


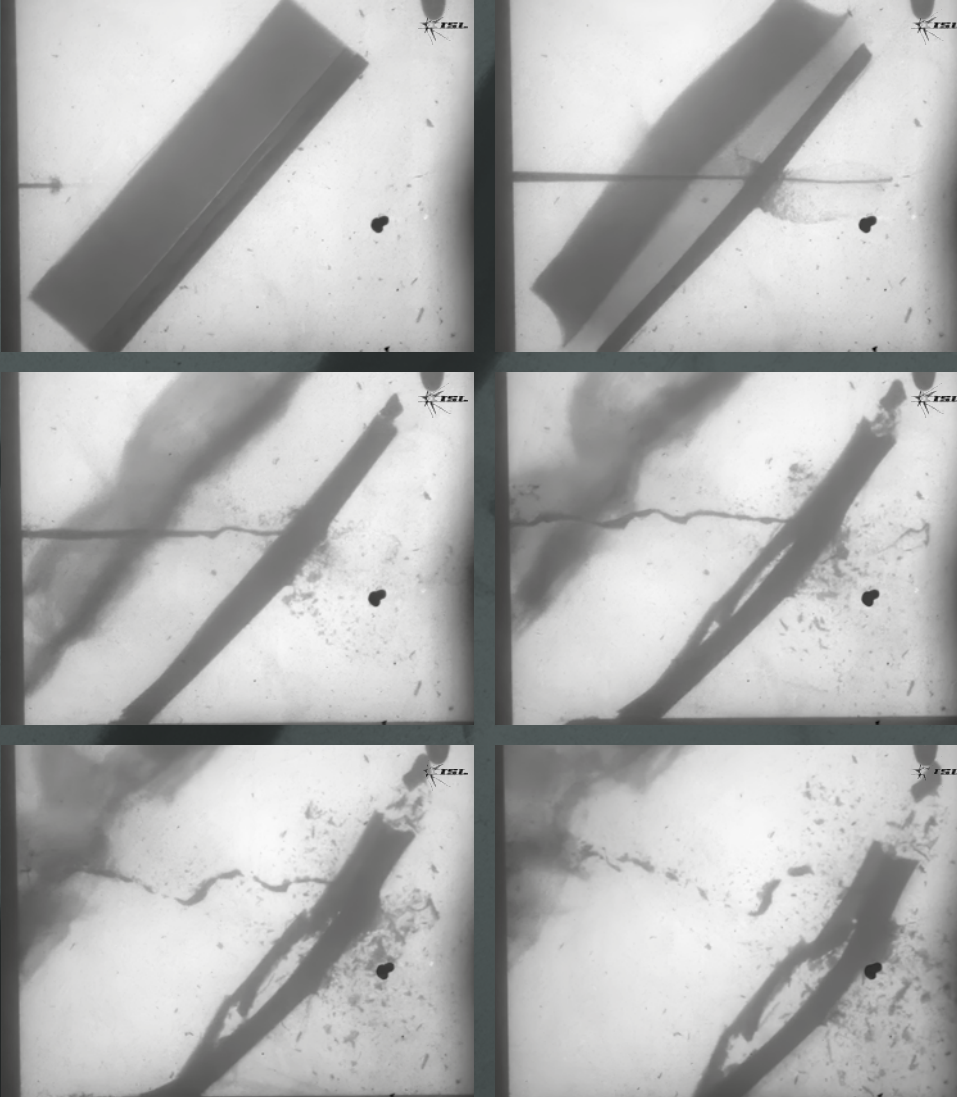
SEE WHAT'S HAPPENING **INSIDE**

EXPLOSIVE REACTIVE ARMOR

WITH **FLASH X-RAY**  **CINEMATOGRAPHY**

VISUALIZE THE INSIDE OF AN ERA AS RESPONDING TO DIFFERENT THREATS

FIXED-AREA TIME SEQUENCE IMAGING WITH MINIMUM PARALLAX



Courtesy of French-German Research Institute ISL

Abstract

In order to obtain detailed information about projectile and shaped charge interactions with a set of different Explosive Reactive Armor (ERA) configurations, a team of the French-German Research Institute of Saint-Louis, ISL, France, deployed Flash X-ray cinematography (Cine FXR) to capture different stages of the dynamic events using a Scandiflash SCF450 6C-MAT flash X-ray source coupled with a detection setup comprising an explosive-protected scintillator screen and a highspeed camera. The experiments were performed at the ISL test site in Baldersheim, France.

