Application note

No. 18

Capturing an event at 1Billion pictures/second.

EXPERIMENT OVERVIEW

The purpose of the test was to capture the electrical discharge between a plate cathode and disk anode with a potential difference between them in the order of kilovolts. The event emitted both visible and UV light for a period of a few nanoseconds.

EXPERIMENTAL SET UP

Potential Gap:

The separation of the anode and cathode was 20mm at the narrowest point. The image below shows a typical array of capacitors capable of providing a short pulse at very high voltage.

Triggering:

The event trigger to the SIMX16 camera was from an induction loop pick up within the high voltage system. This is the safest way to trigger the camera for high voltage applications but inherently creates unknown trigger delays. Since the event duration is 10 – 20ns and the record duration 16ns at 1Bfps, this presents a triggering challenge. A well tested method to find the event relative to the trigger is described below.

Camera set-up and Triggering:

The camera/lens is placed in a large faraday cage. Ethernet communication to the control PC is via the fibre optic connection option mounted in the camera. This arrangement mitigates the likelihood of many kilovolts entering and damaging the camera.

The ability to configure all the channels independently was used to find the correct timing relative to the camera trigger. The delay to the first image (ICCD channel) was estimated. This first channel was set with a long exposure time of several microseconds, and intensifier gain reduced to limit saturation and risk of intensifier damage. This long exposure time allows the user to adjust the delay to search for the event with fewer tests. To narrow down where the event occurred within the first channel exposure, the remaining 15 channel exposures were equally spaced end to end between the start and end of the channel 1 exposure. To capture the event with 1nS interframe time the delay and start/end points of channel one exposure (with all other channels still within these limits) was incrementally adjusted until the correct trigger timing was found.

UK **(Head Office / Factory)**

6 Harvington Park, Pitstone Green
Business Park, Pitstone.
LU7 9GX England

+44 (0) 1442 827728

USA

Specialised Imaging Inc.
40935 County Center Dr. Suite D
Temecula, CA 92591, USA

+1 951-296-6406

GERMANY

Hauptstr. 10,
82275 Emmering
Germany

+49 8141 666 89 50

specialised-imaging.com **info@specialised-imaging.com**

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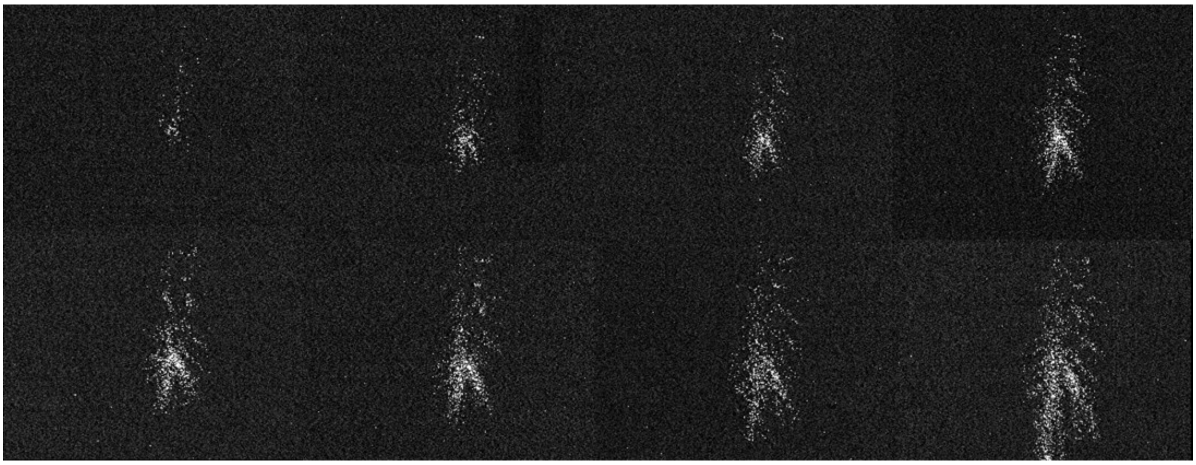
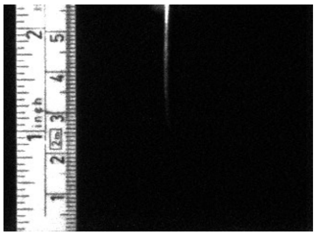
FM 87429

RESULTS

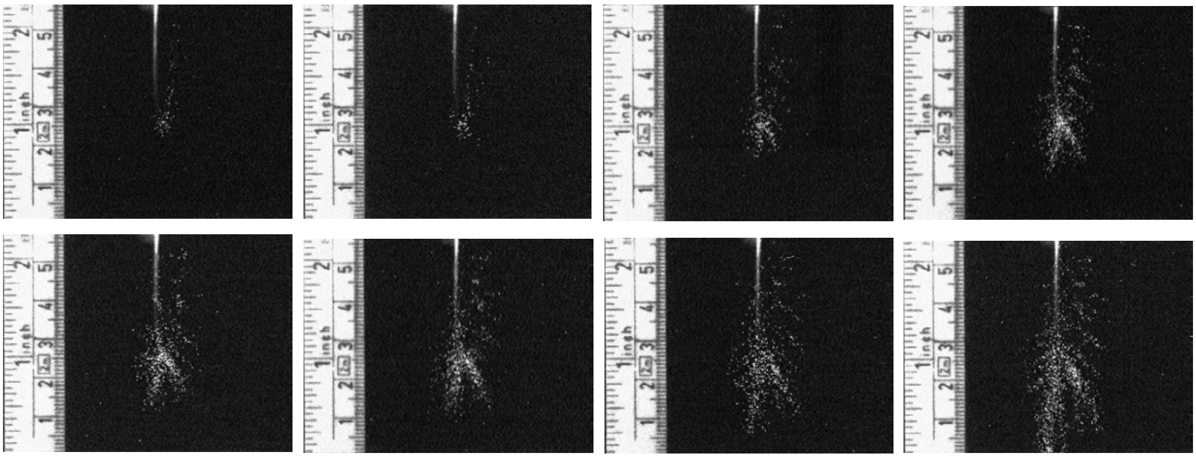
Several shots were taken before the correct delay for the event was found using the method described above. 8 of the 16 images are shown below.



All dynamic sequences were taken without illumination to clearly capture the self-illuminating discharge between the anode disc to the cathode plate, as shown above. To provide context, the "overlay" feature of the SIM camera software was used. This allows merging of a "static" sequences taken with illumination and showing the ruler and anode edge, (shown right) with the "dynamic" image sequence. 8 of these combined images are shown below.



CONCLUSIONS



The purpose of these tests were to establish the camera's ability to capture an extremely short event, emitting relatively weak amounts of light. Four of the cameras many features helped capture these meaningful images; 1) Camera control using Fibre Optic communications allowed safe operation in dangerous high voltage environments, 2) Independent ICCD channel set up and triggering allowed the event to be quickley "found" relative to the input trigger, 3) The system light sensitivity captured clear images of the electrical discharge even when configured with an increadibly short exposure time of 3ns. Finally, the camera "overlay" software function provided a way to place the captured dynamic images within the surrounding infrastructure context.

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LU7 9GX England

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USA

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GERMANY

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