OSS08-2008-020003

Abstract for an Invited Paper
for the OSS08 Meeting of
the American Physical Society

Gamma Rays, Nuclear Structure and the Search for a Clean Energy Release From Nuclei

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Gamma rays are emitted when a nucleus makes a transition from one state to another, so that a sequence of gamma rays chronicles the manner in which a nucleus sheds excess internal energy. The detection and analysis of gamma-ray emission therefore allows a determination of the properties of nuclear states and the probabilities for transitions between them. Not only do these transitions provide important physical insight into nuclear structure, they also present some intriguing possibilities. For example, a nucleus with a fortuitous combination of states might permit stimulated emission of an electromagnetic transition just as in atoms or molecules, leading to the development of a gamma-ray laser. Also, some nuclear excited states are known to decay so slowly that they are considered to be metastable: such isomers, a term borrowed from chemistry, can store excess internal energy with lifetimes up to many decades. It is possible that this energy could be harnessed without resorting to fission reactions, with their accompanying production of radioactive by-products. This talk will discuss the present synergy between state-of-the-art research into nuclear structure and ideas related to a controlled energy release from nuclei.