Lawrence Livermore National Laboratory (LLNL) scientists and collaborators at Los Alamos National Laboratory (LANL) for the first time have taken 3-D snapshots of operating high explosive detonators.

Scientists from LLNL, Los Alamos and National Security Technologies, LLC (NSTech) combined state-of-the-art imaging capabilities with computed tomographic reconstruction (X-ray cross sectional imaging) in experiments performed at the Argonne National Laboratory's Advanced Photon Source to generate 3-D snapshots of exploding foil initiators.

Exploding foil initiators (EFI), also known as slapper detonators, offer safety and timing advantages over other means of initiating high explosives. However, understanding how detonators perform is challenging.

EFI is an improvement of the earlier exploding-bridgewire detonator. Instead of directly coupling the shock wave from the exploding wire, the expanding plasma from an explosion of a metal foil drives another thin plastic or metal foil called a "flyer" or a "slapper" across a gap, and its high-velocity impact on the explosive then delivers the energy and shock needed to initiate a detonation.

"The rich imaging data on EFI and flyer microstructure with time represent a new opportunity to refine the understanding of flyer operation of slapper detonators," said LLNL's Trevor Willey, a co-author of the research. "Parameters can be tuned to achieve optimal performance. The data will aid in understanding the initiation
mechanism for slapper detonators."

The research is important for assessing aging margins, safety and performance, and in developing new and improved designs.

During the experiment, a LANL/NSTech-developed four-camera system acquired four images from successive X-ray pulses from each shot. The first frame was prior to bridge burst. The second images the flyer about 0.16 millimeters (mm) above the surface, but edges of the foil and/or flyer are still attached to the substrate. The third frame captures the flyer in flight, while the fourth shows a completely detached flyer in a position that is typically beyond where slappers strike initiating explosives. The researchers then used the recently developed Livermore Tomography Tools to reconstruct 3-D images of operating flyers.

The technique is now being used to support several ongoing programmatic efforts within LLNL.

The research appears in the *Journal of Applied Physics*.


Provided by Lawrence Livermore National Laboratory

Citation: Imaging high explosive detonators (2017, March 8) retrieved 21 August 2024 from https://phys.org/news/2017-03-imaging-high-explosive-detonators.html
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