Nature's Exotic Masterpieces

FUSTIPEN brings together U.S. and French scientists to complete the nuclear portrait

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France has long been a destination for those hoping to glimpse some of the world's most famous treasures. The Venus de Milo lives there, as does the Mona Lisa. And with a collaboration launched this year, France will host a new group of visitors; those devoted to the exotic and breathtaking art of the scientific world.

Inaugurated in mid-January, the French-U.S. Theory Institute for Physics with Exotic Nuclei (FUSTIPEN) will support U.S. scientists travelling to France to work with French researchers. The objects of their collaborative venture are the rare, or exotic, nuclei. Unlike their more work-a-day relatives—the nuclei that comprise 99.9 percent of the matter around us and provide the fuel for stars—exotic nuclei aren't typically found on Earth and are difficult to replicate experimentally because they live for only a brief time. Yet a complete portrait of nuclei—how they are structured, how they interact, what properties they possess and influence—is impossible if these distant and somewhat fragile cousins aren't included. Coaxing the more skittish nuclei into participation is the expertise of scientists like UTK Physics Professor Witek Nazarewicz, who is the principal investigator on the Department of Energy FUSTIPEN grant that will fund travel for U.S. scientists. Support for French scientists is provided by GANIL (Grand Accélérateur National d'Ions Lourds), which serves as the base for FUSTIPEN. While the institute will focus on theory work, experimentalists are also encouraged to apply. The present funding permits the support of about 10-15 collaborative visits per year to study the role of exotic nuclei in understanding nuclear structure and reaction theory, as well as nuclear astrophysics. Researchers will also use exotic nuclei for tests of the standard model—the theory of how all matter is fundamentally constituted.

Inauguration of FUSTIPEN, January 18th-19th, 2011 in GANIL, Caen, FRANCE

FUSTIPEN opened officially with a two-day meeting January 18 and 19. The 80 attendees spent the first day reviewing the big picture of current research in the realm of exotic nuclei, with an overview of major projects in progress or in the planning stages. Many of those efforts showed the importance of international collaboration in large projects. The second day was a workshop focusing on theoretical problems that could benefit from U.S.-French collaborations. Among the top priorities in that vein is the application of the nuclear density functional theory and configuration interaction methods to nuclear structure, and development of new theoretical frameworks to explain nuclear reactions and fission. Although the traditional shell model works well for many nuclei, it is not a reliable tool for the weakly bound rare isotopes. Here, the complex-energy shell model, developed by UTK-GANIL collaboration, is a very promising tool. FUSTIPEN has already sponsored one topical meeting and has another scheduled for March. Further topical meetings and workshops are scheduled throughout the upcoming year.

FUSTIPEN is the natural progression of an international movement to pool resources and people to study exotic nuclei. In 2006 UTK and Oak Ridge National Laboratory scientists helped establish the Japan-U.S. Theory Institute for Physics with Exotic Nuclei (JUSTIPEN) to facilitate collaborations between U.S. and Japanese scientists whose main research thrust is in the area of the physics of nuclei.