SAND2019-14388C

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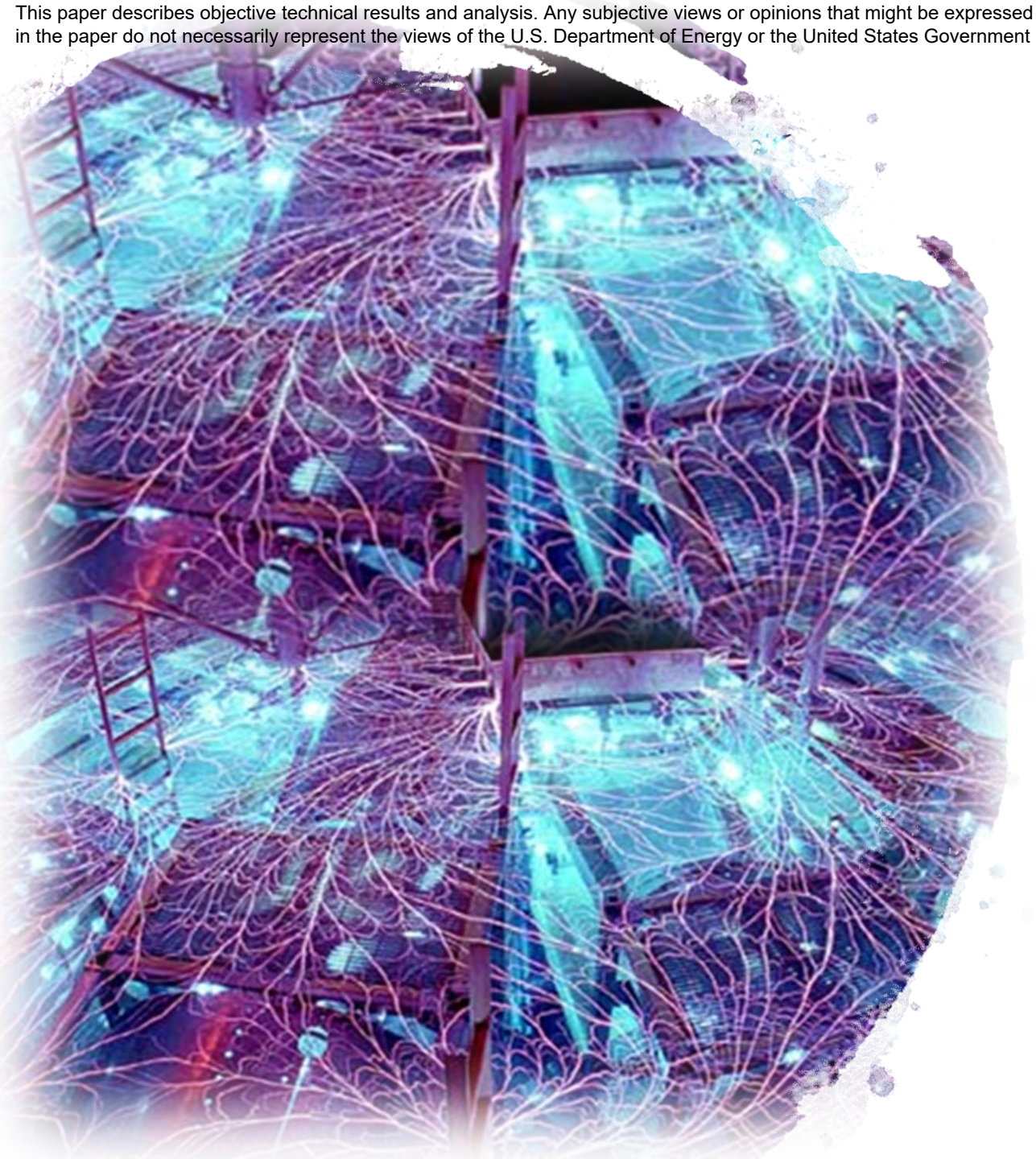

