UCLA researchers probe further into atomic nuclei

By **Donna Wong**
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UCLA researchers recently developed a new generation of high energy machines that may help solve the mysteries of creation — at the atomic level.

These "atom-smashing" machines use a pair of high-intensity lasers to accelerate electrons among superheated ionized gas waves, otherwise known as plasma waves, at the fastest rate recorded to date.

"This is a significant physics milestone. However, many challenges and unsolved problems remain to make it into a working device," said head researcher and UCLA engineering Professor Chand Joshi.

By accelerating particles at faster speeds, researchers can probe further into the structure of an atomic nucleus, gaining considerable information that could have practical applications, such as in the field of nuclear energy.

Compared to modern super colliders which separate and accelerate electrons, this new generation of particle accelerators called Beat Wave Accelerators not only proves that particles can be accelerated 100 times the rate of present accelerators, but in a shorter distance.

The 10 years of research conducted by Joshi and a team from UCLA's electrical engineering department — including main experimentalist Chris Clydon and main engineer Ken Marsh — was reported in the April 1 edition of the journal Nature.

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>
> **John Dawson**
> Professor, Physics

Especially because these accelerators may be smaller and more economical, UCLA researchers said these findings could have a large impact on the scientific and medical fields.

"Making a small compact accelerator could have many implications to medicine, science and high energy physics," said John Dawson, a UCLA physics professor.

One possible outcome of Joshi's research could be the creation of Stroboscopic X-rays that flash like a strobe light and use the particle's high speed to record rapidly occurring atomic-scale processes Dawson said.

Conceived in the 1970s, the idea behind Beat Wave Accelerator originated when Dawson realized the possibility of accelerating plasma particles with high intensity lasers.

Joshi's research executed this theory, and showed that a new generation of particle accelerator can be smaller and more economical, a factor which may make them widely available for future use in medicine and research.

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own decisions, it allowed for conflicting advice, Beasley said.

"The grad council said that graduate nursing should have priority over undergraduate nursing, but the (Committee on Undergraduate Courses and Curricula) said that undergraduate nursing should not be cut," Beasley said. "What do you do with that kind of advice?"

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Particle accelerators that can attain higher speeds will allow researchers to explore deeper into the nucleus — a function that will help researchers to better use and understand nuclear energy.

"Once we saw how the nucleus was built, we were able to get energy out of it," said UCLA physics Professor Claudio Pellegrini.

Joshi's findings are welcome news for many physicists after the congressional cancellation of the $11 billion super collider project in Texas.

"His experiments proved that you can accelerate a particle to a very high energy in a very short distance," Pellegrini said.

Present-day super colliders in the world of particle physics cost billions of dollars and sprawl for miles. Now, the machines may be sized at only a few hundred meters instead of kilometers, and this allows them to be built more economically, Dawson said.

Currently, UCLA researchers are continuing tests with the new UCLA particle accelerator, and hope to accelerate particles with even more energy than demonstrated by Joshi's experiment.

"(Particle acceleration) is 100 times more rapid now, with the potential of maybe going 100 times faster than that," Joshi said.