Scientists develop way to predict properties of light nuclei

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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."

Source: Argonne National Laboratory

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