Courtesy ISL

Philipp Moldtmann, Jerome Limido, Andreas Klavzar and Shannon Ryan, ERA Targets against different threats: Numerical Simulations and Experimental Results. Proceedings 33rd International Symposium Ballistics. Ballistics 2023

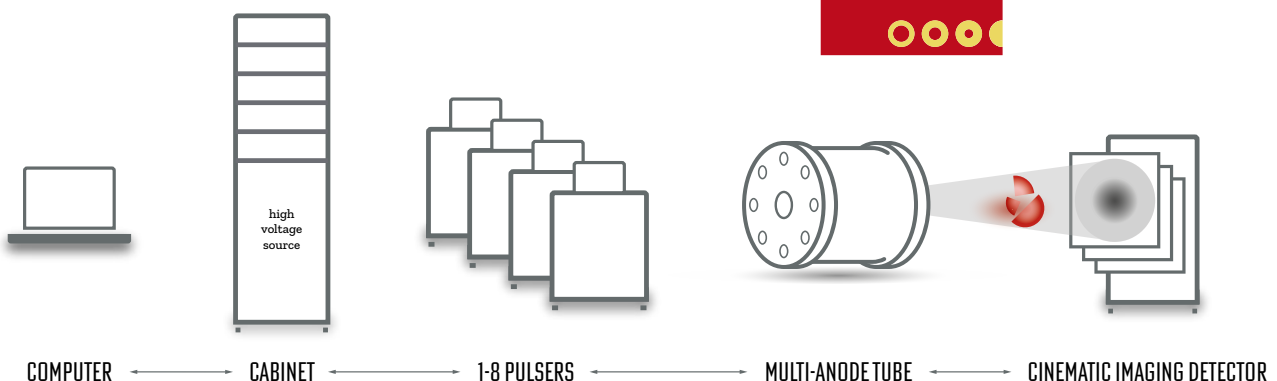
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Scandiflash core equipment

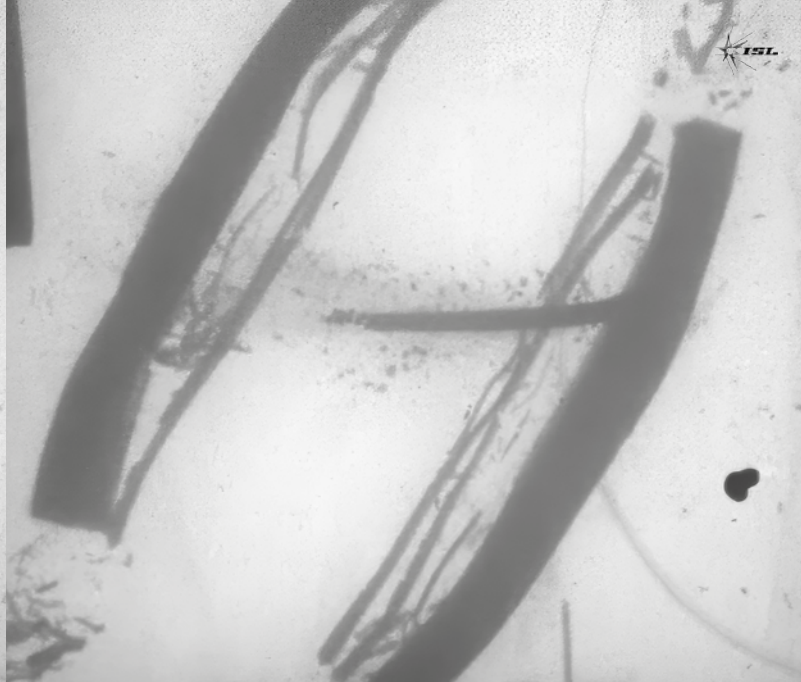
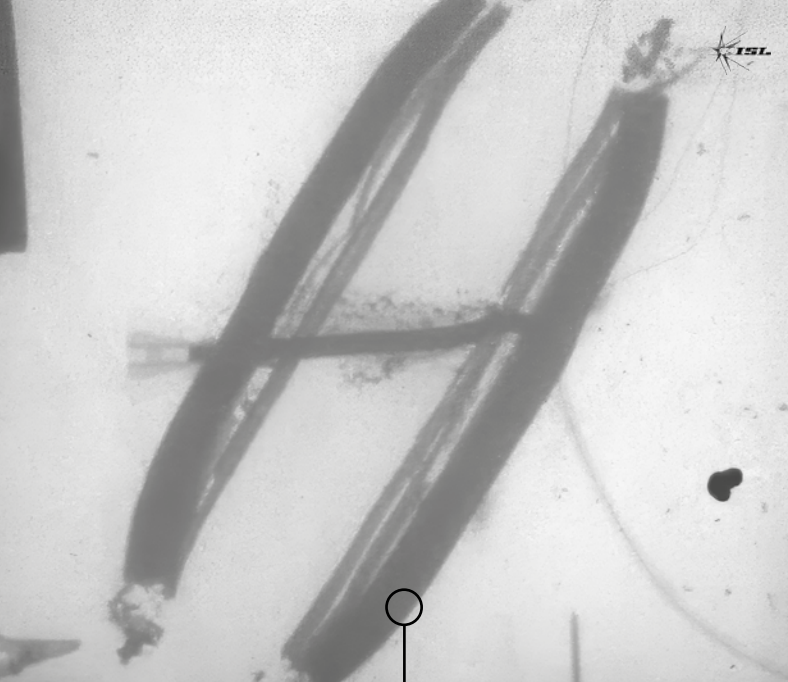
SCF basic channel setup + add-on channels
 MAT Flash X-ray source
 Cinematic Imaging Detector (CID)



