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Opportunities Available at Nevada National Security Site

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Los Alamos, NM 87544

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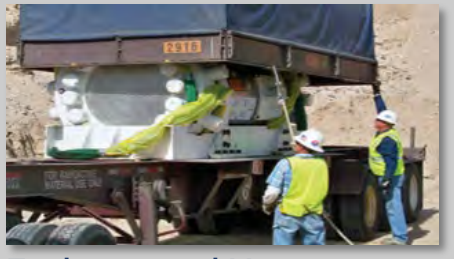
Proudly shaping the future of national security

Since 1951, the Nevada National Security Site has ensured the security of the US and its allies by supporting the stewardship of the nuclear deterrent, providing emergency response capability and training, and contributing key nonproliferation and arms control initiatives.

Stockpile Stewardship

Global Security



Environmental Management

Nevada National Security Site
Mercury, Nevada

Counter Terrorism Operations Support (CTOS) Program
Edgewood, New York

Remote Sensing Laboratory - Andrews
Andrews AFB, Maryland

Livermore Operations
Livermore, California

Los Alamos Operations
Los Alamos, New Mexico

Remote Sensing Laboratory - Nellis
Nellis AFB, Nevada

Special Technologies Laboratory
Santa Barbara, California

North Las Vegas Operations
North Las Vegas, Nevada

Sandia Operations
Albuquerque, New Mexico

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Stockpile Stewardship is an integrated program that spans the national Nuclear Security Enterprise, providing the tools we need to assure the safety, security and reliability of the nuclear stockpile without nuclear testing

Our workforce and infrastructure enable the nation to maintain and modernize an aging stockpile

- Since 1992, subcritical experiments have been essential to the certification of the stockpile.
- An integrated team of engineers, technologists, and scientists from across the Nuclear Security Enterprise executes subcritical experiments at the NNSS U1a facility.
- We obtain critical data using multiple sophisticated diagnostics, designed and fielded by NNSS staff in collaboration with the laboratories.

The Vega Subcritical Experiment Team shown underground in the NNSS U1a facility

Subcritical experiment data are essential in answering questions on dynamic materials behavior needed for ongoing confidence in a safe, secure, and reliable US stockpile.

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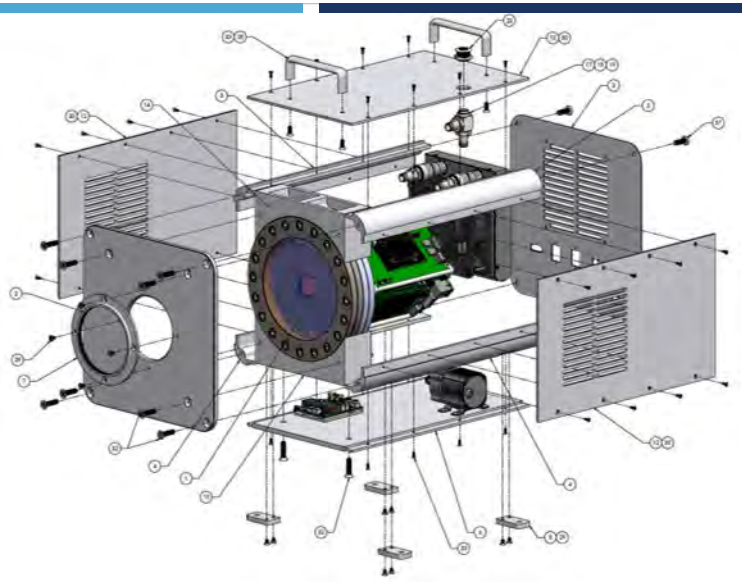
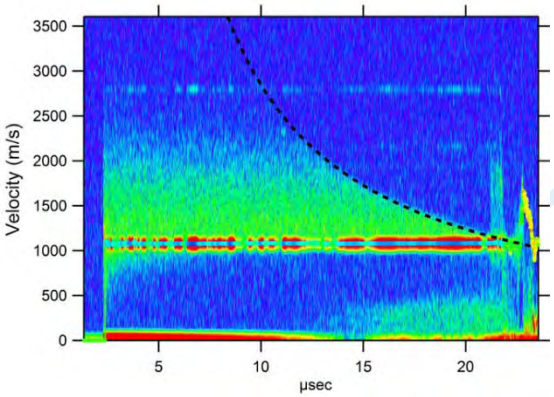
Stockpile Stewardship at the NNSS

- The Stockpile Stewardship Program deploys a wide range of science and engineering technologies to execute dynamic weapons physics experiments on high-hazard experimental platforms.
  - Unique experimental platforms
  - Transformational diagnostics
  - Experiments, data, and results that enhance confidence in assessment and certification

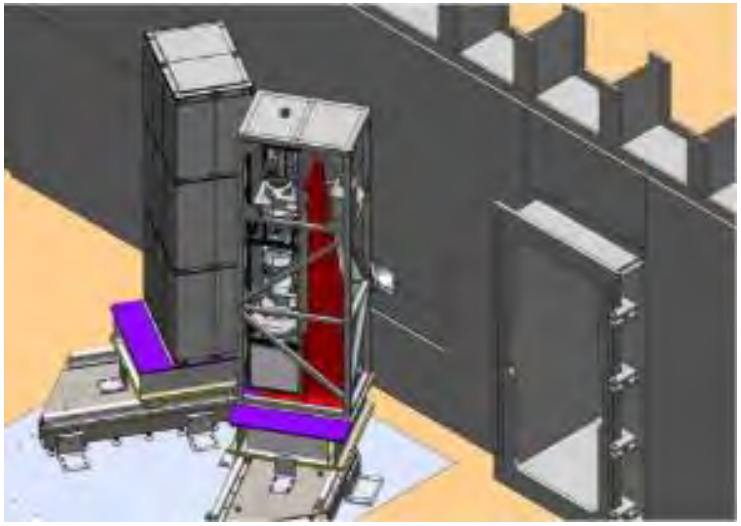


Kraken Camera Development



PDV Signal of Gold Ejecta

Next-Gen Optical Probe



Cygnus Zoom Lens

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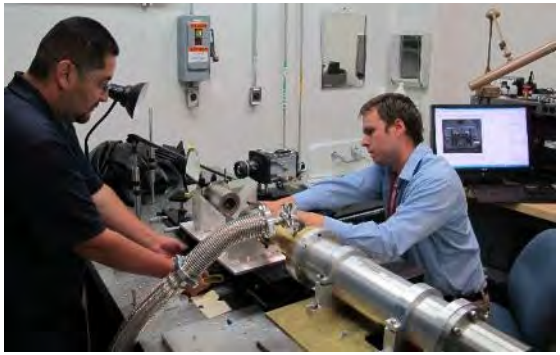
We team with national laboratories

