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Overturned scientific explanation may be good news for nuclear fusion

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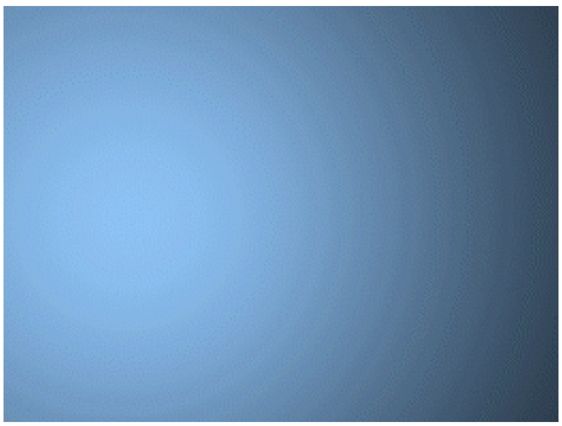

A hydrogen atom slams into boron to make three alpha particles. Credit: Focus Fusion Society. Click "Enlarge" for animation.

Flat out wrong. That's what a team of Duke researchers has discovered, much to its surprise, about a long-accepted explanation of how nuclei collide to produce charged particles for electricity – a process receiving intense interest lately from scientists, entrepreneurs and policy makers in the wake of Japan's nuclear crisis.

Plasma physicists have been trying for 25 years to create electricity from the fusion of boron and hydrogen atoms.

The [new study](#) says their efforts have been based on a misunderstanding of the underlying physics – although the error could end up actually helping those looking to fusion energy as an alternative energy source.

Researchers have been developing reactors to slam hydrogen at high speeds into boron-11, a collision that yields high-energy helium nuclei, or alpha particles. Those alphas then spiral through a tunnel of electromagnetic coils, transforming them into a flow of electrons, or electricity.

“Obviously, a detailed understanding of the energy and location of every outgoing alpha particle is crucial to the development of this reactor,” says Duke nuclear physicist Henry Weller, a co-author of the new study.

Weller and his colleagues took a fresh look at the hydrogen-boron reaction at the Triangle Universities Nuclear Laboratory (TUNL) on Duke’s campus. They expected to confirm the accepted wisdom that a collision of one hydrogen particle and one boron-11 particle produces a single high-energy alpha particle -- which produces electricity well – and two lower energy alphas, which are less useful for generating electricity.

Instead, the team found the collision yields two high-energy alphas, which shoot off at an angle of 155 degrees, along with one lower-energy alpha. The existence of this second high-energy alpha could mean these kinds of fusion systems are able to produce much more electricity than expected, says Duke nuclear physicist and study co-author Mohammad Ahmed. The [results](#) appear online in [Physics Letters B](#).

The unexpected finding appears to confirm a long-forgotten observation from physicists at Cavendish Laboratory in Cambridge, England. In 1936, they made crude, but apparently correct, estimates of the two higher-energy alphas.

Their results were “buried in history” until now, Ahmed says.

Now, 75 years later, the new insight makes the boron-fusion reaction even more interesting as a possible alternative to the nuclear fission process used in reactors in Japan and other parts of the world. A reactor based on this process could produce electricity without radioactive wastes. It also would not produce the carbon dioxide and other gases emitted by coal-powered plants.

Nuclear fusion still faces formidable challenges, one of the greatest being that hydrogen and boron only begin to fuse at temperatures close to 1 billion degrees Kelvin (nearly 2 billion degrees Fahrenheit). But building this type of reactor is realistic, says Weller, whose team is continuing to study the process at TUNL.

Provided by Duke University

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