www.scandiflash.com

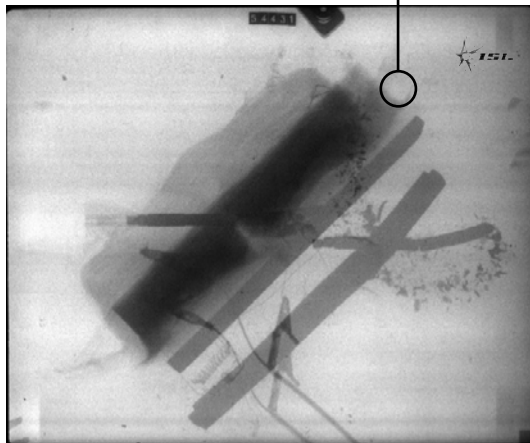


Scandiflash Cine Flash X-Ray solution



Scandiflash Cine Flash X-Ray vs Double Exposure (sometimes less is not enough)

Are you tired of double vision? The Scandiflash Cine Flash X-Ray setup is a configurable plug-and-play solution that can produce up to eight sequential images to clearly reveal the nuances of a dynamic event as it unfolds in time. High-speed X-ray cinematography is the future of flash X-ray. Compare the Cine FXR images above with the double exposure image on the right. **Which would you prefer to use in your studies?**



ISL used Cine FXR imaging to study the “hot spot” where threats collide with ERA resulting in multiple images from a near-single angle of view. The benefit of Cine FXR Imaging is that it enables “fixed-area time sequence imaging” which produces a high-speed time sequence of images of one event at a fixed area of interest in order to study the progress of the event as it unfolds. Cine FXR Imaging is achieved with a specialized flash X-ray tube known as a Multi-Anode Tube (MAT) paired with a carefully constructed and calibrated detection setup.

The team at ISL built their own detection setup with a scintillator screen and high-speed camera capable of recording one image per flash instead of multiple exposures onto a single image plate. Kudos to the ISL team as building this sort of setup is both time consuming and technically challenging!

Scandiflash now simplifies high-speed X-ray cinematography with a ready-to-go and configurable Cine FXR solution utilizing our Cinematic Imaging Detector (CID).

Flash x-ray cinematography has successfully been applied in terminal ballistics in small caliber laboratory condition tests (see for example E. Strassburger et.al., Defence Technology, 12(2016)277 and N. Faderl et al., SPIE, 10999(2019)78). Here Philipp Moldtmann, Jerome Limido, Andreas Klavzar and Shannon Ryan apply Cine FXR to medium caliber projectiles (above) and shaped charge (front page) ERA tests under harsh conditions using a Scandiflash multi-anode flash X-ray tube, MAT 450L-6C, that creates up to 6 X-ray flashes at predefined times. The tests took place at the ISL test site in Baldersheim, France.

The penetrators used were APFSDS launched with velocities of around 1400 m/s and shaped charges of 79 mm caliber with a conical copper liner. The ERA targets were made from Dyneema® HB26 for the composite plates, and ArmoX500 T for the armor steel plates. The sheet explosive was Semtex PI SE M (HP) of EXPLOSIA, with an explosive content of 88% RDX and PETN.

The experiments provided detailed images of the interactions between a sub-caliber projectile and a typical shaped charge jet as the X-rays captured views through the explosions revealing both the ERA and penetrator behavior during the dynamic events.

For more information regarding this research see Philipp Moldtmann, Jerome Limido, Andreas Klavzar and Shannon Ryan, ERA Targets against different threats: Numerical Simulations and Experimental Results. Proceedings 33rd International Symposium Ballistics. Ballistics 2023.

> SEE THE REPORT



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