron Transfer Reactions ◇

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The ^{192}Os(d,p)^{193}Os Reaction

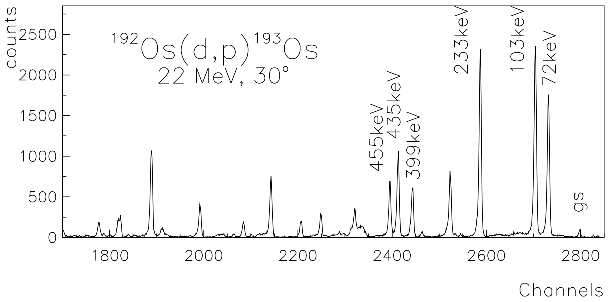

Fig. 1: Displayed is part of the ^{193}Os(d,p) spectrum up to an excitation energy of about E_x=900keV with a resolution of 5keV FWHM.

A very complex transitional region is spanned by the W, Os and Pt nuclei, which has attracted considerable interest in the past years both, to experimentalists and theoreticans. The Interacting Boson Model (IBM) [2] has three limiting symmetries which correspond to the group classifications SU(5) (anharmonic vibrator), SU(3) (deformed symmetric rotor) and O(6) (deformed γ-unstable oscillator). In the framework of the IBM the even-even Pt nuclei have been successfully described in the limit of the O(6) symmetry, and in the Os isotopes a O(6) $\rightarrow$ rotor transition is observable [5]. These results initialized further studies of the corresponding odd-A nuclei in the mentioned region. An extension of the IBM, the Interacting Boson Fermion Model (IBFM) describes even-odd and odd-even nuclei. An overall analysis of the ^{191}Os structure [4] shows coexisting oblate and prolate configurations. We are now interested to investigate the heaviest osmium isotope which is accessible in single neutron transfer: ^{193}Os. Excitation energies are known from ^{192}Os(d, p)^{193}Os [1] and ^{192}Os(n, γ)^{193}Os measurements [1,3], but there is limited information about quantum numbers.

We have measured the single neutron transfer ^{192}Os(d,p) reaction at the Munich tandem accelerator using the high resolution Q3D magnetic spectrograph and a focal plane detector. The 22MeV deuteron beam was 200nA on target. The target consisted of 135$\frac{\mu g}{cm^2}$ highly enriched ^{192}Os (99%) on 16$\frac{\mu g}{cm^2}$ ^{12} carbon backing. The ^{193}Os spectrum (fig. 1) shows a nice resolution of up to 5keV. The ground state is the very weakly populated 1/2+. Data evaluation is still in progress. Data will soon be complemented with a measurement of the ^{192}Os($\vec{d}$, p) reaction with a polarized deuteron beam .These data will enable us to assign spin and parity of the neutron states.

References

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Study of ^{112}Cd($\vec{d}$,p)^{113}Cd

The ^{113}Cd nucleus plays an important part in the understanding of nuclear synthesis and provides a good test for the Interacting Boson Fermion Model (IBFM) [1]. The even-even core ^{112}Cd is well described by the U(5) vibrational limit of the Interacting Boson Model (IBM) [2]. This allows to perform IBFM calculations varying only the parameters describing the odd neutron and its coupling to the even-even core. In the IBFM model space the additional neutron may occupy the following orbitals: $2d_{\frac{5}{2}}$, $1g_{\frac{7}{2}}$, $3s_{\frac{1}{2}}$, 3d $_{\frac{7}{2}}$. These are positive parity states. The $1h_{\frac{11}{2}}$ is taken into account forming the sole negative parity state. The parameters of the Hamiltonian describing the system are further restricted by considering semi-microscopic arguments. The established low-lying intruder states of the ^{112}Cd core are not included in the IBM model space. We expect to find additional single particle states of the odd neutron coupling to an ^{112}Cd-intruder state.

We have measured the ^{112}Cd($\vec{d}$,p)^{113}Cd reaction using the 22MeV polarized proton beam of the Munich tandem accelerator and the high resolution Q3D magnetic spectrograph. Targets of 98.6% enriched 134$\frac{\mu g}{cm^2}$ ^{112}Cd foil on 17$\frac{\mu g}{cm^2}$ carbon backing were used. Main impurities are due to ^{113}Cd (0.5%) and ^{114}Cd (0.6%). The spectra (fig. 2) show a good resolution of 5keV. The polarized deuteron beam (150nA on target) allows of spin assignments and extraction of spectroscopic factors up to 2.4MeV excitation energy. Observed energy levels up to 1MeV of our ^{113}Cd data are in good agreement with ^{112}Cd(d,p) measurements of poorer resolution [3] (12keV) and recent ^{110}Pd(α,nγ)^{113}Cd data [1] of N. Warr et. al..

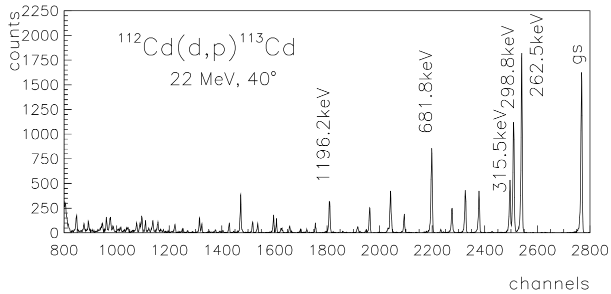

Fig. 2: The ^{112}Cd(d,p)^{113}Cd spectrum measured with a 22MeV deuteron beam at the Q3D spectrograph. The peaks show a good resolution of 5keV FWHM. Energy levels of the lower-lying prominent states are shown.

References

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