

MOXIE

Movies Of eXtreme Imaging Experiments

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Imaging System Overview

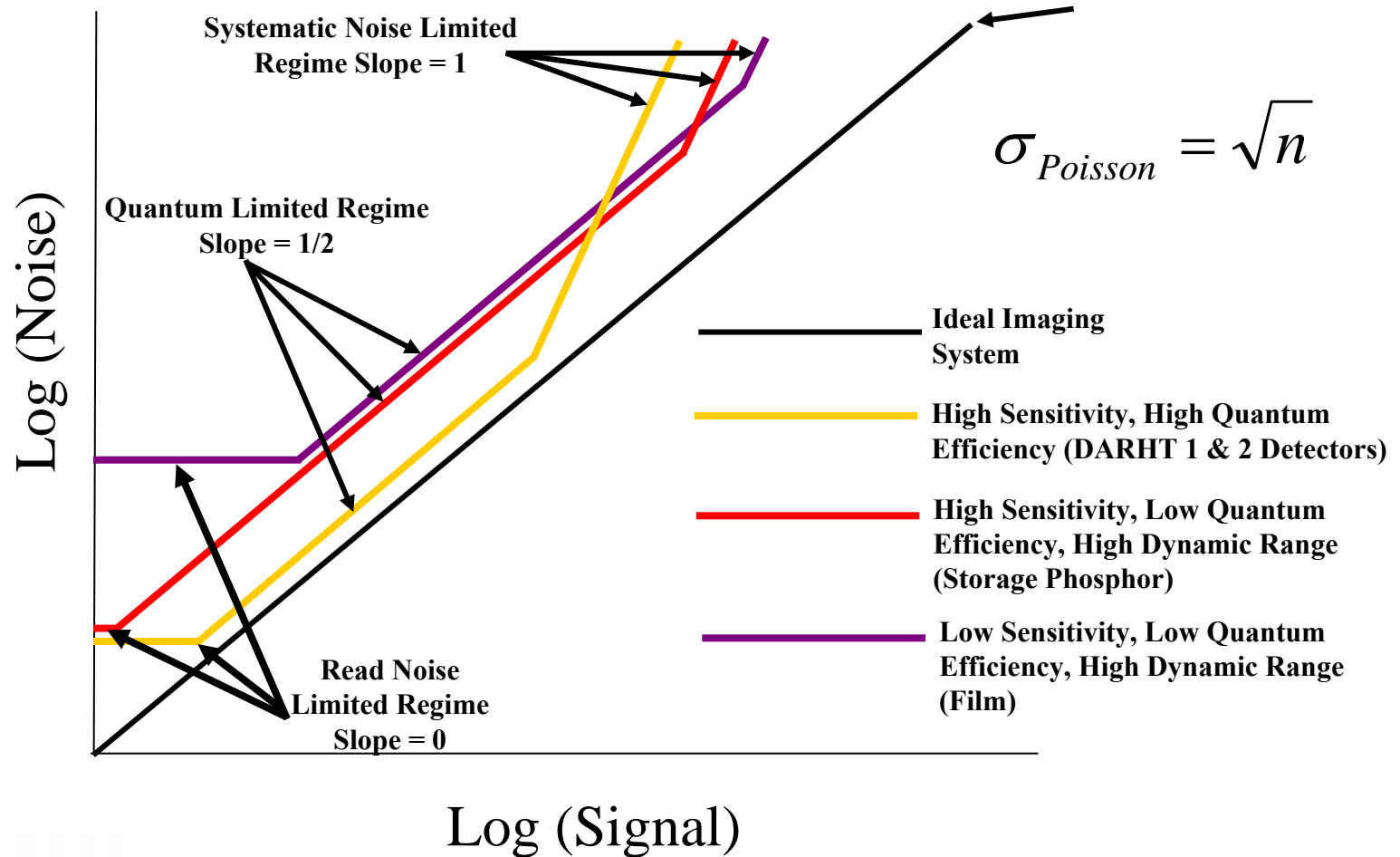


Illustration of DQE

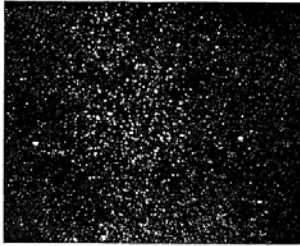


FIG. 1. Number of photons, 3×10^3 ; high-light luminance (foot-lamberts), 10^{-4} .



