

FULL MOTION VR

for Nuclear Arms Control and Disarmament Verification

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PIIC Beijing Seminar on International Security
Suzhou, China, November 1–5, 2016

BUILDING FROM LIVE EXERCISES

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➤ UK-Norway Initiative

UKNI Managed Access exercises took place in Norway in 2008 and 2009, and in the UK in 2010. The exercises were underpinned by a framework which included a hypothetical treaty between two fictitious countries: a weapon state and a non-weapon state.

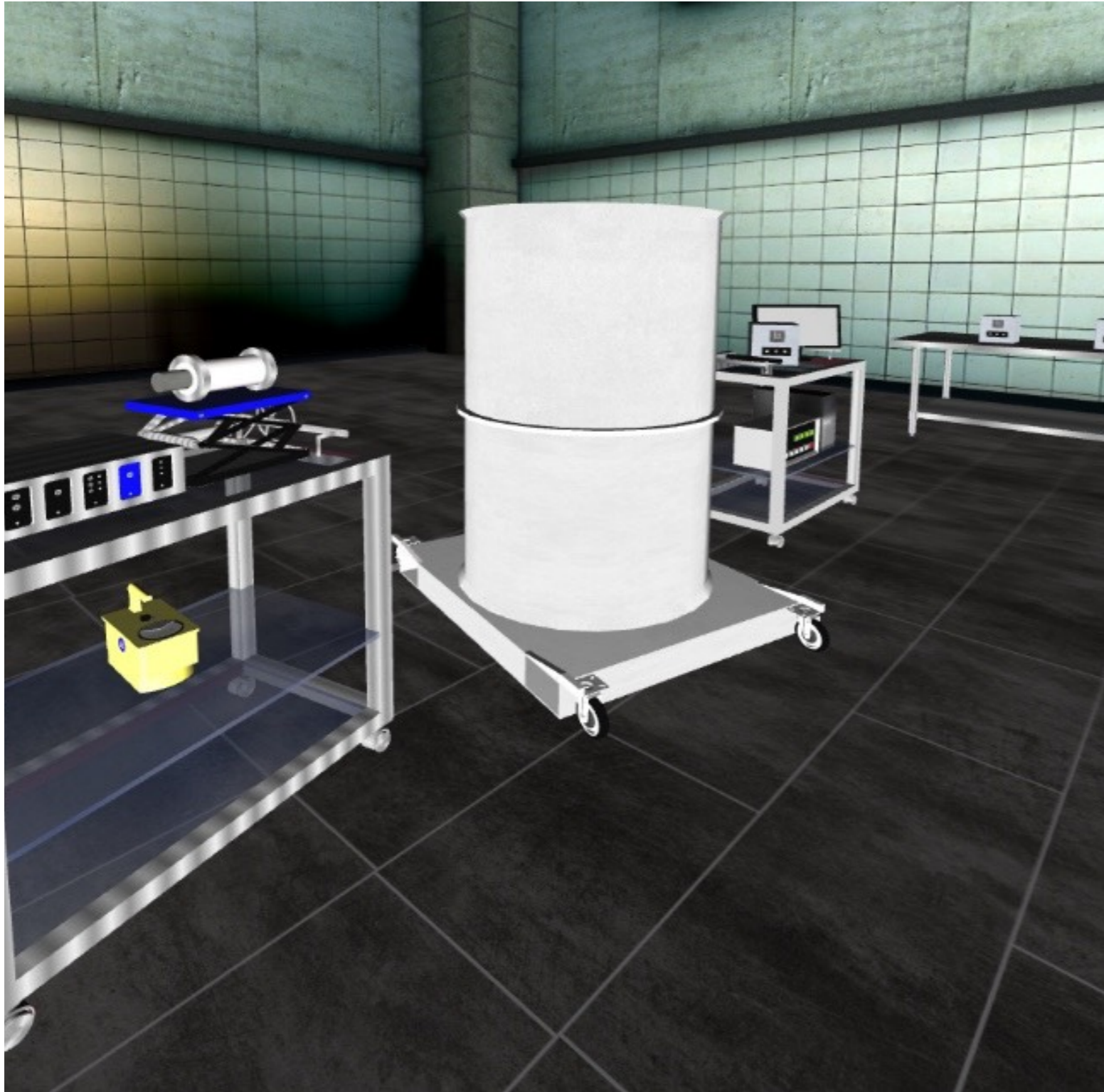
Inspectors deployed a number of techniques and processes, including radiation monitoring, tags and seals, digital photography of the tags and seals, CCTV cameras, and an information barrier system for gamma measurements.