- Experiment design and fielding (including plutonium, other actinides, and surrogates) in partnership with the three national laboratories
- High-reliability, high-fidelity data capture from hundreds of high-bandwidth signals
- Diagnostic research, development, and deployment of next-generation detectors and instrumentation systems for a suite of weapons science and dynamic materials applications, including characterization and, where applicable, absolute calibration capabilities
- Software and algorithm development for capture and post-processing of data for both legacy underground tests and modern experiments
- Development of experimental platforms for optical, x-ray, and neutron science applications

LLNL support: assembling the broadband laser ranging diagnostic critical to the Sierra Nevada experiments



LANL support: development of x-ray sources for soft radiography diagnostics for future subcritical experiments

Sandia support: deployment of MCP cameras at Z

Lawrence Livermore National Laboratory

Los Alamos NATIONAL LABORATORY EST. 1943

Sandia National Laboratories

Helping move national security weapons science forward

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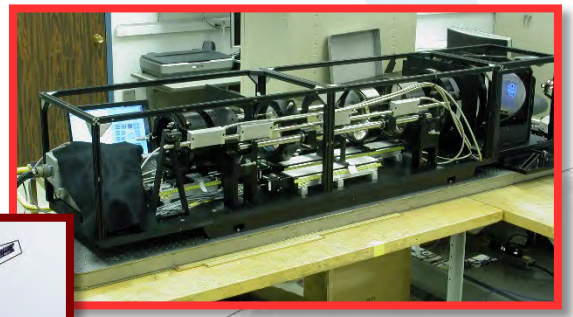
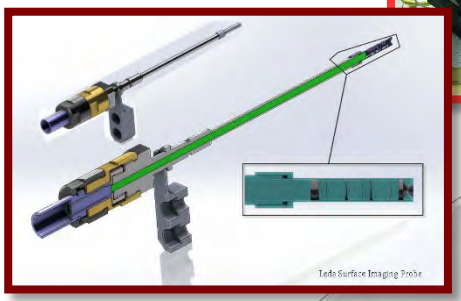
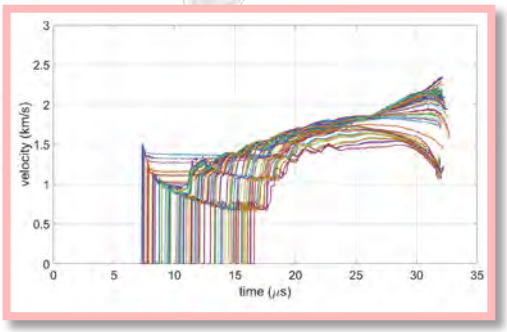
TDI-Los Alamos plays a major role in diagnostic development, from helping design and build technical answers to physics questions to field support and data analysis







