Argonne NATIONAL LABORATORY

PHY Seminar

Physics Division Seminar

Christopher Chiara

Army Research Laboratory

First Experimental Evidence of Nuclear Excitation by Electron Capture

Host: Shaofei Zhu

Monday, October 30, 2017 – 203, R150, 3:30 PM

Internal conversion is a well-established mechanism by which nuclear states can decay through ejection of a bound atomic electron rather than by emission of a γ ray. The inverse process, known as nuclear excitation by electron capture (NEEC), whereby a free electron is captured into an atomic orbital and subsequently excites the nucleus to a higher-lying state via a virtual energy exchange, was predicted to exist over 40 years ago. Despite various attempts, however, this process had not been previously demonstrated experimentally. To search for this excitation mode, we performed an experiment at the ATLAS facility at Argonne National Laboratory in which the 6.85-h, $21/2^+$ state of ^{93}Mo was populated in the ^{7}Li(^{90}Zr,p3n) reaction. NEEC was predicted to induce depopulation of this isomer as the fast-moving ^{93m}Mo recoils slowed in the target material, emitting a characteristic sequence of γ rays in the process. I will present the considerations behind the design of the experiment and its implementation, culminating in the successful identification of the signature γ rays using Digital Gammasphere, and the interpretation as the first observation of NEEC with an unexpectedly large cross section.