The changing shape of an atomic nucleus

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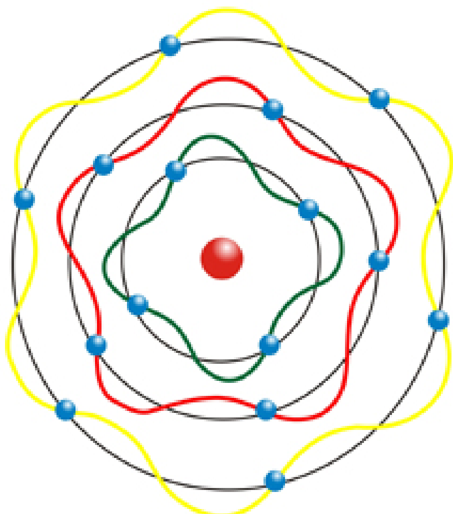

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The nucleus of an atom can have different shapes that co-exist. European scientists investigated nuclear shape change with advanced experimental techniques.

Most people are familiar with the general structure of an atom, made up of a nucleus consisting of protons and neutrons around which electrons orbit. An element's identity and its position in the Periodic Table of Elements is defined by the number of positively charged protons in the nucleus (atomic number), which is equivalent to the number of negatively charged electrons.

A different number of protons (and thus electrons) means a different element. However, a given element can have several forms (isotopes) depending on the number of neutrons in the nucleus. Isotopes of an element have different masses resulting in different properties related to relative stability, type of radioactive decay and the like.

One of the goals of nuclear physics is to understand the nature of co-existing nuclear shapes and their relationship to fundamental interactions such as nuclear vibrations or rotations.

The field of macroscopic nuclear shape change has exploded in recent years due to important technological advancements enabling experimental detection of nuclear shape changes. Lead (Pb) isotopes have proved to be quite useful as a case study of co-existing nuclear shapes and have been studied extensively.

European researchers initiated the Heavyrib project to study the nuclear structure of neutron-deficient nuclei. Scientists employed nuclear excitation and advanced experimental detection technology (the novel MINIBALL gamma-ray detector and the series CD particle detector system).

Heavyrib also developed novel methods for manipulation and preparation of radioactive beams. Experimental results include a number of firsts. Analysis of data will allow a study of the systematic behaviour of mixing between different co-existing nuclear shape structures.

In addition, the researchers have also initiated another important project to enable simultaneous detection of gamma-rays and conversion electrons previously only possible in isolation.

The Heavyrib project made important advances in understanding the nature and behaviour of co-existing atomic nuclear shapes and their role in interactions among nuclear constituents. Results help position the EU as a leader in a new and rapidly growing field of research.

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