FIG. 4. Number of photons, 7.6×10^4 ; high-light luminance (foot-lamberts), 2.5×10^{-4} .



FIG. 2. Number of photons, 1.2×10^4 ; high-light luminance (foot-lamberts), 4×10^{-4} .



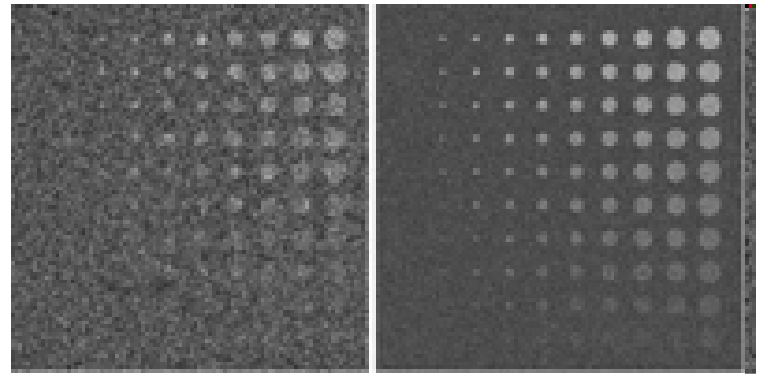
FIG. 5. Number of photons, 3.6×10^4 ; high-light luminance (foot-lamberts), 1.2×10^{-3} .



FIG. 3. Number of photons, 9.3×10^3 ; high-light luminance (foot-lamberts), 3×10^{-4} .



FIG. 6. Number of photons, 2.8×10^4 ; high-light luminance (foot-lamberts), 9.5×10^{-4} .



(a)

(b)

Collaborators



Mikro Systems, Inc.

