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The highly efficient neutron detector NEDA reveals the structure of proton-rich nuclei populated in fusion-evaporation and transfer reactions.

Over the last decades nuclear spectroscopy has shown its capabilities to investigate the effective nucleonnucleon interaction in nuclear matter. Technically, this has been possible thanks to the continuous improvement in germanium γ -arrays performances and in their associated instrumentation, that has allowed an enormous increase of the experimental sensitivity.

In this presentation, I would like to discuss the progress achieved in nuclear structure physics thanks to the newly constructed neutron-detector array NEDA [1], that was recently coupled with the state-of-the-art gamma-ray spectrometer AGATA at GANIL. In particular, I will address the octupole collectivity development when approaching the N=Z line in the Xe isotopes. This mass region is noteworthy since the Fermi surface for both protons and neutrons lies between the non spin-flip orbitals $2d_{5/2}$ and the $1h_{11/2}$, with $\Delta L = \Delta J = 3$, where the octupole correlation is expected to be enhanced. In fact, the B(E3) transition probability measured in the neighbour isotope ¹¹⁴Xe is one of the highest reported experimentally [2].

In addition, I will discuss the possibility to use in the future neutron detectors, such as NEDA, to perform inverse kinematics transfer reactions, with radioactive ion beams, where the emitted particle is a neutron. I will concentrate in the ³⁶Ca case, where the intruder 0⁺ state in ³⁶Ca is predicted at 2.7 MeV, i.e. 720 keV below its mirror nucleus ³⁶S; this represents the largest Mirror Energy Difference (MED) in the whole Segrl'e Chart for bound states. This phenomenon has been dub Colossal Mirror Energy Difference (CMED) [3]. A two-proton transfer reaction, such as ³He(³⁴Ar,n)³⁶Ca will give access to the intruder 0⁺ to study its intruder nature.

[1] J.J. Valiente-Dobón, et al., NIM A 927, 81 (2019).

[2] G. de Angelis, et al., Phys. Lett. B 535, 93 (2002).

[3] J.J. Valiente-Dobón, A. Poves, A. Gadea, B. Fernandez-Dominquez, Phys. Rev. C 011302(R) (2018).

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