XR@Z

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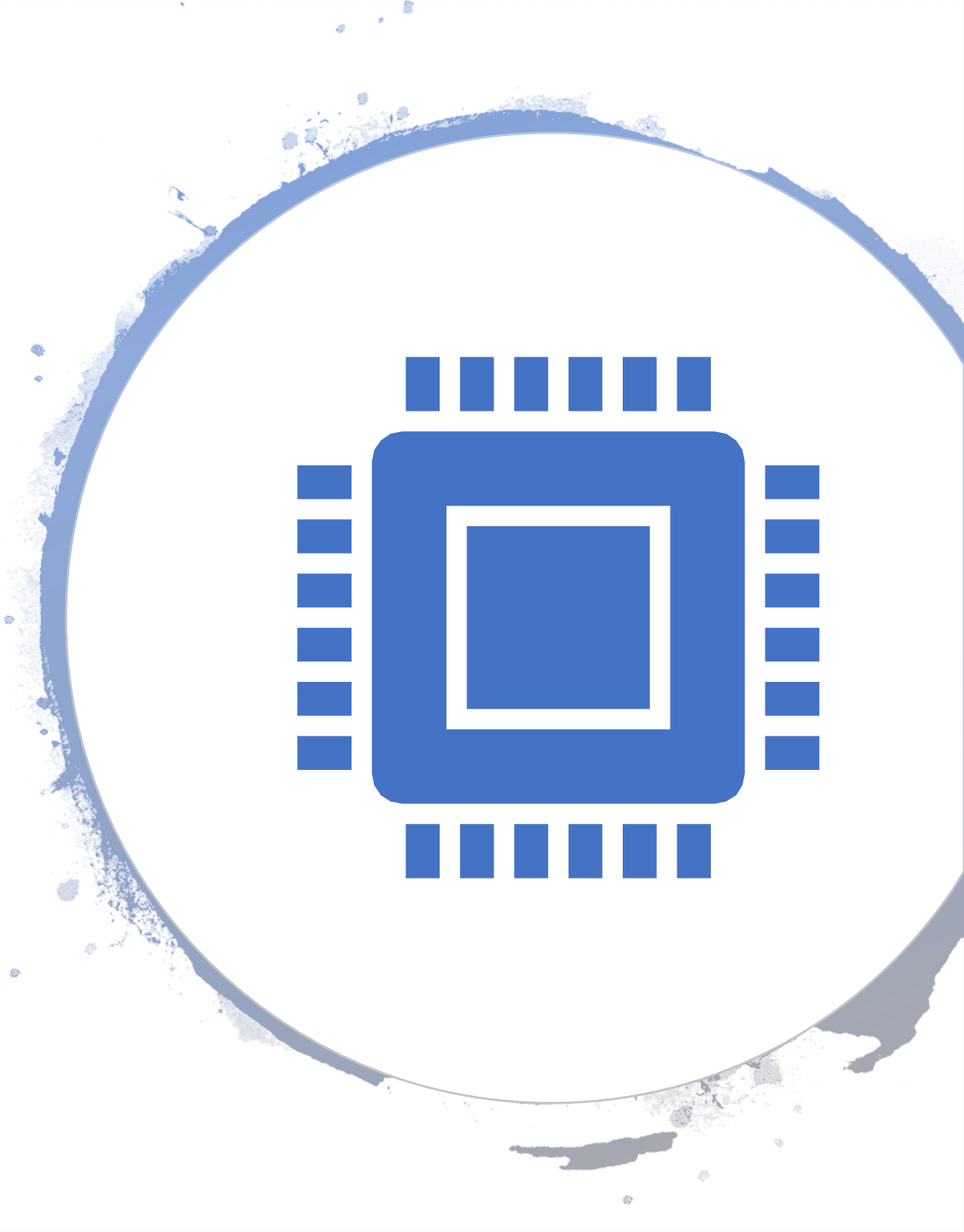
CISM, TOGAF, ITIL, AWS-CSAP

What is XR?

Extended reality (XR) is a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables. It includes representative forms such as augmented reality (AR), mixed reality (MR) and virtual reality (VR) and the areas interpolated among them.

- Wikipedia



What is Z?

Sandia National Lab's Z machine is Earth's most powerful pulsed-power facility and X-ray generator.

Z compresses energy in time and space to achieve extreme powers and intensities, found nowhere else on Earth. In approximately 200 shots Z fires every year, the machine uses currents of about 26 million amps to reach peak X-ray emissions of 350 terawatts and an X-ray output of 2.7 megajoules.