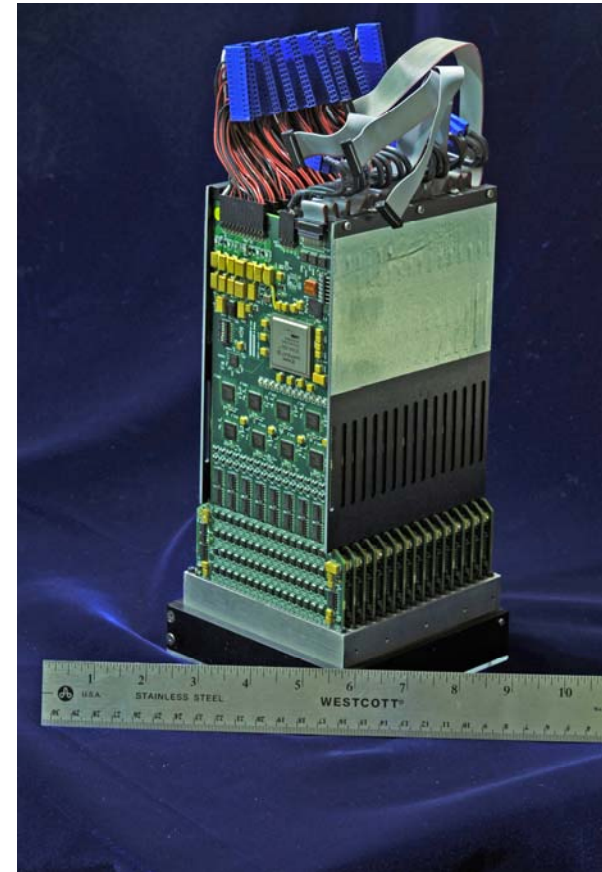
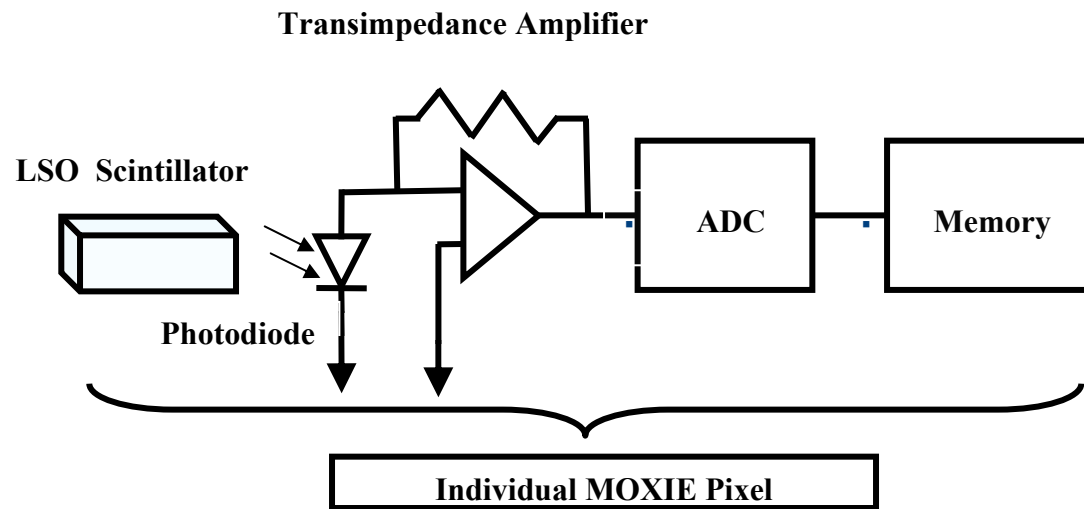


2010 R&D 100 Award Winner

Overview

- **MOXIE combines high-sensitivity with high-speed and large frame depth.**
 - The combination of these characteristics are truly unique and have been **demonstrated successfully** with MOXIE.
 - MOXIE is capable of capturing a staggering **4000 frames at 20 Million frames per second with sub μ R sensitivity.**
 - With multiple MOXIE modules, **30+ frame, high spatial and temporal resolution, movies of evolving physical processes can be obtained.** Such data is extremely beneficial to the validation of simulation codes.
 - MOXIE can be used to image protons, neutrons gamma rays and visible light.
 - With MOXIE, users can obtain full start to finish movies of high-speed phenomena.

