Argonne NATIONAL LABORATORY

News Release

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Argonne scientists develop way to predict properties of light nuclei; may help understand origins of elements

ARGONNE, Ill. (May 21, 2008) – Scientists have spent 70 years trying to predict the properties of nuclei, but have had to settle for approximate models because computational techniques were not equal to the task.

In the 1990s, scientists at the U.S. Department of Energy's (DOE) Argonne National Laboratory and elsewhere succeeded in breaking through the computational barrier to provide accurate predictions of light nuclei based on how individual neutrons and protons interact with each other. Now they are learning to compute what happens when nuclei collide.

"We have new tools that should allow us to compute nuclear reaction rates that determine how the stars work and how the nuclei around us are made in the universe," physicist Ken Nollett said.

Predicting nuclear properties requires elaborate calculations in light elements such as helium, but it becomes increasingly complicated in heavier elements. Using advanced mathematical models and sophisticated computers, Argonne scientists have been able to predict the properties of elements up to carbon-12.

Extending these calculations to include colliding nuclei will help to understand the origins of the elements and the insides of stars, where such collisions occur. Studies of stars and element production rely on collision properties provided by complicated experiments. Nollett's calculations will supplement these experiments, maybe even making some of them unnecessary.

"Astrophysics depends on these difficult experiments," Nollett said. "Our calculations should provide another way to get that information."

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Funding for this research was provided by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics. The mission of the Nuclear Physics program is to foster fundamental research in nuclear physics that will provide new insights and advance our knowledge on the nature of matter and energy and develop the scientific knowledge, technologies and trained workforce that are needed to underpin the Department of Energy's missions for nuclear-related national security, energy, and environmental quality. The program provides world-class, peer-reviewed research results and operates user accelerator facilities in the scientific disciplines encompassed by the Nuclear Physics mission areas under the mandate provided in Public Law 95-91 that established the department.

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