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THE DIGITAL COLLEGIAN

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SCI-HEALTH

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## Researchers find explosions occur faster than models show

By Marc Friedenberg [EMAIL](#)  
 Collegian Staff Writer

Penn State researchers have proven that explosive detonations can take place at velocities far greater than those predicted by current models.

The discovery will not lead to more powerful weapons or other military advantages, but can help create external propulsion systems for space and may explain the behavior of supernovae.

James Anderson, professor of chemistry, and Lyle Long, professor of aerospace engineering, showed that under rare circumstances, particles of gas could go faster than the explosion wave. This is not possible according to traditional models.

The type of explosion the researchers studied does not often happen naturally.

"It takes some pretty special cases to do that," Anderson said.

A very fast, powerful reaction in a mixture of hydrogen and fluorine is needed, he added.

The traditional Zeldovich-von Neumann-Döring model, which has been in use since 1945, said that a

detonation is caused by a shock wave moving through a reactive gas "like a wave in a stadium," Anderson said.

The wave moves through a reactive gas such as methane, which causes a chemical reaction that continues to propel the explosive wave.

The chemical reaction was thought to move only at the speed of sound, but the researchers have shown this is not true.

Anderson and Long used a computer model based on the Monte Carlo method, a stochastic method that differs greatly from most traditional differential methods.

Stochastic processes are based on molecules and do not require sophisticated equations.

The system, developed by the Greeks, became possible with the advent of the computer.

The Monte Carlo method involves breaking up space into tiny volumes that contain simulated particles.

They represent the average of thousands of other particles, which move and collide, and can move into different cells.

"We move, collide, sort and we just keep doing that over and over," Long said.

The models the researchers ran took days and dozens of computers because of the large number of factors involved.

"I think this demonstrates that we really understand what happens in a detonation now. People keep up with some really great theories, and they were really close, but now we can really simulate detonations," Long said.



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