Spectroscopy of ^{159}Gd via (d,p) and (d,t) Reactions

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The even-even nuclei of the rare-earth region have lately been the center of investigations regarding the existence of multiphonon excitations. Whereas evidence for double-phonon vibrations has been suggested in several deformed nuclei [1], the supporting arguments can also be explained by band-mixing effects or even disproved by misplacements of γ-transitions as has been recently reported [2] in the neighboring ^{158}Gd. In this regard, a detailed study of the low-energy decay scheme in ^{159}Gd can serve as an useful tool to examine γ-vibrational bands and their one-quasiparticle admixtures in this region. This nucleus also provides a testing ground for the IBFM model, which has been applied to ^{159}Tb [3] with SU(3) dynamical symmetries. Previous spectroscopic information on the nuclear states and transitions in ^{159}Gd was rather incomplete and suffers from too poor accuracy to reliably allow the determination of its decay scheme. For all these purposes, the transfer reaction experiments will complement our extensive new high-resolution data on primary and secondary γ-transitions in ^{159}Gd [4,5].

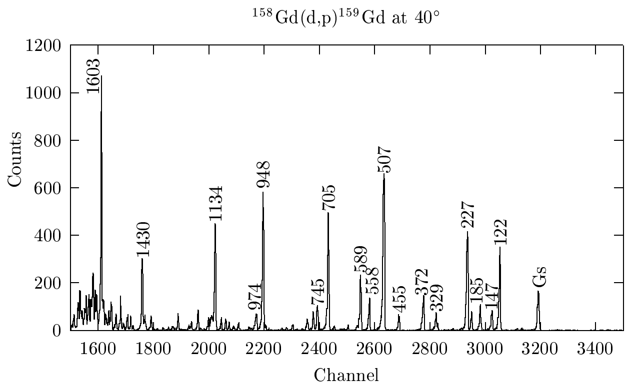

Fig. 1: Part of ^{158}Gd(d,p)^{159}Gd spectra measured at the Q3D spectrograph. Prominent peaks are marked by their level energy in keV.

We performed measurements of the ^{158}Gd(d,p)^{159}Gd reaction with an unpolarized deuteron beam (E_d = 18.0 MeV) at ten angles between 13 and 55 degrees. The target consisted of 130 μg/cm^2 Gd_2O_3 (97.9% enriched in ^{158}Gd) 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 [6] which covered an excitation range up to almost 3.2 MeV with one magnetic setting of the spectrograph. The energy resolution of the experiment was around 6 keV FWHM. An example of the ^{158}Gd(d,p)^{159}Gd spectra is shown in fig. 1. Illustrative angular distributions for some selected states are presented in fig. 2. The evaluation of data is in progress. The reaction ^{160}Gd(d,t)^{159}Gd has been initiated and its angular distribution is yet to be measured.

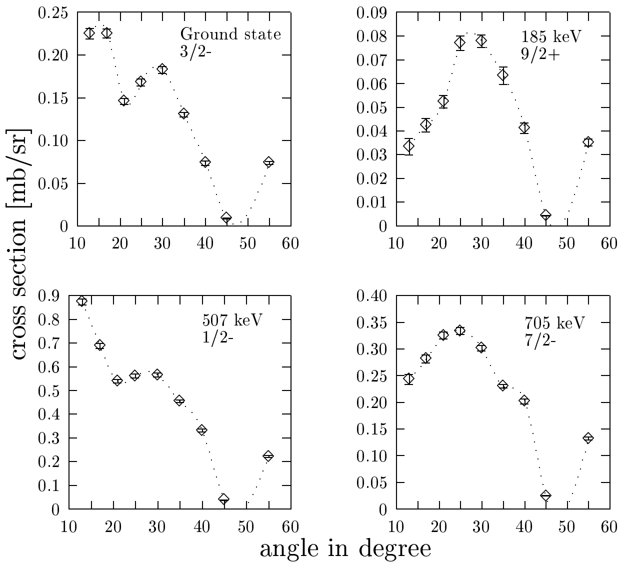

Fig. 2: Angular distribution of levels in ^{159}Gd. (Note: Curves only join the experimental points.)

References

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