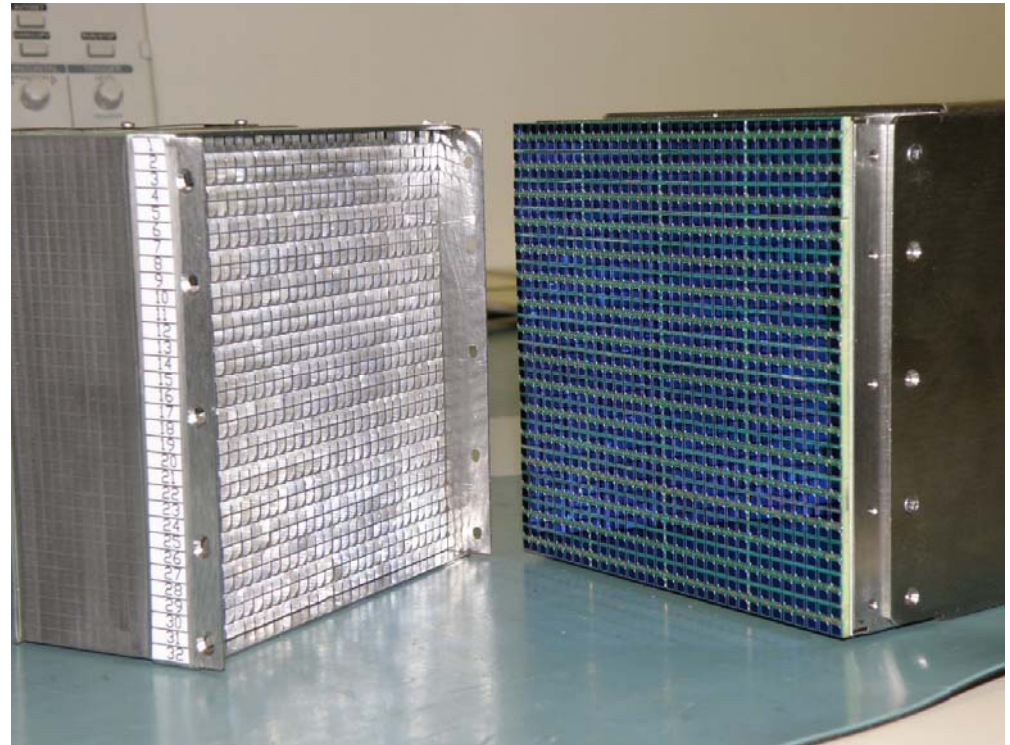
Device Architecture



MOXIE (Movies of eXtreme Imaging Experiments)

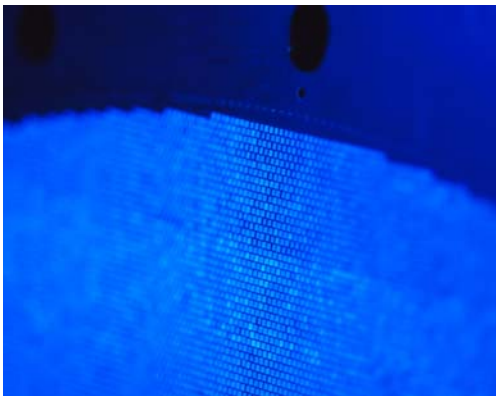
Worlds Fastest Movie Camera

- $1\mu\text{R}$ x-ray Sensitivity
- 20 MFPS Frame Rate
- 4096 Frame Depth
 - expandable
- Diverse Capabilities
 - X-Rays
 - Protons
 - Neutrons
 - Visible Light



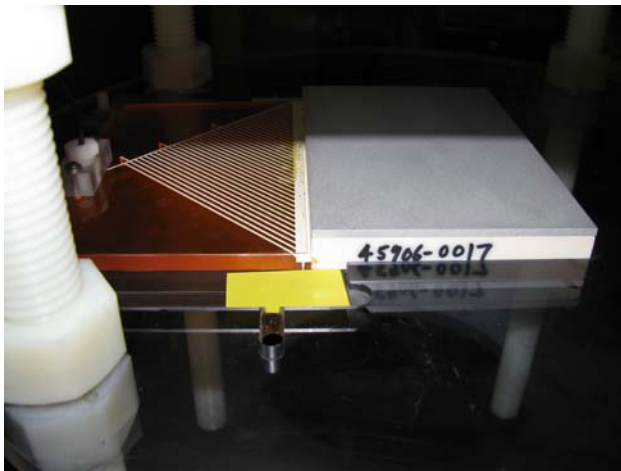
LSO Scintillator

- 45 cm diameter, 1.1 mm pitch, 4 cm thick.
- Single ~45 ns time constant.
- High light output.
 - ~25,000 photons/MeV.
- High Density.
 - 7.4 g/cm³