Physics Questions

Design

Fabrication

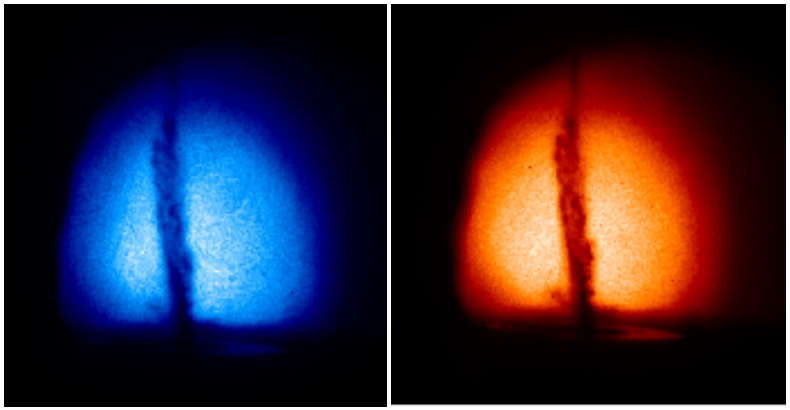
Fielding

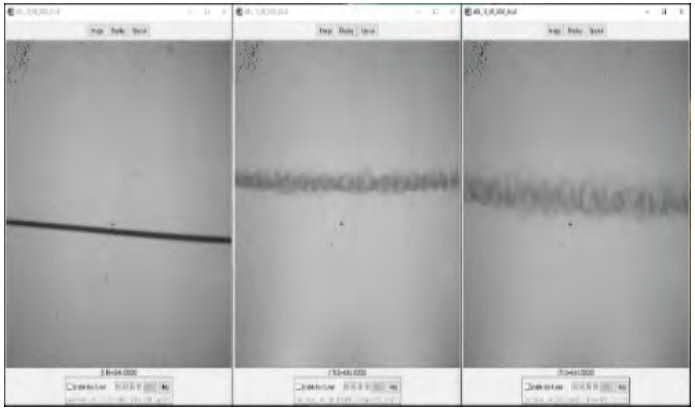
Data Analysis

Transformational diagnostics enable solutions to complex stockpile challenges

Wolfsbane two-color shadowgraph of ejecta

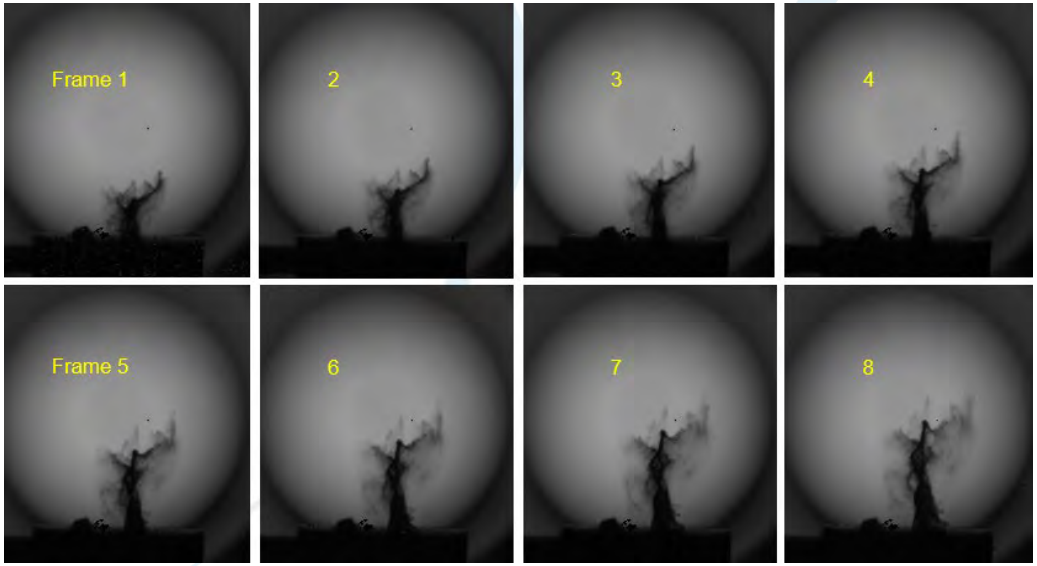
Development of a shadowgraphy diagnostic to capture image data at two different wavelengths along with density measurements to deduce new information about particle size.





Kraken image data from burst wire experiment

First execution of dynamic, multi-probe radiography at pRad with the NNSS-developed Kraken camera system and four-pulse x-ray source.



Eight frames of particle ejecta captured with Kraken

Laser-driven ejecta were captured with the Kraken digital eight-frame camera. A high-powered laser provides a shock impulse to a packet of 5 to 30 μm silica spheres placed below the scene. The laser impact sends the particles up into the field of view, and the result is recorded in an eight-frame time sequence on the Kraken camera.

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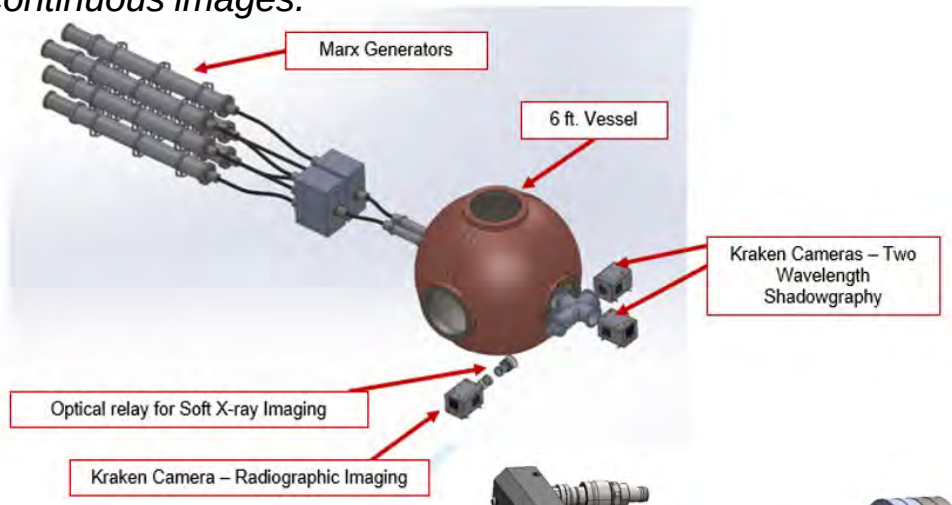
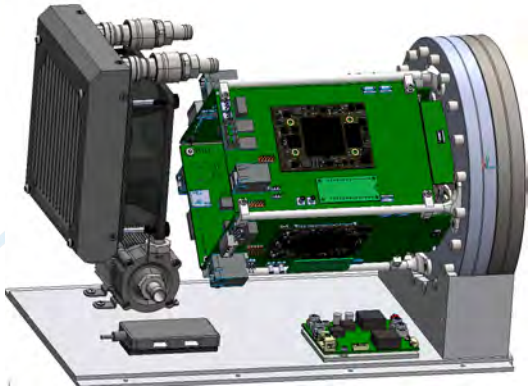
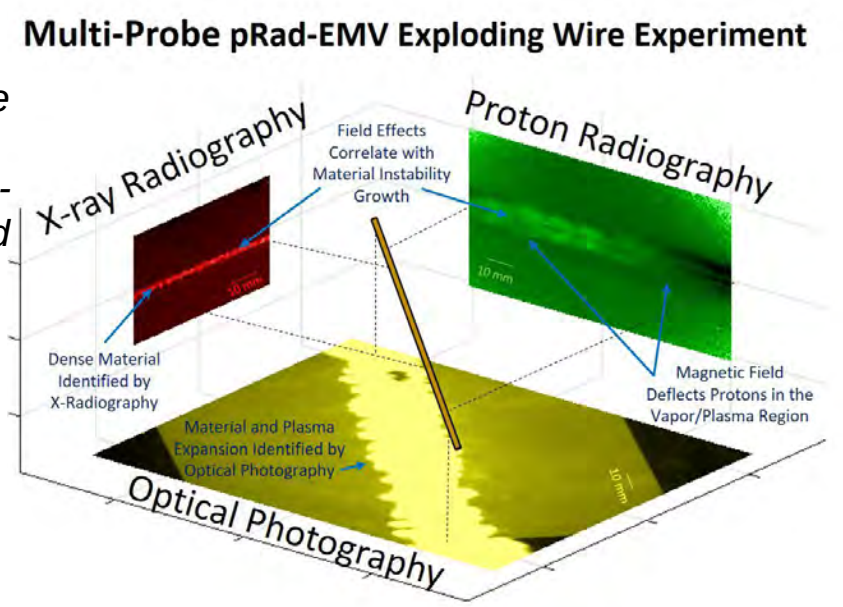
TDI staff shared diagnostic breakthroughs in LANL's LANSCE Futures- Dynamic Radiography workshop

