Università degli Studi di Firenze
Dipartimento di Fisica e Astronomia

PhD Dissertation

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Looking Inside Atoms: Shapes of Atomic Nuclei using Low-Energy Coulomb excitation

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The atomic nucleus is a strongly interacting quantum many-body system, characterized by single-particle motion and collective degrees of freedom. This system explores different behaviors, ranging from the spherical magic to the deformed (axial, triaxial, pear-like) or cluster shapes up to the nucleon haloes. It is an extremely changeable system, which makes the field of nuclear structure fascinating. Thanks to this complexity, the atomic nucleus shows phenomena that are also relevant for fundamental physics, matter physics and astrophysics, making this system also a good laboratory for other fields of research. Our experimental investigations to date have been limited to nuclei either in the valley of stability or near it. This because beams and targets used in accelerators are usually composed of stable nuclei and the nuclei produced in the reactions are therefore in or near the stability. The first experiments using radioactive beams have already shown intriguing features and unexpected changing in the nuclear structure **[1]**, **[2]**. For this reason the development of facilities for the acceleration of radioactive beams represents a vast and very active field of research in physics.
In this talk I will briefly introduce the nuclear structure challenges and perspectives, focusing on exotic nuclei and cross-disciplinary recent results. I will describe the low-energy Coulomb excitation technique, a well known tool to study the nuclear collectivity **[3]**. This technique is widely used at radioactive beam facilities and offers the possibility to observe the shape of the atomic nucleus. A new low-energy Coulomb excitation set-up, recently installed at LNL, will be also presented.

[1] D. Steppenbeck et al., *Nature* 502, 207–210 (2013)
[2] L. P. Gaffney et al., *Nature* 497, 199–204 (2013)
[3] A. Görgen, *J. Phys. G: Nucl. Part. Phys.* 37, 103101 (2010)