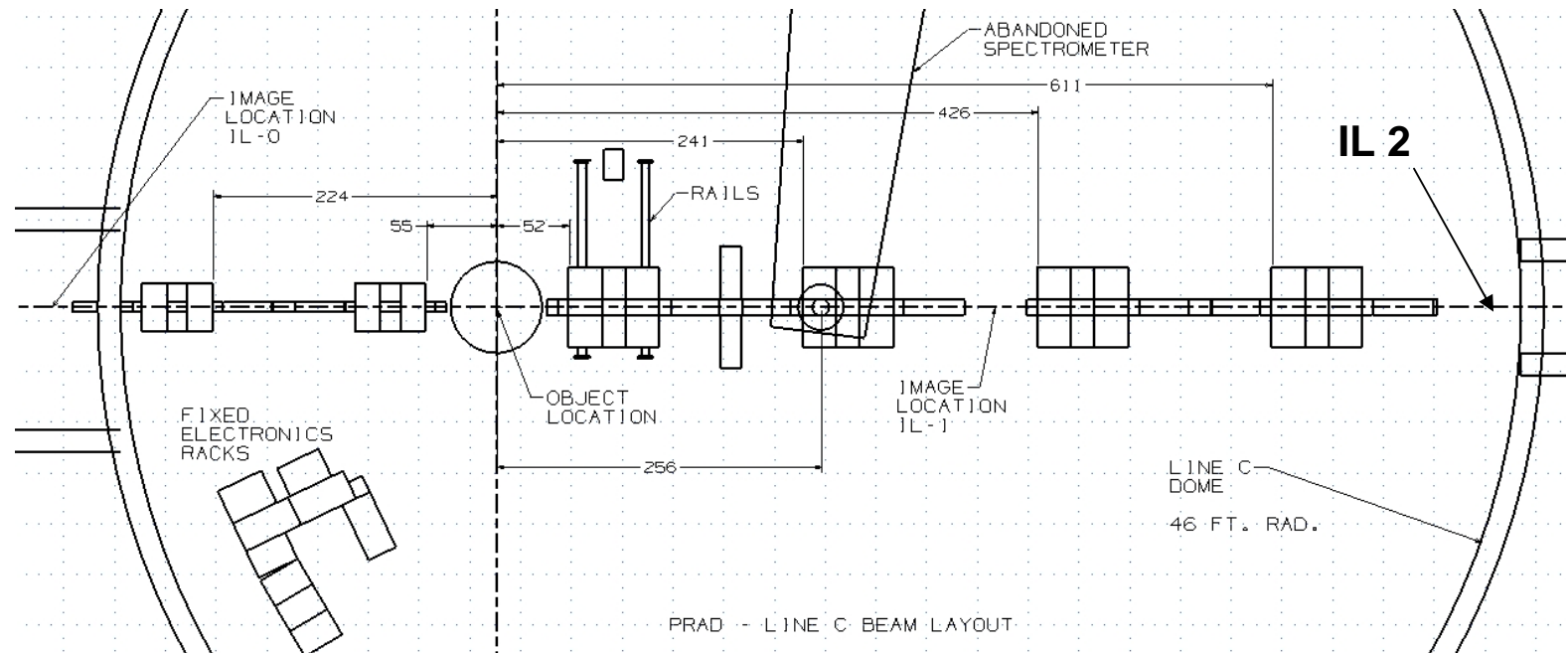


The “Side Lit Flyer Plate” Experiment

- **Purpose:** To capture a 20 MFPS movie of an explosively driven event. The data will demonstrate the **temporal** resolution, and high-sensitivity of MOXIE.
- **Successfully executed on July 1, 2010**
 - Yielded an unprecedented, 50 nsec frame interval, 100 μ sec duration, movie of a 2.54mm aluminum plate driven by a 356g explosive main charge and a line initiated booster.