Wolfsbane multi-probe ejecta diagnostic- S Baker and A Corredor: *A new diagnostic, essential for execution of the Wolfsbane SCE, will characterize ejecta particle distribution size by combining ejecta density measurements plus new two-wavelength shadowgraphy. The diagnostic requires a new multi-pulse 200 keV soft x-ray source with reduced parallax combined with the digital Kraken camera to produce eight frames of continuous images.*







Multi-probe radiography: status of multi-color, multi-mode and multi-species radiography for focused experiments- D Clayton (invited talk): *Density measurements of dynamic materials are key to future SCEs.*

Flexible design approach yields new, large-area framing camera- L Fegenbush and A Lewis: *The new Kraken camera enables deployment of a high-sensitivity, framing imager for SCEs. A 2 x 2 version will provide best-in-complex options.*

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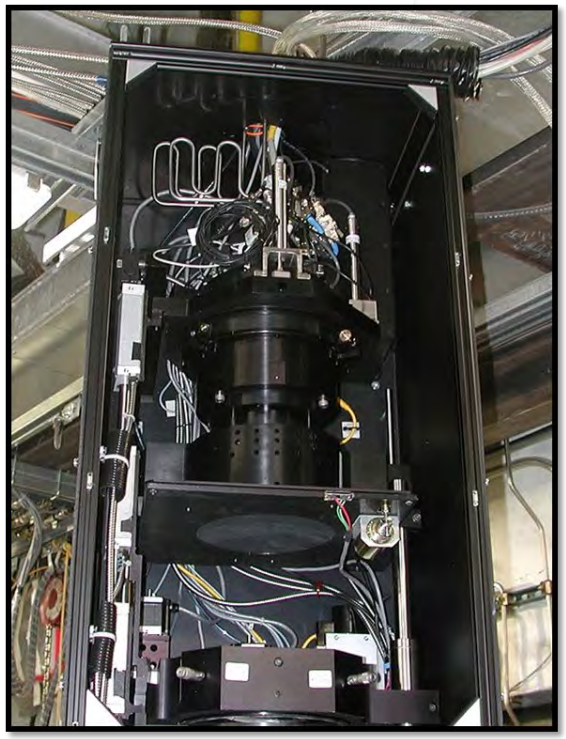
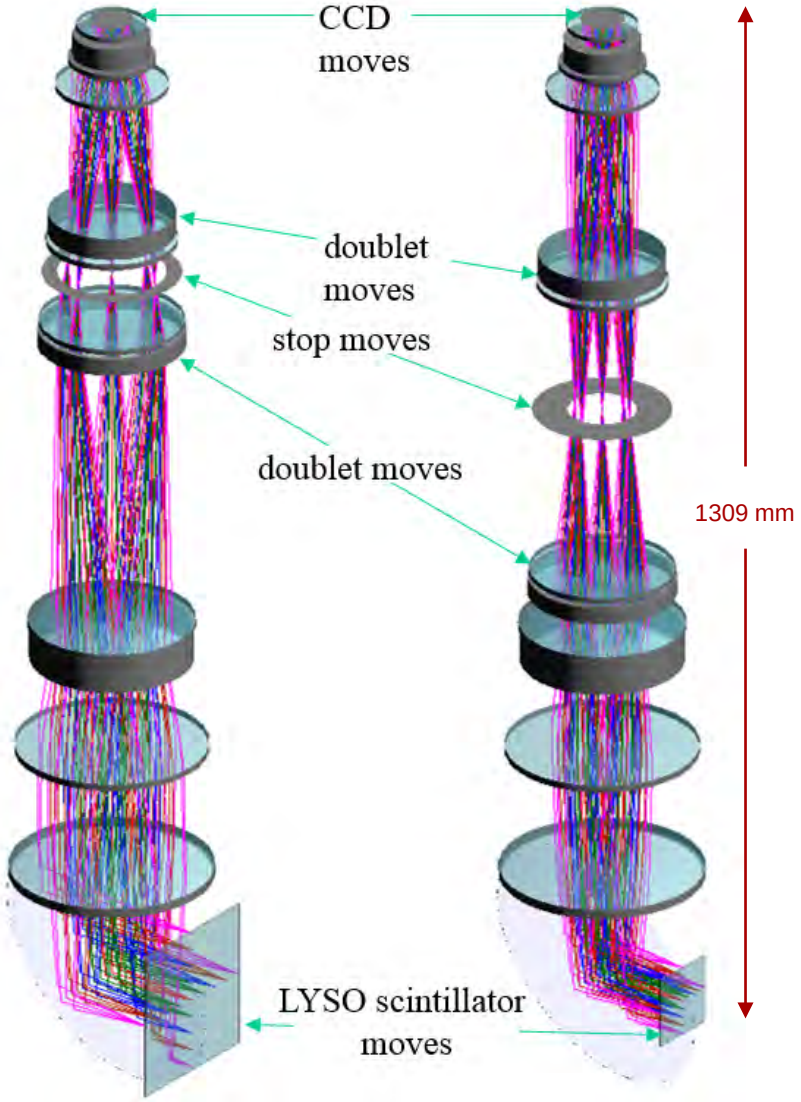
Optical design

