Contribution ID: **146** Type: **Oral Contribution**

Nuclear shapes from energy density functionals and heavy-ion collisions

Wednesday, 26 October 2022 15:45 (25 minutes)

The interpretation of the emergent collective behavior of atomic nuclei in terms of deformed intrinsic shapes is at the heart of our understanding of the rich phenomenology of their structure, ranging from nuclear energy to astrophysical applications across a vast spectrum of energy scales. A new window into the deformation of nuclei has been recently opened with the realization that nuclear collision experiments performed at high-energy colliders, such as the CERN Large Hadron Collider (LHC) or the BNL Relativistic Heavy Ion Collider (RHIC), enable experimenters to identify the relative orientation of the colliding ions in a way that magnifies the manifestations of their intrinsic deformation [1].

In this talk, I will present recent results obtained from the application of a state-of-the-art energy density functional framework to the description of some isotopes collided at high-energy at LHC and RHIC. In particular, I will show the first evidence of nonaxiality in the ground state of a nucleus, namely the ^{129}Xe, observed in the context of ions collided at ultrarelativistic energies [2]. Indeed, comparing our results with LHC data obtained by the ATLAS Collaboration [3], we demonstrate that the later are only compatible with a triaxial deformation ($\beta \approx 0.2, \gamma \approx 30°$) for the ground state of ^{129}Xe, which is in good agreement with our nuclear structure calculations as well as recent experimental results from Coulomb excitation of the adjacent isotope ^{130}Xe [4]. Finally, I will discuss new results on the heavy odd-mass nucleus ^{197}Au.

[1] G. Giacalone, Phys. Rev. Lett. 124, 202301 (2020).

[2] B. Bally, M. Bender, G. Giacalone, and V. Somà, Phys. Rev. Lett. 128, 082301 (2022).

[3] ATLAS Collaboration, Conference Note ATLAS-CONF-2021-001 (2021).

[4] L. Morrison et al., Phys. Rev. C 102, 054304 (2020).

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Presenter: BALLY, Benjamin

Session Classification: P2 Nuclear Structure, Spectroscopy, and Dynamics

Track Classification: P2 Nuclear Structure, Spectroscopy, and Dynamics