The Z machine is located in Albuquerque, N.M., and is part of Sandia's Pulsed Power Program, which began in the 1960s. Pulsed power is a technology that concentrates electrical energy and turns it into short pulses of enormous power, which are then used to generate X-rays and gamma rays. Produced in the laboratory, this controlled radiation creates conditions similar to those caused by the detonation of nuclear weapons, which is why from its earliest days pulsed power has been used to study weapons effects.

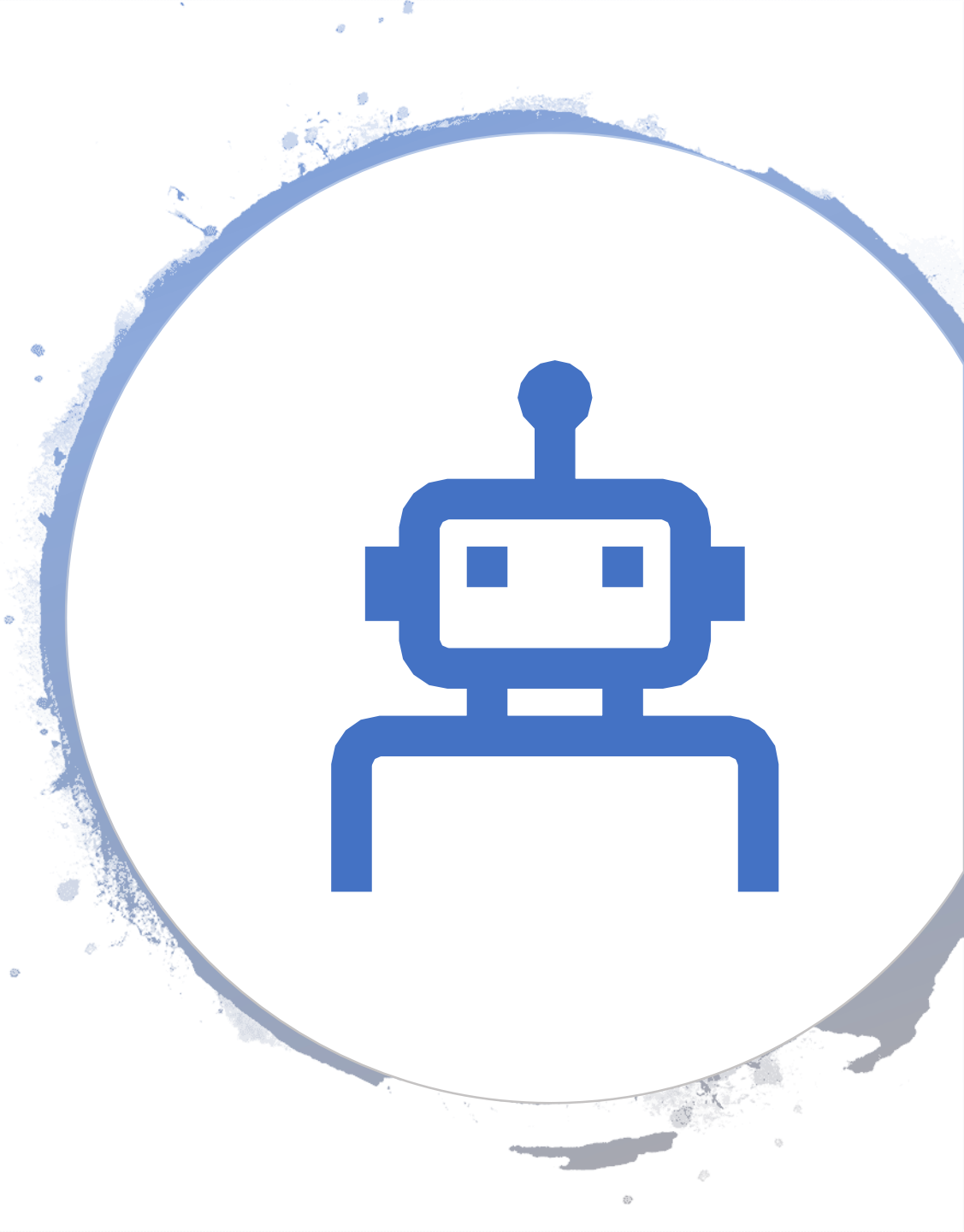
- sandia.gov

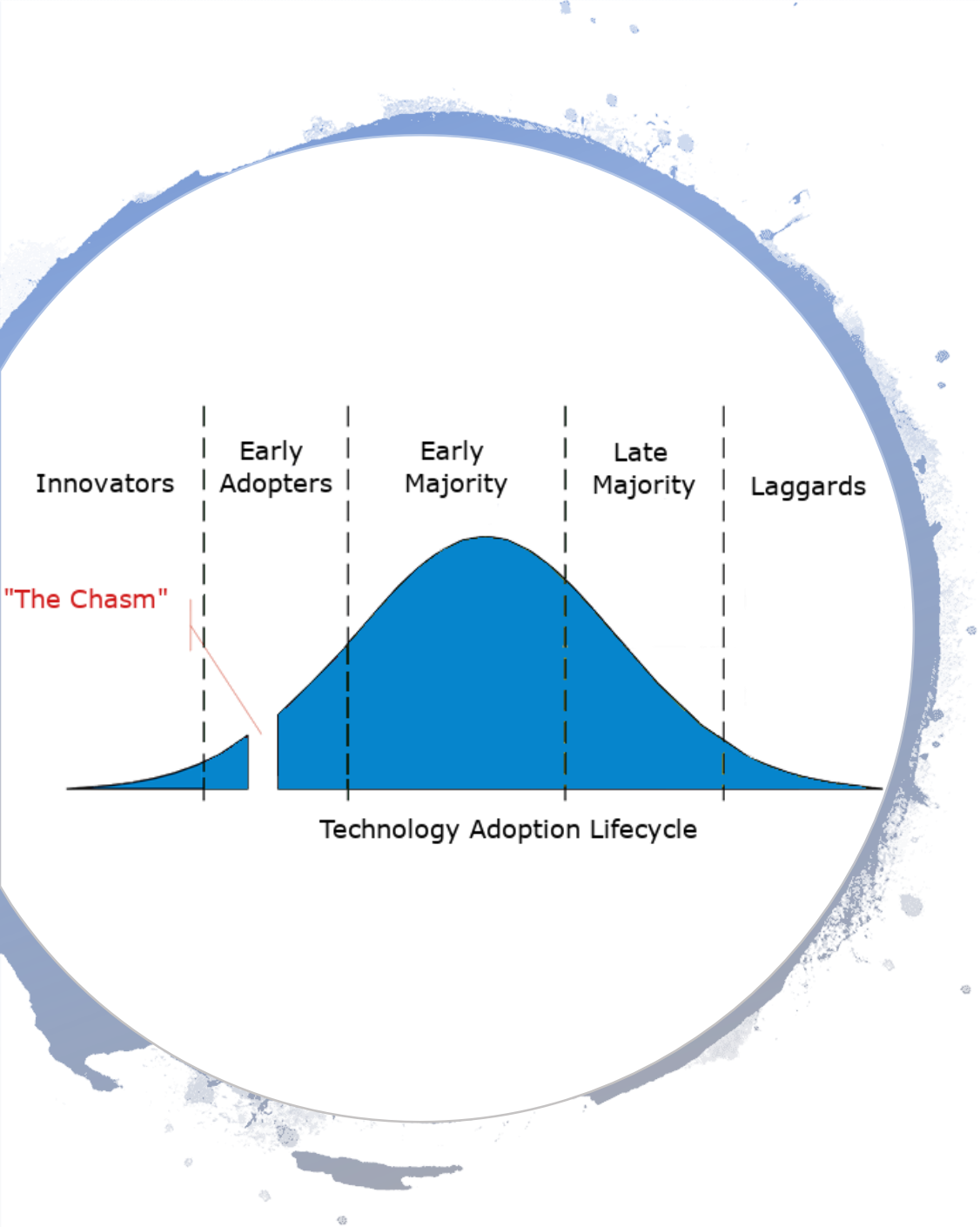
Why XR@Z?

FASTER-TIME-TO-SCIENCE!

Over time, the Z Machine has increased in shot complexity and usage demand

Teams are researching and developing new ways to aid in the increased shot complexity and demand while ensuring the mission is safe and secure





How XR@Z?