PDV Fisheye Lens



Zoom lens in vertical position



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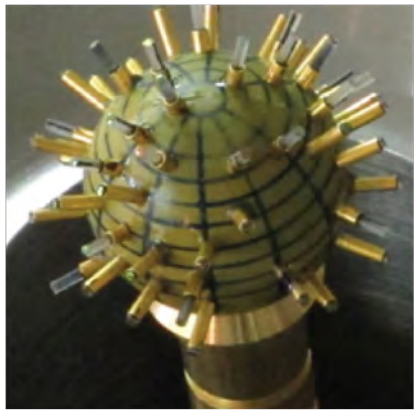
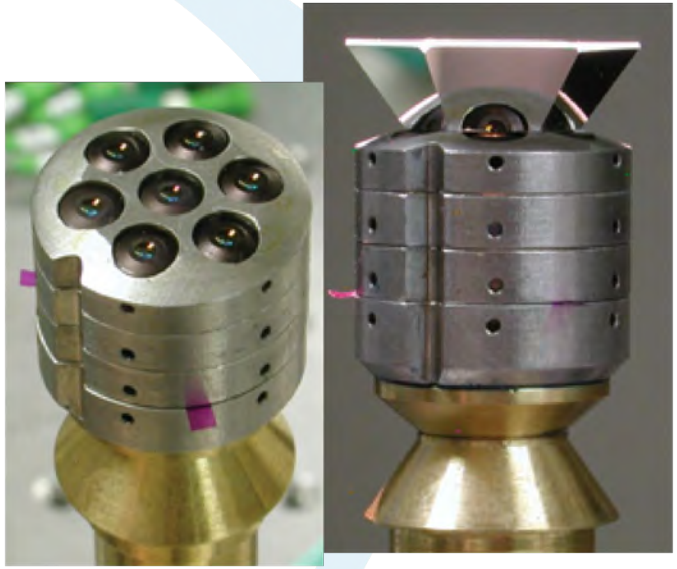
Probe/MPDV diagnostic support

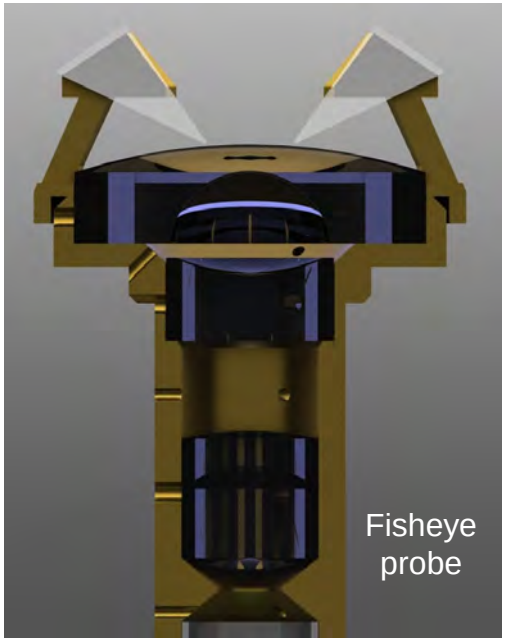
Two proposed optical probe designs to measure movement of a curved imploding surface



Discrete probe



Multifaceted prism probe (left) without prism and (right) with prism



Gen-1 MPDV: Delivered to U1a; used on Gemini and Leda

Gen-2 MPDV: Delivered to LANL for DARHT Facility

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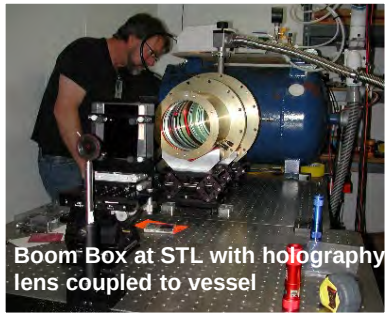
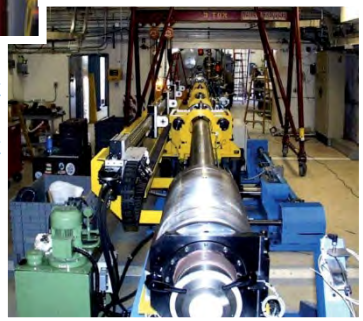
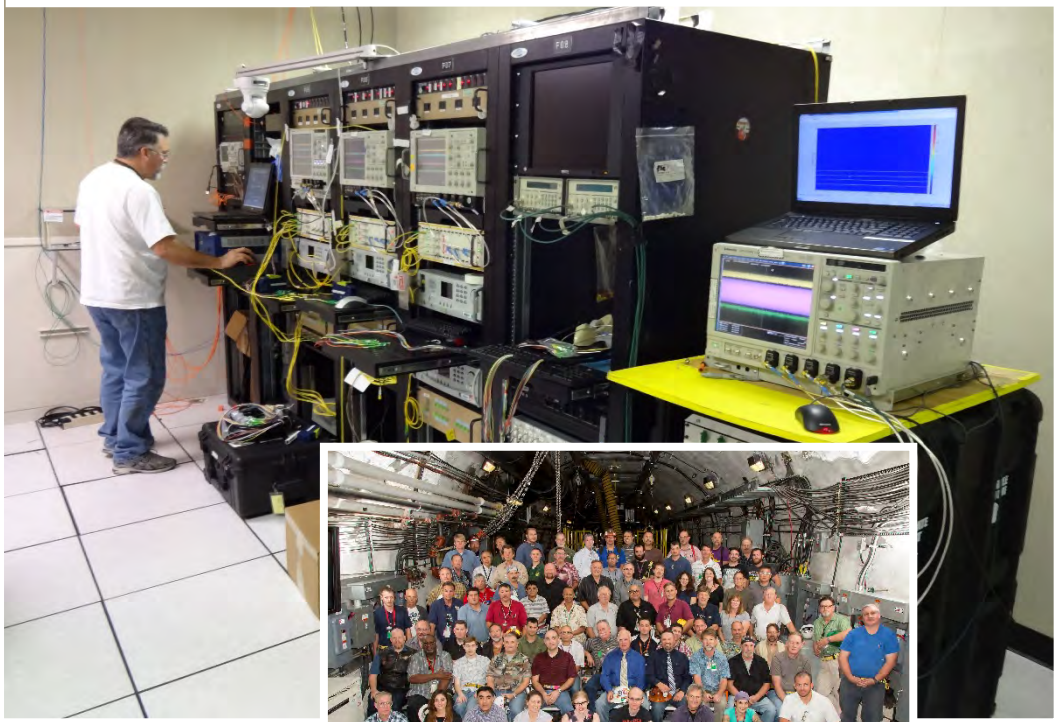
Experiment field support