➤ UK-US Cooperation

From 2002 through 2011, the United Kingdom and United States conducted four major managed access exercises, concluding with an extensive Warhead Monitored Dismantlement exercise.



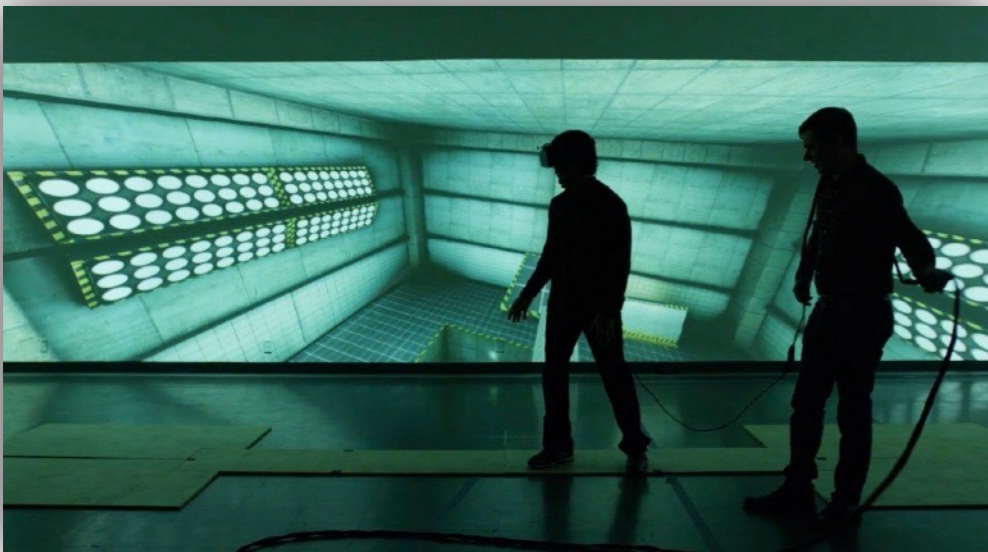
Images from the UK-Norway Initiative



“FMVR provides a flexible and powerful way to extend the research community's ability to examine larger numbers of options and technology combinations for verification approaches.”