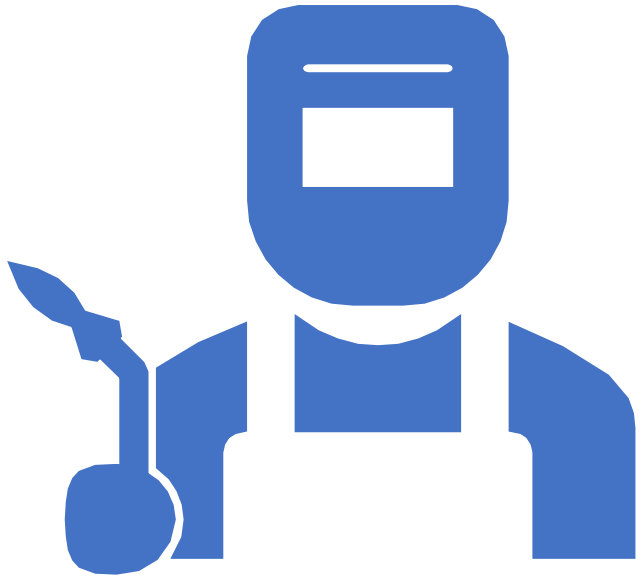
Technology Adoption Lifecycle

XR has potential to provide value-add, but needs to be further explored and evaluated pragmatically

XR@Z Use Case

Can XR provide value-add to help achieve the following goal?

To establish confidence that we can safely and sustainably execute 140-180 downline shots on Z per Calendar year



XR@Z Use Case Cont.

Potential Issue obstructing the desired shot goal

- Workforce training for Z Center Section:
  - Copious knowledge of worker activity is tacit and resides only within the team lead
  - Training the workforce is constrained to the availability of the team lead
  - Single point of failure exists due to lack of additionally trained workers

Potential exploration for XR to support shot goal

- Scale Workforce training for Z Center Section:
  - Enhance and augment training via XR
  - Multi workers can train concurrently via XR
  - Knowledge transfer is documented and digitized vis-à-vis XR

Scale Workforce Training

Learn:

Virtual Training

Modeling and Processing with electronic devices

Apply:

Augmented Training

Augmented Overlay with Surrogate Physical Models

Synthesize:

