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# Accessing the neutron single-particle structure of the PDR and the CeBrA demonstrator for particle-$\gamma$ coincidence experiments at the FSU SE-SPS


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In atomic nuclei, the term pygmy dipole resonance (PDR) has been commonly used for the electric dipole (E1) strength around and below the neutron-separation threshold. It has been shown that the PDR strength str ongly impacts neutron-capture rates in the *s*- and *r*-process, which synthesize the majority of heavy elements in our universe. A precise understanding of the PDR's microscopic structure is essential to pin down how it contributes to the gamma-ray strength function ($\gamma$SF) often used to calculate the neutron-capture rates. In fact, the different responses to isovector and isoscalar probes highlighted the complex structure of the PDR and emphasized that different underlying structures would indeed need to be disentangled experimentally if stringent comparisons to microscopic models wanted to be made.

Featuring the recent study of $^{208}$Pb, I will present how the neutron one-particle-one-hole structure of the PDR can be studied with high-resolution magnetic spectrographs. The data on $^{208}$Pb were obtained from *(d,p)* one-neutron transfer and resonant proton scattering experiments performed at the Q3D spectrograph of the Maier-Leibnitz Laboratory in Garching, Germany. In this contribution, the new data will be compared to the large suite of complementary, experimental data available for $^{208}$Pb highlighting how we established *(d,p)* as an additional, valuable, experimental probe to study the PDR and its collectivity. Besides the single-particle character of the states, different features of the strength distributions will be discussed and compared to Large-Scale-Shell-Model (LSSM) and energy-density functional (EDF) plus Quasiparticle-Phonon Model (QPM) theoretical approaches. The comparison clearly points out the importance of understanding both the population of the PDR in nuclear reactions and its $\gamma$-decay properties.

To highlight future possibilities, I will also present first results from a new experimental program with the Super-Enge Split-Pole Spectrograph at Florida State University. Here, particle-$\gamma$ coincidence capabilities have been recently added to study the PDR around the N = 28 shell closure, where the dipole-type neutron-skin mode is expected to develop.


## Tuesday, October 31st, 2023

## 4:00 pm

## Lindley Hall room 321