SYSTEMATIC STUDIES OF (P,t) REACTIONS ON THE ER ISOTOPES

P.E. Garrett[1], C. Burbadge[1], A. Finlay [1], D. Kisliuk[1], G.C. Ball[2], V. Bildstein[1], S. Chagnon-Lessard[1], A. Diaz Varela[1], M.R. Dunlop[1], R. Dunlop[1], T. Faestermann[3], R. Hertenberger[4], D.S. Jamieson[1], B. Jigmeddorj[1], K.G. Leach[5], J. Loranger[1], P.Z. Mabika[6], A.D. Maclean[1], B. Olaizola[1], A.J. Radich[1], E.T. Rand[1], B. Rebeiro[6], C.E. Svensson[1], S. Triambak[6,7], and H.-F. Wirth[4]

[1] Department of Physics, University of Guelph, Guelph, ON N1G2W1, Canada
[2] TRIUMF, 4004 Wesbrook Mall, Vancouver BC V6T2A3, Canada
[3] Physik Department, Technische Universität München, D-85748 Garching, Germany
[4] Fakultät für Physik, Ludwig-Maximilians-Universität München, D-85748 Garching, Germany
[5] Department of Physics, Colorado School of Mines, Golden, CO 80401, USA
[6] Department of Physics, University of Western Cape, P/B X17, Bellville, ZA-7535, South Africa
[7] iThemba LABS, P.O. Box 722, Somerset West ZA-7129, South Africa

The nature of excited 0^+ states in well-deformed nuclei continue to pose a challenge in nuclear structure. Often, even the nature of the first-excited 0^+ state, 0_2^+, is unclear and interpretations involving β vibrations, pairing excitations, two-phonon γ vibrations, etc., have been advanced with different degrees of success. A major issue historically has been the paucity of data on excited 0^+ states, and especially for detailed systematic studies across an isotopic chain. In light of this, the study of the Er isotopes has been performed with a series of (p, t) reactions on highly-enriched targets of ^{162}Er – ^{168}Er. The ^{162}Er and ^{164}Er targets were manufactured some 50 years ago by passing commercially separated isotope through a second isotope separator, resulting in targets with enrichments of $>$ 99% that are essentially irreplaceable in today's climate. The experiments were performed at the Maier-Leibnitz Laboratory using 22–24 MeV proton beams, and the reaction products were analyzed with the Q3D magnetic spectrograph. Strong populations of the 0_2^+ states have been observed in ^{160,162,164}Er that are an order of magnitude (or more) stronger than other excited 0^+ states. In the heavier Er isotopes, ^{166}Er and ^{168}Er, the strength is shifted upwards in energy tracking very closely the location of orbitals relative to the Fermi surface. The systematics of the strong population of the 0^+ states in the Er(p,t) reactions, together with other properties, sheds light on the underlying nature of these levels.