Real-life Training

Live on-the-spot training with the Trainer/Supervisor

Example of ‘Learn’ Stage

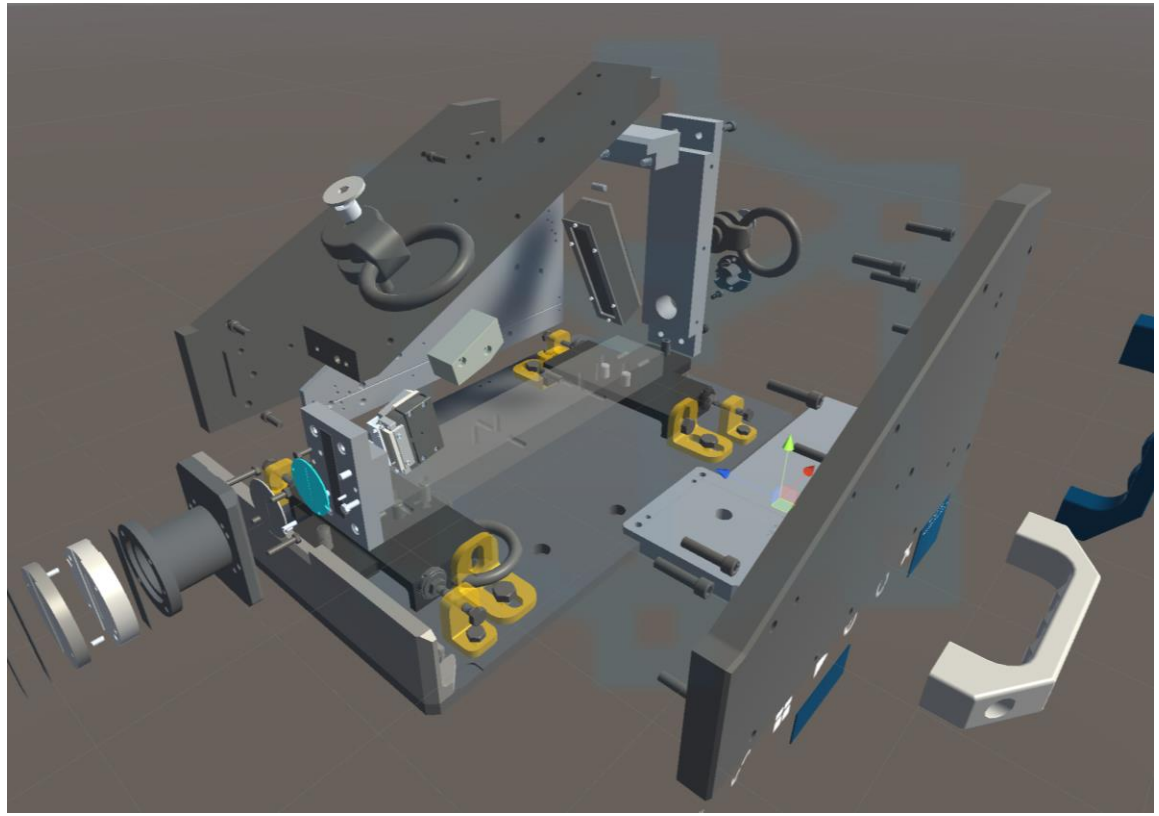


Figure 1: Exploded assembly drawing of the CRITR diagnostics
CRITR Exploration Augmented Reality (AR) Demonstration
Brandon Klein, Trent Yocom, Nadine Miner
SAND: SAND2019-14385 O

Creation of an interactive, digital library that is dynamic and interconnected to the pupil with helpful recommendations

For additional reading on the CRITR diagnostic, please see the recommended American Institute of Physics publication:

Compact, rugged in-chamber transmission spectrometers (7–28 keV) for the Sandia Z facility
D. B. Sinars; D. F. Wenger; S. A. Pikuz; B. Jones; M. Geissel; S. B. Hansen; C. A. Coverdale; D. J. Ampleford; M. E. Cuneo; L. A. McPherson; G. A. Rochau; Review of Scientific Instruments 82, 063113 (2011) DOI: 10.1063/1.3600610

Example of ‘Learn’ Stage cont.

Learn digitally, from anywhere, to understand appropriate objects, procedures, and associative nomenclature

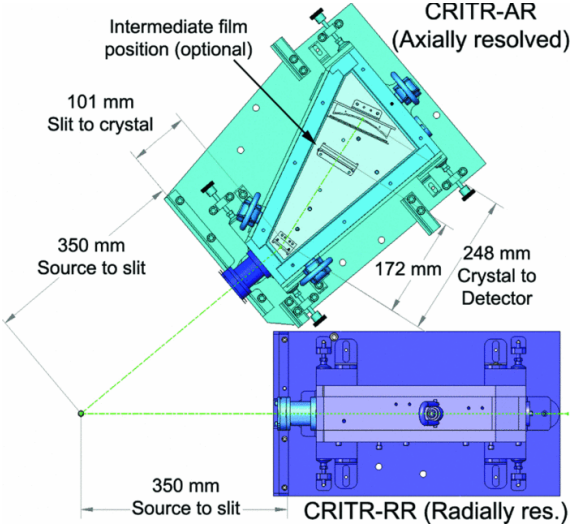


Figure 2*: Model view of the CRITR-AR and CRITR-RR diagnostics with appropriate dimensions called out. The dimensions inside the -AR and -RR boxes are identical. Also shown is the position of an optional intermediate film position