Boom Box at STL with holography lens coupled to vessel

JASPER – Primary target chamber (blue) inside the Secondary Containment Chamber – NNSS




Tunnel at the U1a Complex




Photonic Doppler velocimetry team at U1a with Lt. General Frank Klotz

Lyra-Orpheus Team

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The NNSS and the national laboratories form an integrated team executing the Stewardship mission

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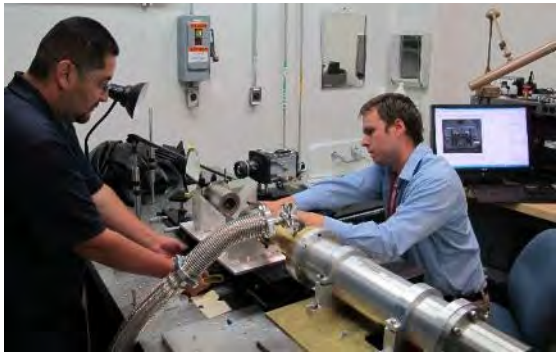
- High-reliability, high-fidelity data capture from hundreds of high-bandwidth signals
- Diagnostic research, development, and deployment of next-generation detectors and instrumentation systems for a suite of weapons science and dynamic materials applications, including characterization and, where applicable, absolute calibration capabilities
- Software and algorithm development for capture and post-processing of data for both legacy underground tests and modern experiments
- Development of experimental platforms for optical, x-ray, and neutron science applications

Assembling the broadband laser ranging diagnostics used in the Sierra Nevada SCEs



LANL support: development of x-ray sources for soft radiography diagnostics for future subcritical experiments

Sandia support: deployment of MCP cameras at Z

Lawrence Livermore National Laboratory

Los Alamos NATIONAL LABORATORY EST. 1943

Sandia National Laboratories

Helping move national security weapons science forward

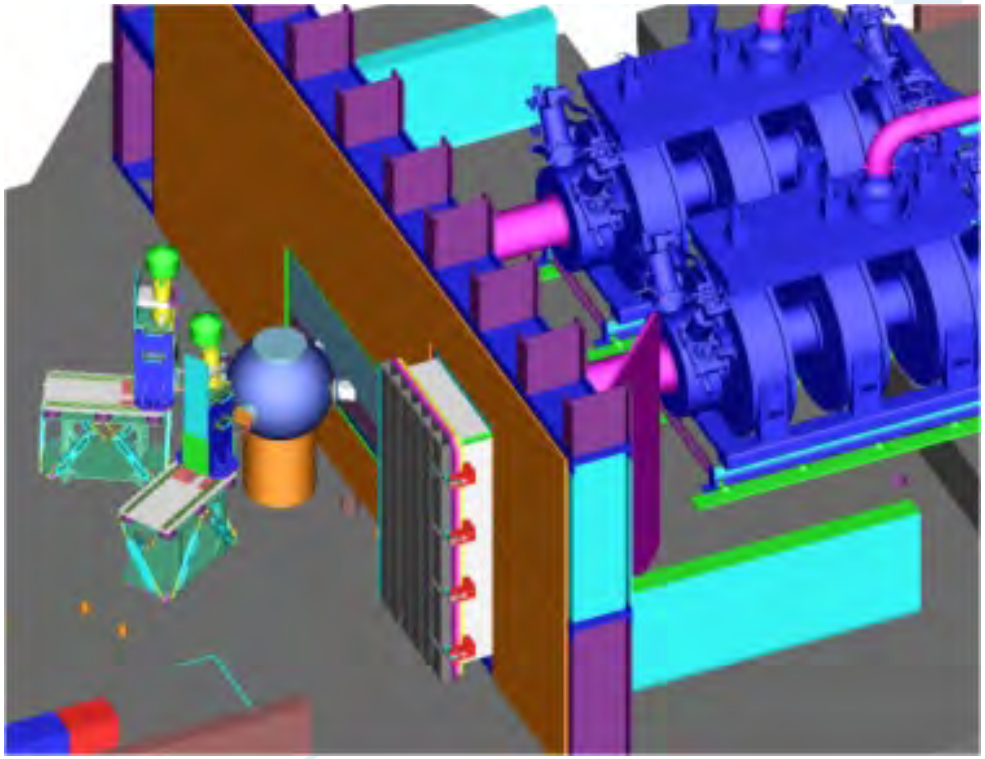
The U1a facility at the NNSS is the key venue for stewardship experiments at the NNSS

- 1968, original shaft mined for an underground nuclear test - later canceled.
- 1988: Shaft reopened, 1,460-foot horizontal tunnel mined south at the 962 foot level of the shaft.
- 1990: Ledoux nuclear test
- Today: Horizontal tunnels mined to the North, at the base of U1a vertical shaft - 963 feet beneath the surface, it represents a complex underground laboratory for SCEs

Hoist for personnel, equipment and mining tailings at the surface in Area 1

SCEs at U1a.05 provide an essential physics data for Stockpile Stewardship

- Weapon-relevant scales and materials, including plutonium
- Experiments are confined in 3-foot diameter vessels
- Category 2 nuclear facility during SCE execution operations
- **In the US, execution and entombment of Pu experiments using high explosives at these scales is only possible at the NNSS**



“Zero Room” illustration depicting (r to l) Cygnus radiography machines (blue), containment barrier wall (brown), spherical confinement chamber, and radiographic cameras.