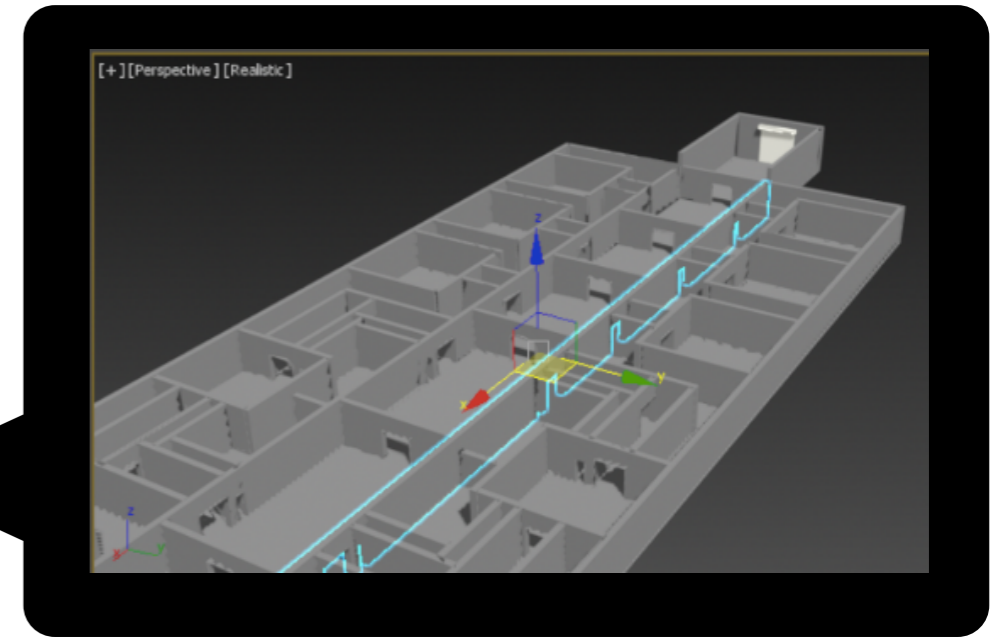
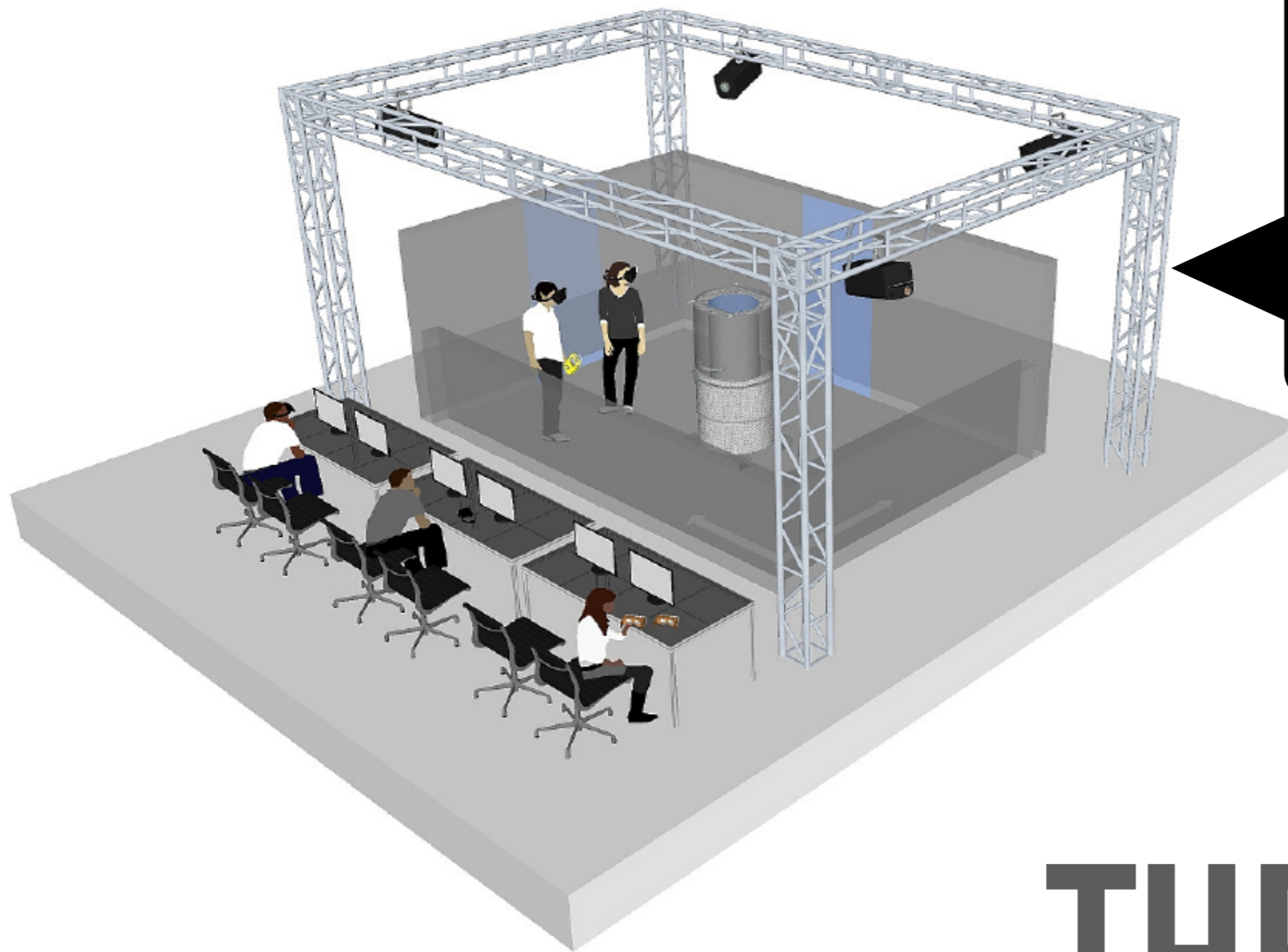
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The brain doesn't much care if an experience is real or virtual.



Jim Blascovich and Jeremy Bailenson
Infinite Reality: The Hidden Blueprint of Our Virtual Lives

More to explore: www.youtube.com/watch?v=9jx2YWzxvbs



THE SYSTEM

WorldViz Walking Virtual Reality System



COLLABORATION

SIMULATION

DESIGN

TEACHING

NEGOTIATION

TRAINING

QUESTION SETS FOR VR

➤ 1. ARCHITECTURE

- Existing versus dedicated facility?
- Should the structure prioritize disassembly efficiency or verification?
- How "integrated" can inspectors be in the facility?