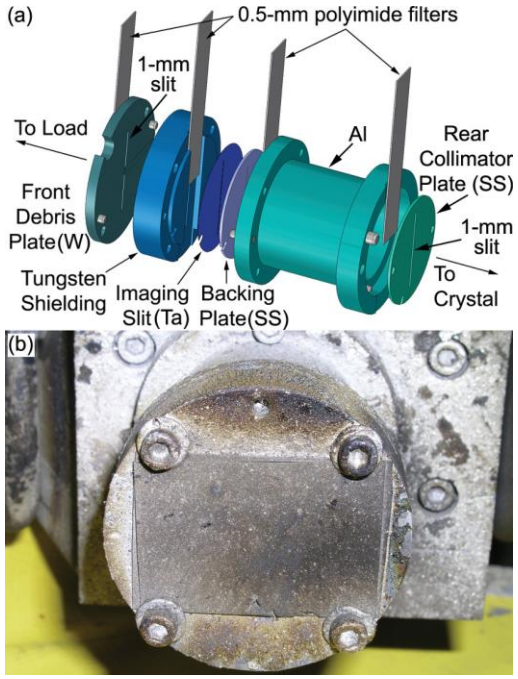


Figure 3*: (a) Exploded assembly drawing of the imaging snout used on both CRITR diagnostics. The 8-mm field of view of the CRITR is set by the 44-mm distance between the 1-mm rear collimator slit and the imaging slit. (b) Photo of a prototype (CRITR-AR) snout design illustrating typical damage from debris. Two pieces of 0.5-mm thick polyimide were placed on the front of the snout. Debris punctured several holes through both pieces

***Compact, rugged in-chamber transmission spectrometers (7–28 keV) for the Sandia Z facility**:
D. B. Sinars; D. F. Wenger; S. A. Pikuz; B. Jones; M. Geissel; S. B. Hansen; C. A. Coverdale; D. J. Ampleford; M. E. Cuneo; L. A. McPherson; G. A. Rochau; *Review of Scientific Instruments* **82,** 063113 (2011)
DOI: 10.1063/1.3600610