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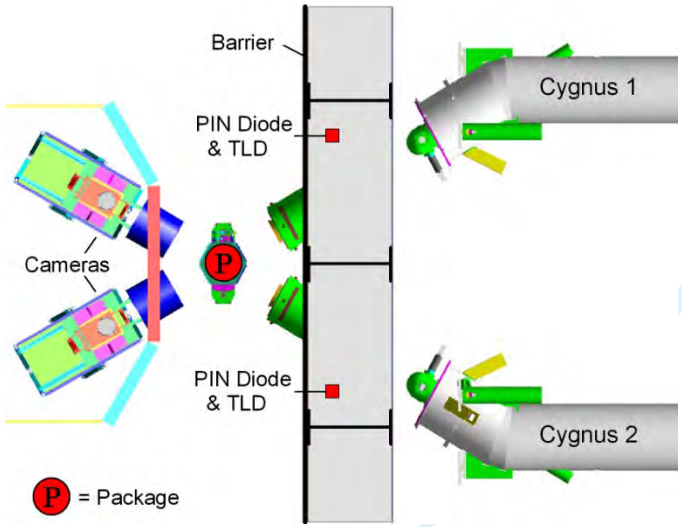
The U1a.05 Test Bed has been the workhorse for SCEs since 2004 and continues to provide diagnostic flexibility

The U1a.05 Test Bed supported all SCE experiments in the last ~15 years

- Reconfigured multiple times to support diagnostic needs unique to focused physics experiments using 3-foot diameter confinement vessels
- Cygnus dual-axis x-ray machine provides a medium energy (~2.2 MeV) radiographic capability and recent advancements have enabled low-energy (<0.5 MeV) radiography
- Diagnostics include Photon Doppler Velocimetry (PDV), Baseline Laser Ranging (BLR), pyrometry, HE shorting switches, pins, Asay foils & others
- Recently-added entombment capacity can accommodate up to 60 additional 3' vessels

Cygnus Radiography Schematic



3' Vessel Confinement System in the U1a.05 TestBed

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NNSS and the laboratories are planning to bring two new testbeds online in U1a in the coming years

2020 2025 2030

U1a .05

- Focused experiments
  - Dynamic material properties
- 3’ confinement vessels
- Enhanced diagnostics access
- Cygnus radiography
- Standard diagnostics (e.g. Multiplexed PDV)
- Developmental diagnostics
  - Visible imaging, radiance, etc.

U1a .03

- Integral experiments without radiography
  - Early-time hydro, safety, surety
- 6’ confinement vessels
- Neutron Diagnosed Subcritical Experiments (NDSE)

U1a.100

- Scorpius machine x-ray radiography
- 6’ confinement vessels
- Pu “core-punch” experiments

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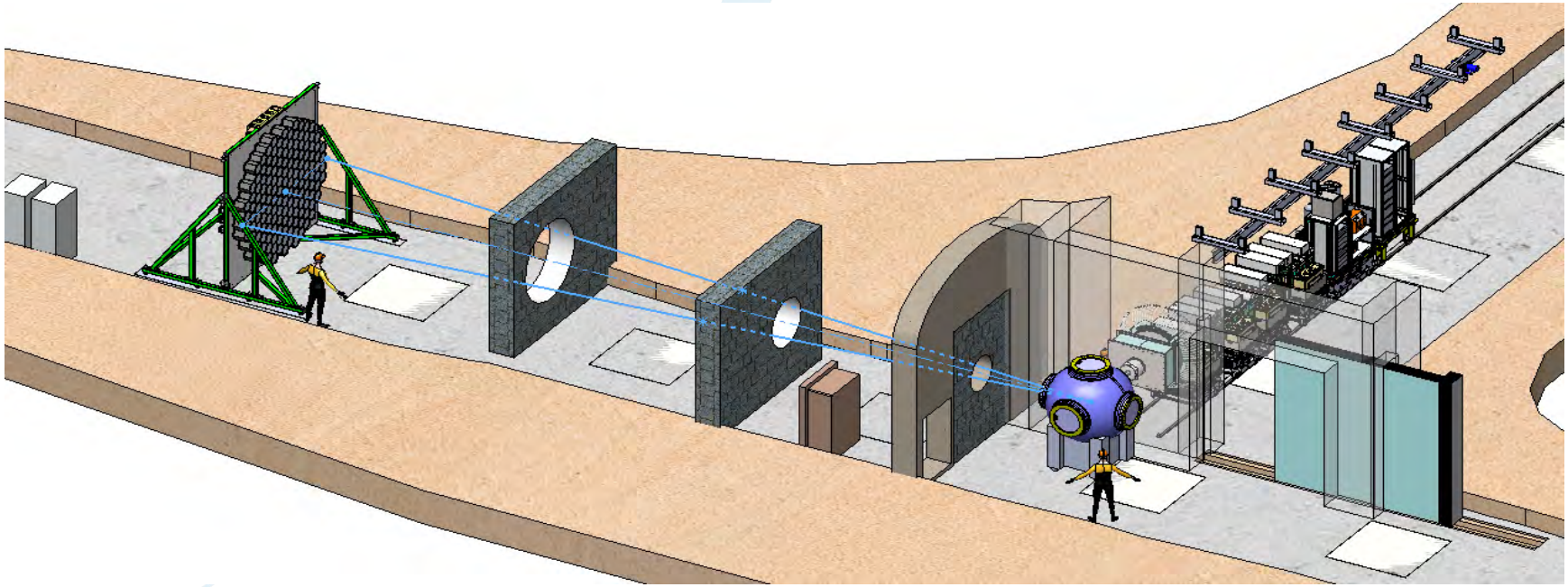
A new testbed at U1a.03 is being developed to support future SCEs using 6' vessels and NDSE

- **Multiple SCEs were previously executed in the U1a.03 drift**
  - Infrastructure established for Mario, Rocco, Krakatau, etc. will be re-used where possible
- **Updating and reconfiguring the infrastructure to support the NDSE apparatus and 6' v**
  - Constructed a new entombment drift with a capacity of 22 expended vessels
  - Designing shielding and collimation for personnel protection and high NDSE data quality
  - New diagnostic control room and Vault-Type-Room for data processing
  - Updated power, cooling, ventilation and other infrastructure required for 6' vessel operations and NDSE



