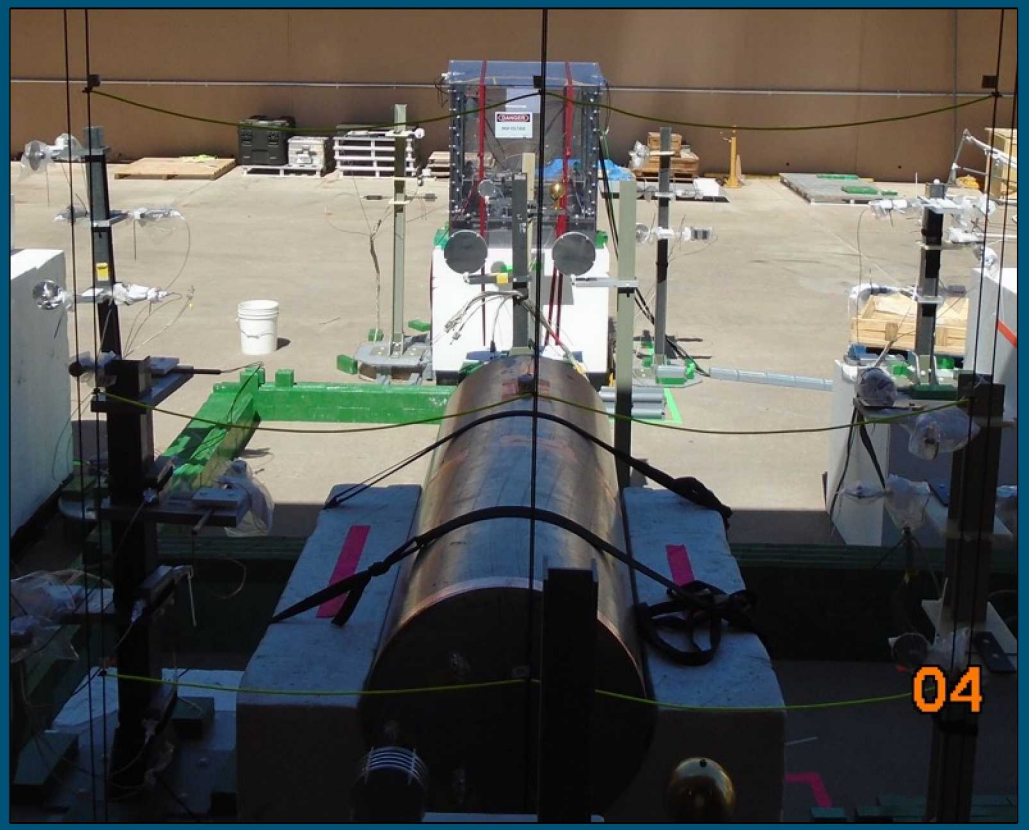
SAND2018-10788PE

BIG DEAL SUMMIT

B.T. Yee ORG 1878

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Pulsed Radiation Environments for Effects Testing and Validation



Acknowledgements: Keith Cartwright, Eric Berry, Troy Powell, Tim Pointon, Dan Holslin, Norm Kolb, Rick Harrison, Lori Basilio, Steve Neville (USAF), Mandie Gehring (LANL), Ray Martinez, Erik Hurd, John Pyle, Steve Tullar, Iain Thurston (AWE), Rob Beacham (AWE), Georgia Wright (AWE), Michael Moutrie (AWE), Dan Catt (AWE), Michelle Espy (LANL), and many more …

Science-Engineering Big Deal

Gamma radiation transport and effects play a critical role in Sandia's mission. With unique facilities for pulsed gamma irradiation, we can ask science and engineering questions that no one else can while facing novel challenges in characterizing the properties and output of our systems. In our continued work, we are developing a new suite of diagnostics for unprecedented insight on machines like HERMES III and SPHINX.

Significance and Impact

As we improve our knowledge of the properties of these pulsed power facilities, we can begin to answer important questions on topics like radiation transport, and electrical breakdown. Furthermore, these data represent an important part of the validation hierarchy being used to establish confidence in next generation ASC codes.

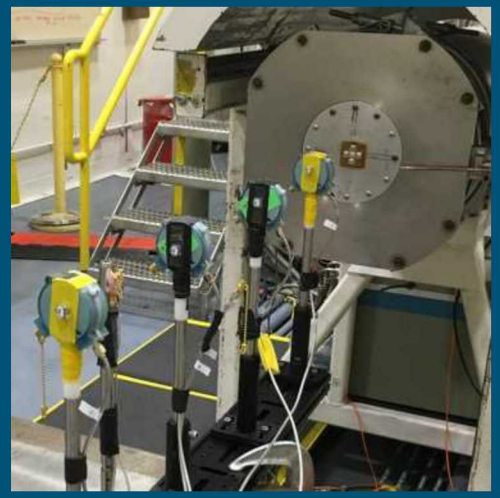
Research Details

New diagnostics cover a wide array of sensors and techniques:

- 3D-printed air conductivity sensors
- High energy differential absorption spectrometers
- Optical dose mapping
- Electrical sensors for high radiation environments

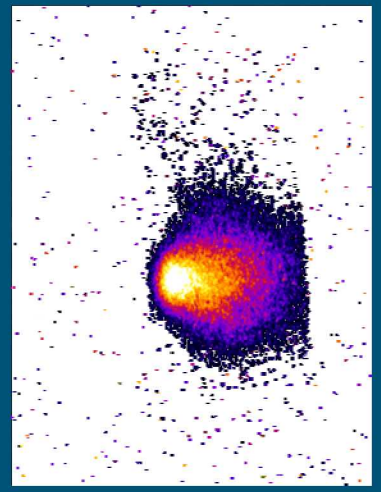
Air Conductivity Sensors

High gamma ray flux can ionize air, substantially increasing its electrical conductivity. Knowing the conductivity is crucial to accurately modeling the gamma ray effects. In collaboration with AWE, new sensors were developed using Sandia's capabilities for 3D printing, physical vapor deposition, and electroplating are providing order of magnitude improvements over previous measurements.



Optical dose mapping

Radiation dose has traditionally been measured using discrete TLDs, an expensive and tedious process with limited spatial resolution. However, ionizing radiation also produces an optical signature that can be correlated to dose. By using fast gated imaging, we are developing new ways to measure dose with high spatial resolution for model validation.



Time-integrated spectra

The spectral output of pulsed gamma machines has repercussions both in understanding device physics and the effects of the emitted radiation. In collaboration with LANL we are fielding a unique Compton spectrometer designed for high endpoint energies. This will provide the first direct experimental measurements of the HERMES III output.

Dynamic spectral analysis

A pulsed gamma ray spectrum is a time changing quantity which can strongly impact short timescale phenomena. In this portion of work, we are developing spectroscopic diagnostics with new material and new techniques (e.g. machine learning) to create truly time-resolved spectra.