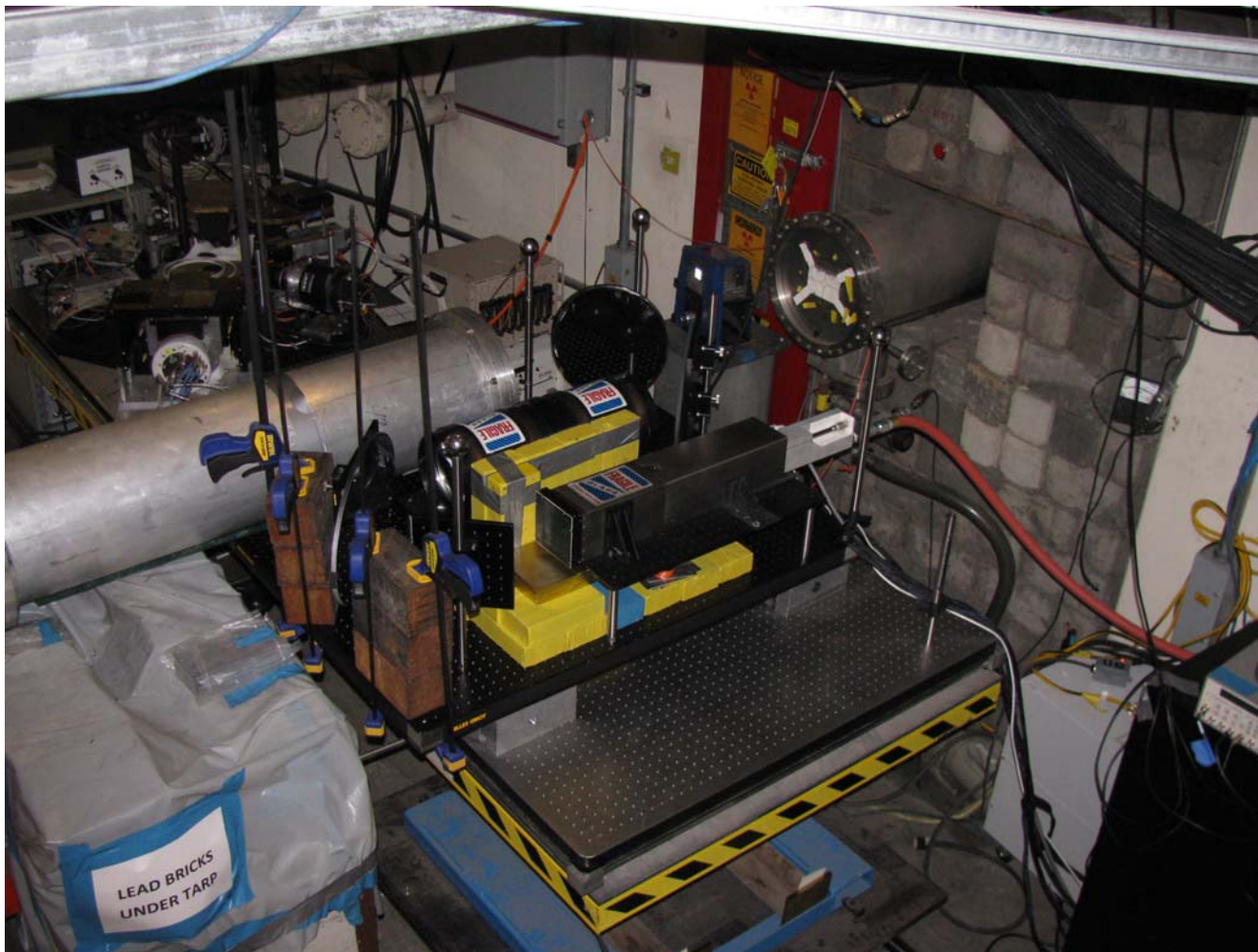


Experimental Setup

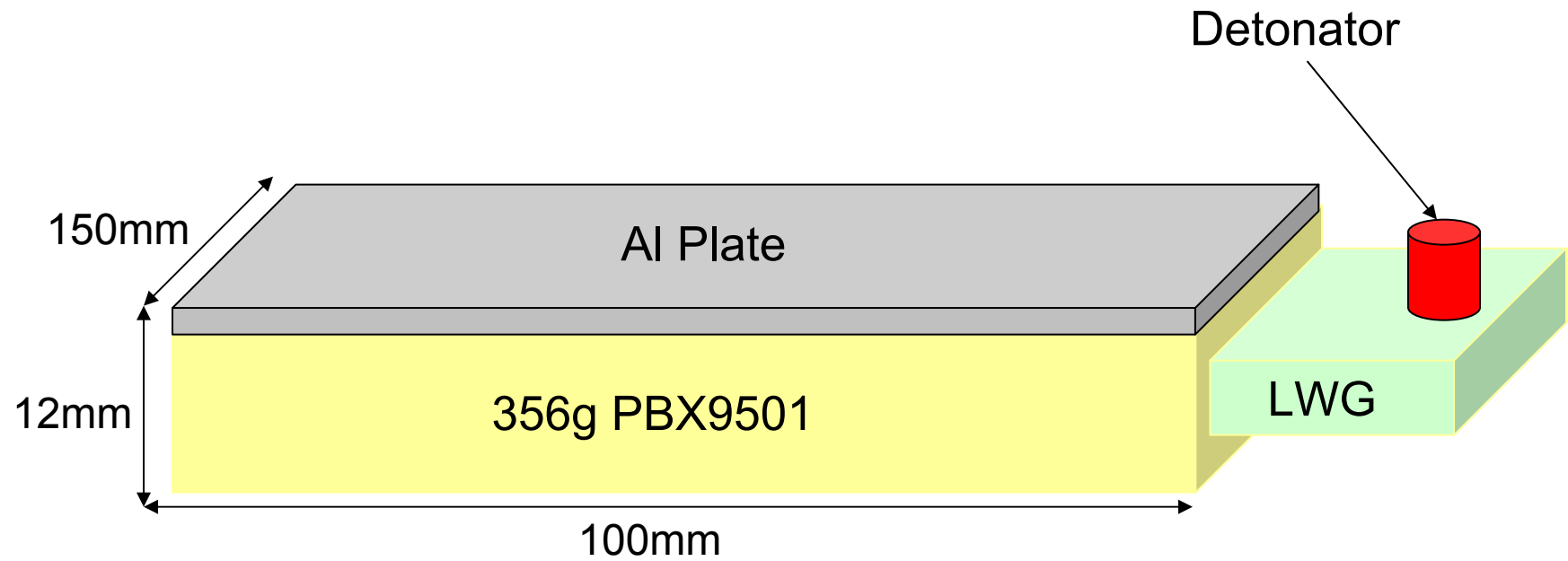


- X1 Identity Lens
- 120 mm FOV
- ~120mm square, 2mm thick, 3x3 LSO Tile Scintillator