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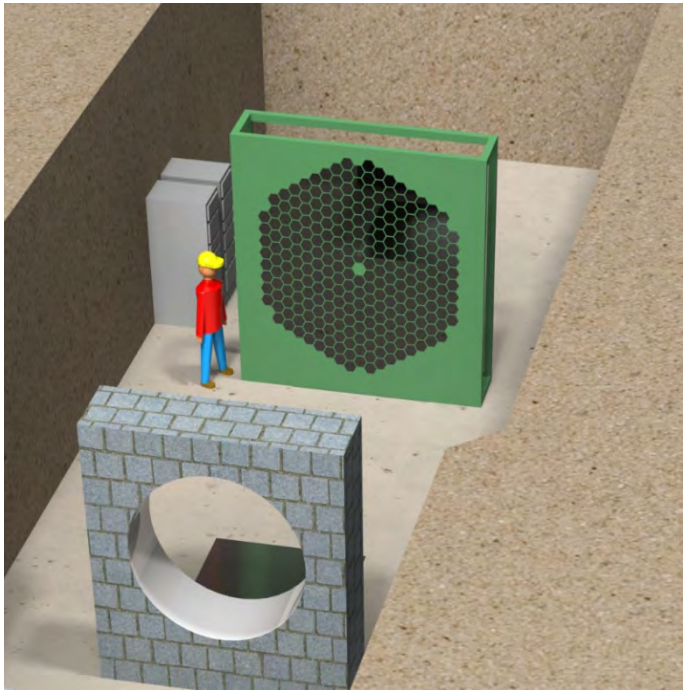
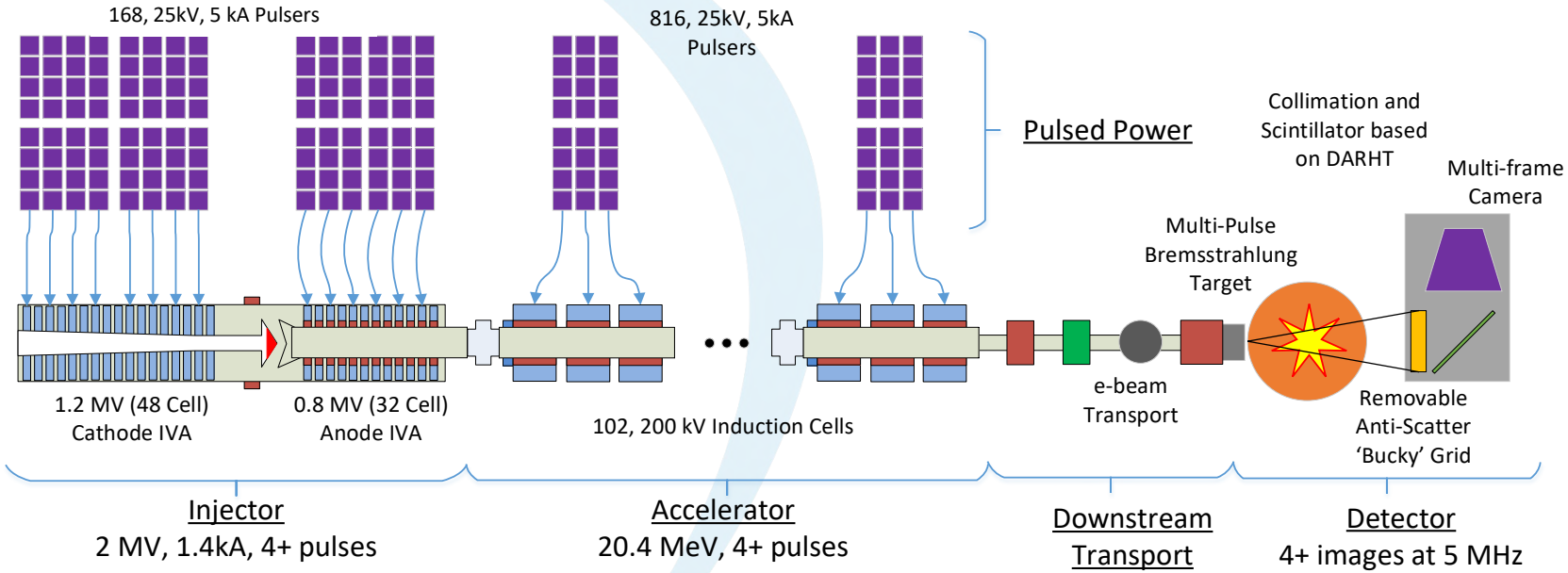
NDSE apparatus consists of a dense plasma focus (DPF) neutron source and a 3-meter-diameter gamma-radiation detector wall

- **The NDSE neutron source consists of three main subsystems:**
  - A pulsed power system designed and constructed by LLNL
  - A well-demonstrated deuterium-tritium DPF tube designed and constructed by NNSS
  - A tritium confinement and processing system designed by NNSS and SRNL
- **Gamma-ray detector design has been developed and tested over several years time using static configurations of various test objects with the existing DPF DT neutron source at our Area 11 facility**
  - Pixel array of scintillators coupled to photomultiplier tubes
  - Components are being procured



NDSE Detector Wall

The Scorpius accelerator will be a DARHT-class, multi-pulse, high-energy x-ray source for radiography of dynamic experiments in 6-foot vessels



- **Injector – ≥ Four-pulse, 2 MV, 1.4 kA, 20-80 ns (4 x 80 ns equivalent V·s)**
  - Vacuum Inductive Voltage Adder (IVA) with thermionic cathode
- **Accelerator – 102, 200 kV Internal IVA Cells accelerates electrons to about 20 MeV**
- **Pulsed Power – 25kV, ≥ 5kA, ≤ 1% RMS variation into matched load**
- **Downstream Transport – Multi-pulse Bremsstrahlung target**
- **Imaging systems likely based on DARHT-2 systems with removable anti-scatter "Bucky" grid**