Measurement of the direct neutron decay of ^{68}Ni*

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The investigation of low-lying dipole strength in atomic nuclei is of great interest due to its connections to fundamental nuclear properties, such as neutron-skin thicknesses or the symmetry energy of the equation-of-state of nuclear matter. The experimental data presented here was obtained using the R^{3}B-LAND setup at GSI in Darmstadt, offering a possibility to study collective excitations in radioactive nuclei. One of the goals of the present experiment was to study the dipole strength in neutron-rich Ni isotopes, such as ^{68}Ni which is discussed here.

In the present experiment, the measured E1 strength is limited to excitation energies above the neutron threshold. The energy range of interest, covering the low-lying E1 strength and the Giant Dipole Resonance regions, involves mainly the (γ,n) and (γ,2n) reaction channels in ^{68}Ni. The quantitative description of the experimental data relies on the precise understanding of the response of the various detector systems of the setup. A trial input is convoluted with this response and compared to the measured data, as is shown for the neutron kinetic-energy distributions in Fig. 1. As an example for the various observables, the neutron kinetic-energy differential cross section for the 1n channel is presented in the upper and those for the 2n channel in the lower panel. The former shows the experimental data (open black dots) and the corresponding convoluted E1 strength input distribution (solid black line). This distribution can be divided into a statistical-decay contribution (dashed blue line) and into a direct-decay contribution (dotted red line), where the compound nucleus de-excites into the ground state by emitting a single neutron.

The lower panel presents the kinetic-energy differential cross section of both detected neutrons (solid black dots), as well as the sum of the kinetic energies of both neutrons (open red boxes). The corresponding convoluted E1 strength input distributions are shown as solid black and dashed red lines, respectively. While the trial E1 strength

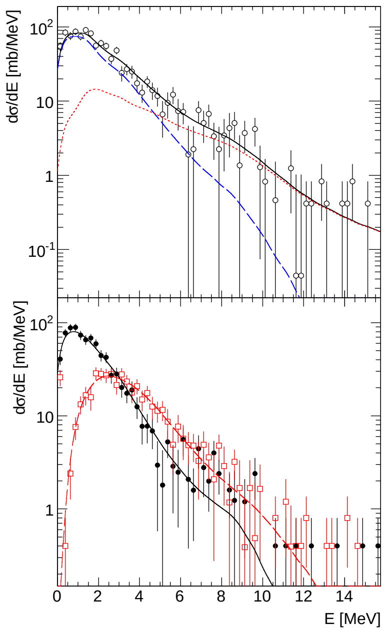

Figure 1: Neutron kinetic-energy differential cross sections. See text for description.

input is adjusted to describe the 1n and 2n data shown in Fig. 1, the branching ratio for the direct neutron decay can also be obtained by using this quantity as a free parameter during the fitting procedure. A direct-decay contribution of 25(2)% was obtained, which is in good agreement with estimation values of ≈30% for the A=60 mass region [1].

References

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* This work has been supported by HIC for FAIR and EMMI.