Example of ‘Apply’ Stage

CRITR Exploration Augmented Reality (AR) Demonstration

Brandon T. Klein, Trent Yocom, Nadine Miner
SAND2019-14385 O

Z-Machine Box and Target Demo Targets with Augmentation

Brandon T. Klein, Trent Yocom, Nadine Miner
SAND2019-14386 O

Demonstrations provided to the conference during the XR Demo time slot

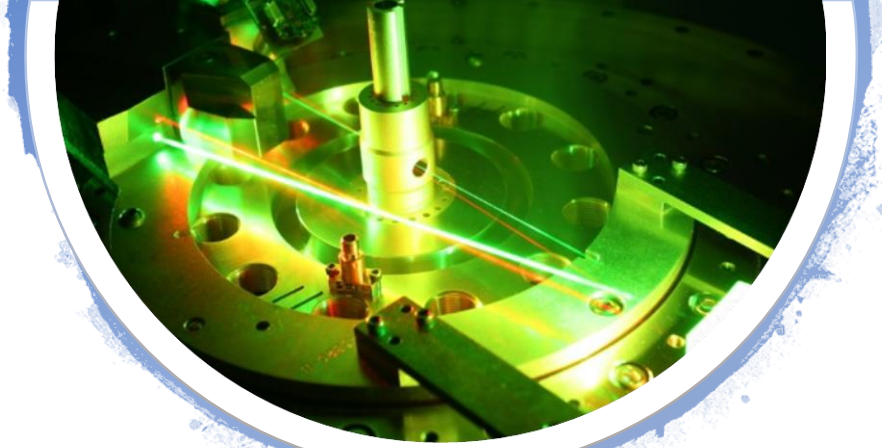
Example of ‘Synthesize’ Stage

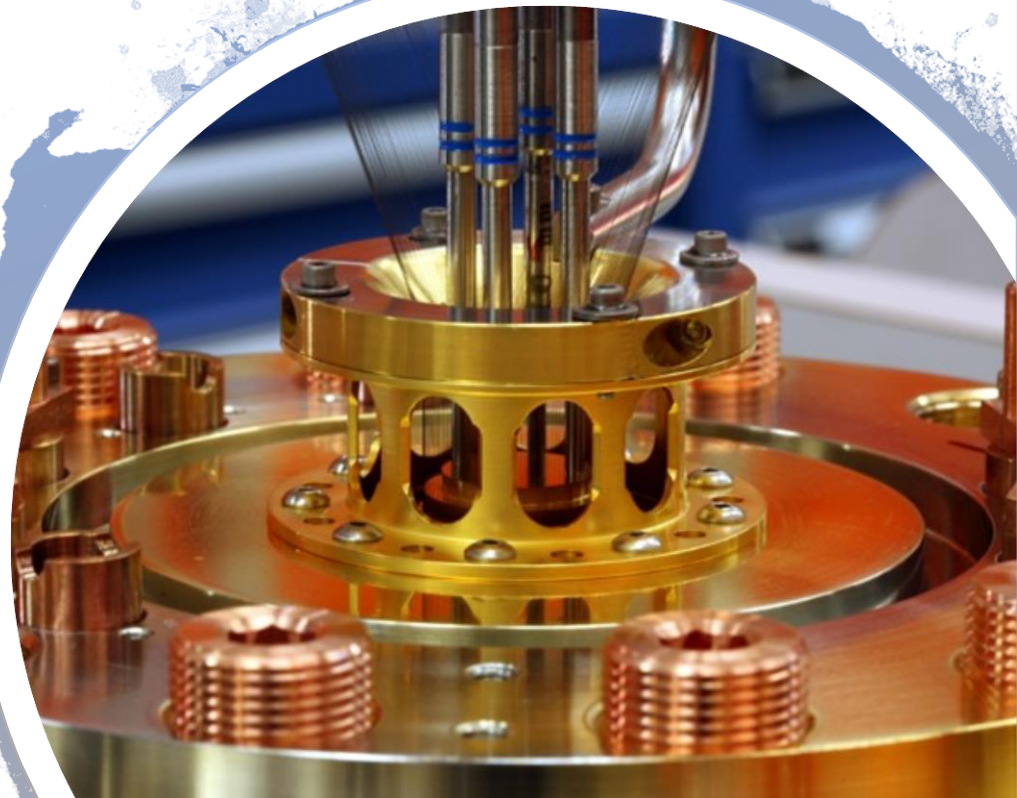
FY19 XR@Z

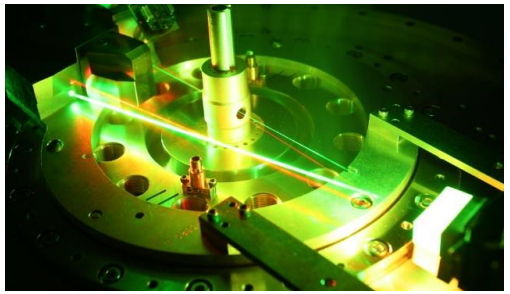
Obtained necessary hardware and software to research and develop XR:

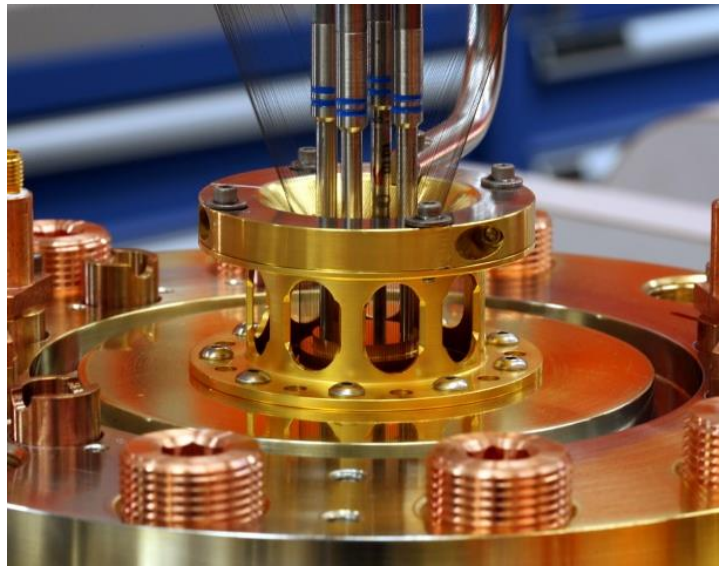
- Microsoft HoloLens
- Unity Development Platform

Collaborated with Nadine Miner PhD, and the XR Software Simulation (XRSS) team at Sandia. Demonstrated and delivered augmented software capability









FY20 XR@Z

Strengthen XR competency:

- Continue development of solutions
- Continue collegiate collaboration
- Continue conference presentations
- Written publications

Future XR@Z

Additional research and development in XR to be explored with:

- Edge Computing
- Machine Learning and Deep Learning
- Realtime Data Visualization
- Natural Language Processing
- Robotics
- Simulated Z Machine Shots
- …

Thank You!