Spectroscopy of ^{181}Hf via the ($\vec{d}$,p) reaction

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The nuclear structure of the heaviest Hf nuclei has attracted special interest due to a vicinty to the complex transitional region of the W, Os and Pt nuclei.

^{181}Hf is the last in the chain of Hf isotopes which can be studied with nucleon transfer reactions. At present the experimental information is rather unsatisfactory and there are many uncertainties concerning the location of Nilsson states even at energies below 1 MeV excitation energy. There is ambiguous information about quantum numbers from previous (d,p) [1] and (n,γ) [2] studies. We hope that the application of polarized deuterons in conjunction with a superior energy resolution will allow to solve the question of the J^π values for most of the levels in ^{181}Hf.

We performed measurements of the ^{180}Hf($\vec{d}$,p) reaction at $E_d = 24.0$ MeV. A polarized deuteron beam of the Munich Tandem Van de Graaff accelerator was used (with a polarizaton of ≈0.60). The target consisted of 105 μg/cm^2 HfO_2 (96.2% enriched in ^{180}Hf) evaporated on a 5.6 μg/cm^2 carbon backing. The reaction products were analyzed with the Q3D magnetic spectrograph and detected in the 1.8 m long focal plane detector [3] which covered an excitation range up to almost 3.4 MeV with one magnetic setting of the spectrograph. The energy resolution of the experiment was around 6 keV FWHM. Spectra (see fig.1) for the two orientations of the spin have been measured at 10 angles between 11° and 45°.

Five new levels below 1 MeV excitation energy are proposed in the present studies. The evaluation of data is in progress. An example demonstrating the ability of spin-parity assignments is shown in fig.2.

The present studies are complemented with new measurements of thermal-neutron capture gammas performed at the Nuclear Physics Institute at Řež near Prague.

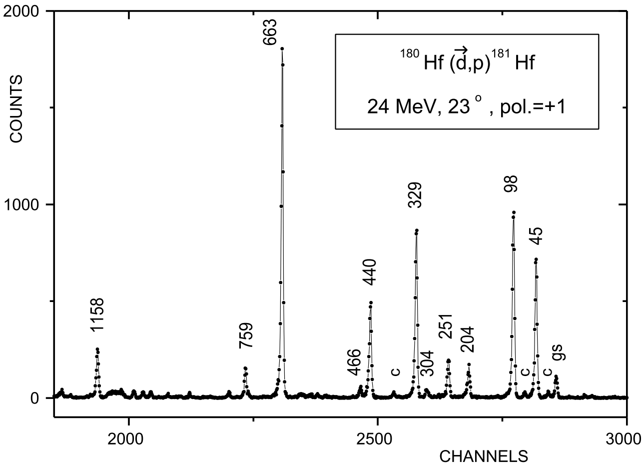

Fig. 1: An example of the ^{180}Hf($\vec{d}$,p)^{181}Hf spectra measured at the Q3D spectrograph. The prominent peaks are marked by their energy in keV. Contaminants are denoted by c.

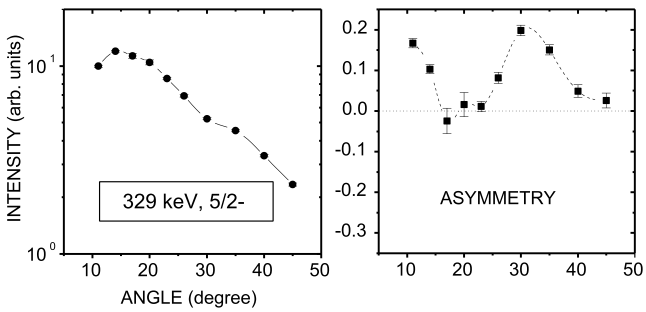

Fig. 2: Example of an angular distribution of a level in ^{181}Hf. (Note: The curves only join the experimental points.)

References

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