$K^{\Pi} = 0^{+}$ EXCITATIONS IN DEFORMED NUCLEI

Abstract

by

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This thesis describes experiments to study levels in deformed nuclei of the rare earth region of the chart of nuclides. Two types of experiments were done; γ-ray spectroscopy measurements following the (α,2n) reaction on various targets performed at the Notre Dame Nuclear Structure Laboratory to study the ^{178} Hf and ^{154} Gd nuclei and lifetime measurements using ultra-high precision crystal spectrometry and the GRID method performed at the Institut Laue Langevin for ^{178} Hf, ^{162} Dy and ^{156} Gd nuclei. These studies focused primarily on the excited $K^{\pi} = 0^{+}$ bands in these nuclei. The (α,2n) γ-ray spectroscopy experiments failed to populate significantly any excited $K^{\pi} = 0^{+}$ bands. However we were able to extend information on previously observed excitation bands via γ-γ coincidence measurements and DCO ratios. In ^{178} Hf we observed a new excited band. The lifetime measurements were much more successful. The work reported in this thesis makes a significant contribution to the known information on lifetimes of $K^{\pi} = 0^{+}$ bands. Lifetimes of 12 levels from excited $K^{\pi} = 0^{+}$ were measured in three nuclei, 8 in ^{156} Gd, 1 in ^{162} Dy and 4 in ^{178} Hf. The measured lifetimes along with relative γ-ray

intensities were used to calculate absolute B(E2) values and provide evidence for the degree of collectivity observed in multiphonon vibrational excitations in several deformed nuclei.