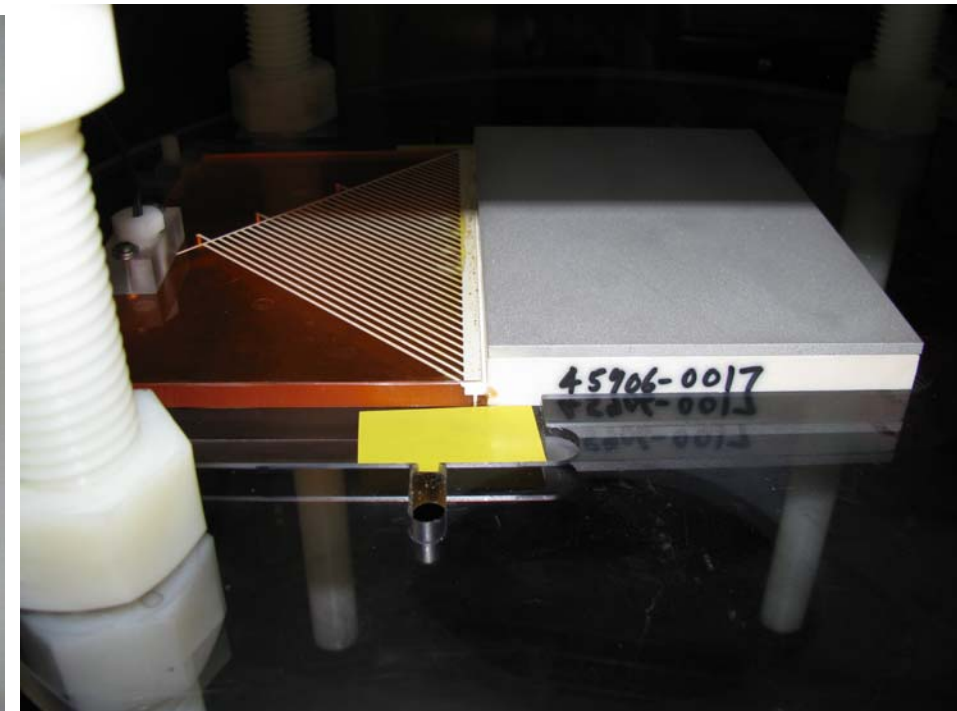
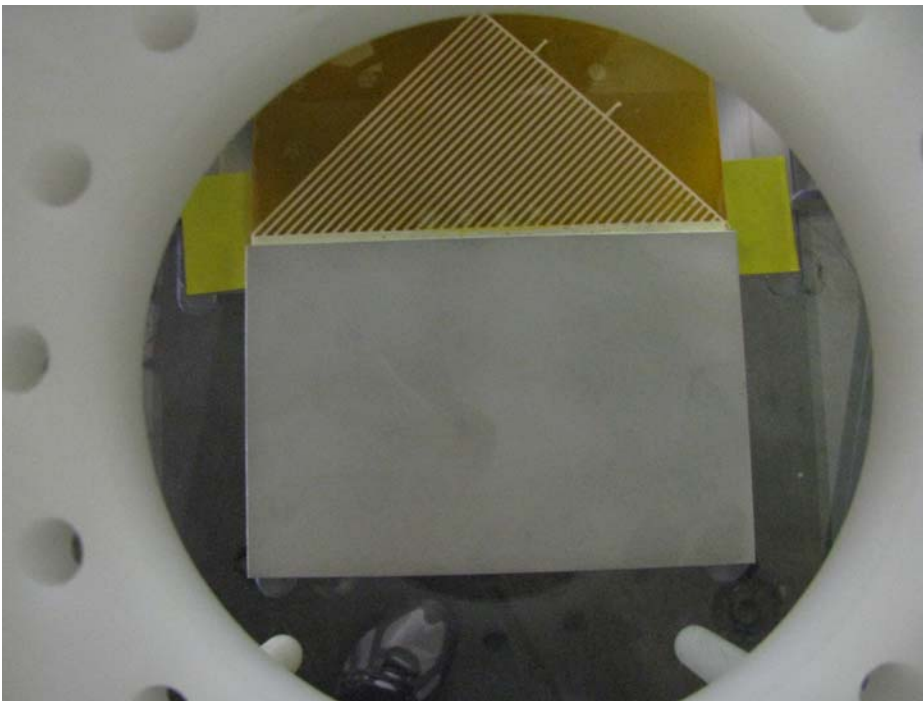
Camera Setup



Shot Design



Shot Design



MOXIE_Flyer_Plate.avi

Results

- **MOXIE can yield an equivalent amount of data in a single experiment that would have previously required dozens to hundreds of experiments.**
 - **Unprecedented time resolution and frame depth.**
 - **High sensitivity.**
 - **Experimental flexibility.**
 - **Ease of integration.**
 - **Portable.**
 - **Expandable.**
 - **Low cost per frame pixel**



spark_plug_movie.avi

Device Characteristics

PARAMETER	MOXIE
FRAME DEPTH	4,096
FRAME RATE	20,000 Mfps
DETECTION CAPABILITIES	x-rays , p ⁺ , neutrons, visible light
X-RAY SENSITIVITY	< 1 μR
X-RAY QE	50%
VISIBLE QE	85%
ACTIVE AREA	29 CM ²
PIXEL FORMAT	32X32/MODULE
DYNAMIC RANGE	12 BITS @ 20 MHz 16 BITS @ 100 kHz
TRIGGER TYPE	ASYNCHRONOUS, SYNCHRONOUS, POST EVENT

Questions

