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Neutron rich Ni isotopes studied by intermediate energy knock-out reactions

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Neutron-rich isotopes represent a steady source of new information on the behavior of the nucleus. Sometimes, unexpected phenomena occur such as halo-nuclei or the disappearance of the well-established magic numbers. Spin-isospin parts in the nucleon-nucleon interaction, e.g., the proton-neutron tensor force (in particular, the strongly attractive monopole parts) are expected to modify shell structure in exotic nuclei. These potential changes in the intrinsic shell structure are of fundamental interest.
Since the properties of 78Ni are much debated, neutron-rich Ni, Co and Cu isotopes have been the object of much experimental effort. The study of the single-particle character of the first excited states of odd-A, n-rich Ni isotopes allows to document the effective single-particle energies (ESPE) of neutron orbitals around the Fermi surface, and represents a step forward in the understanding of the region and the nature of the NN interaction at large N/Z ratios. Detailed knowledge of neutron and proton ESPE in the vicinity of the 78Ni doubly-magic shell closure will serve as a fundamental benchmark for the modelling of nuclear structure in regions with even larger N/Z ratios.
At the National Superconducting Cyclotron Laboratory we studied the distribution in single-particle strength in the neutron-rich 67,69,71Ni isotopes via one-neutron knockout reactions, a well-established technique to address this specific issue. The secondary 68,70,72Ni beams were produced by fragmentation reactions of a primary 82Se beam impinging on a Be target, and further purification and separation of the beam was achieved with the A1900 fragment separator. The secondary beams were transported to the S800 large-acceptance spectrometer, tuned to accept the one-neutron knock-out fragments. The de-excitation rays were measured by means of the GRETINA tracking array.
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Primary author: RECCHIA, Francesco (Dipartimento di Fisica e Astronomia - Universita' di Padova)

Co-authors: Dr GADE, Alexandra (NSCL/MSU, East Lansing, USA); Mrs KORICHI, Amel (CSNSM-IN2P3/CNRS); CAMPBELL, C.M. (LBNL, Berkeley, USA); HOFFMAN, Calem R. (ANL, Argonne, USA); Dr LANGER, Christoph (NSCL/MSU, East Lansing, USA); Dr CHIARA, Christopher J. (ANL. Argonne, USA); BAZIN, Daniel (NSCL/MSU, East Lansing, USA); Dr WEISSHAAR, Dirk (NSCL/MSU, East Lansing, USA); BERRYMAN, Eric (NSCL/MSU, East Lansing, USA); LUNDERBERG, Eric (NSCL/MSU, East Lansing, USA); Dr KONDEV, Filip (ANL, Argonne, USA); CRAWFORD, H. (LBNL, Berkeley, USA); CHEN, J. (ANL, Argonne, USA); Prof. WIMMER, Kathrin (NSCL/MSU, East Lansing, USA); Dr ALBERS, Michael (ANL, Argonne, USA); Dr CARPENTER, Michael P. (ANL, Argonne, USA); STROBERG, Ragnar (NSCL/MSU, East Lansing, USA); JANSSENS, Robert V.F. (ANL, Argonne, USA); WILLIAMS, Scott (NSCL/MSU, East Lansing, USA); NOJI, Shumpei (NSCL/MSU, East Lansing, USA); Dr LAURITSEN, Torben (ANL, Argonne, USA); BAUGHER, Travis (NSCL/MSU, East Lansing, USA); Mr BADER, Vincent (NSCL/MSU, East Lansing, USA); Dr SHAOFEI, Zhu (ANL, Argonne, USA)

Presenter: RECCHIA, Francesco (Dipartimento di Fisica e Astronomia - Universita' di Padova)

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