➤ 2. VERIFICATION TECHNOLOGY

- Explore differences in protocols for different technologies, e.g. attributes vs. template-matching
- Chain-of-custody technology: how to track weapons and components?

➤ 3. MANAGED ACCESS

- How can hosts grant inspector confidence without revealing classified information?
- How can inspectors gain confidence without gathering any proliferation-sensitive information?

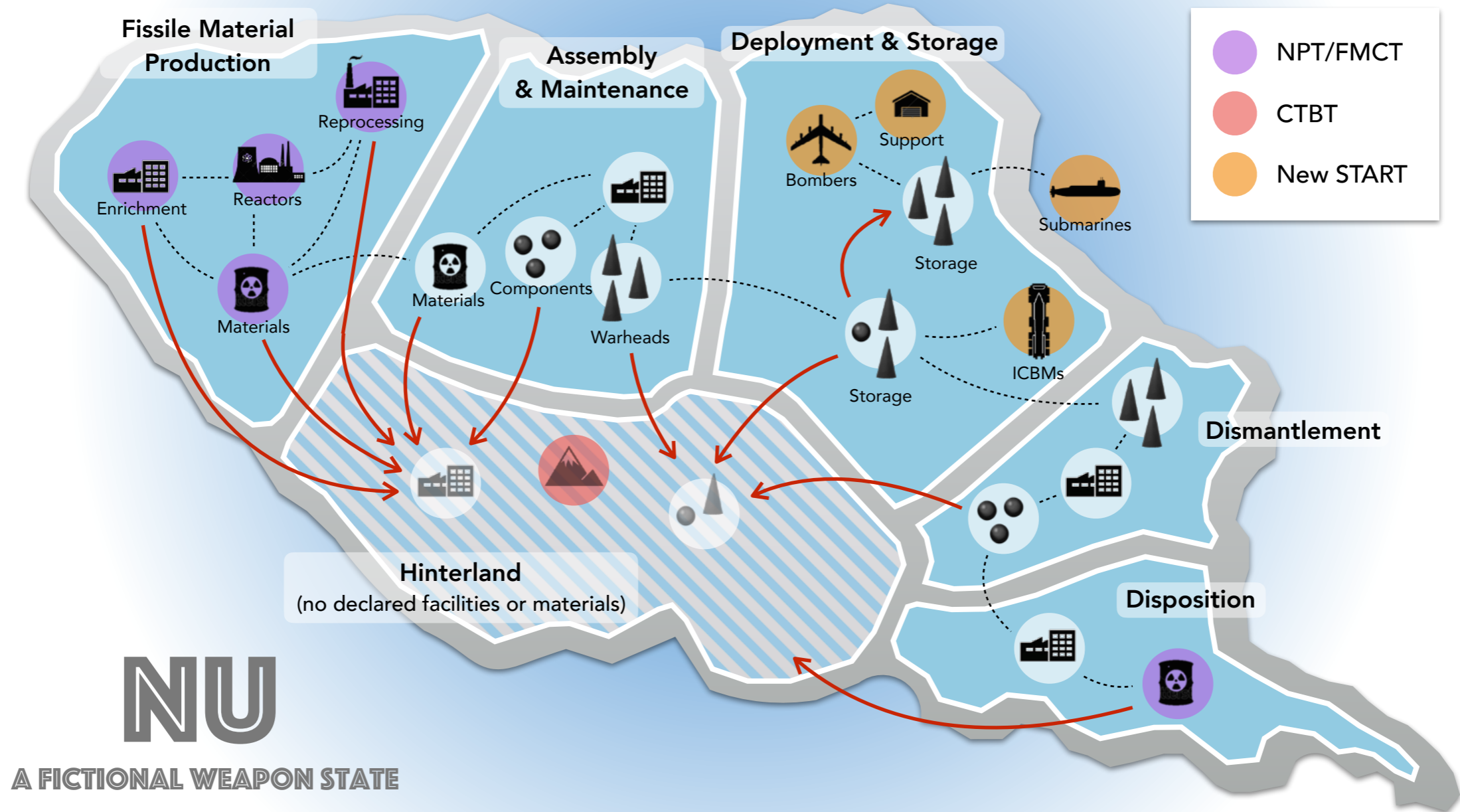
Elements of a

CASE STUDY

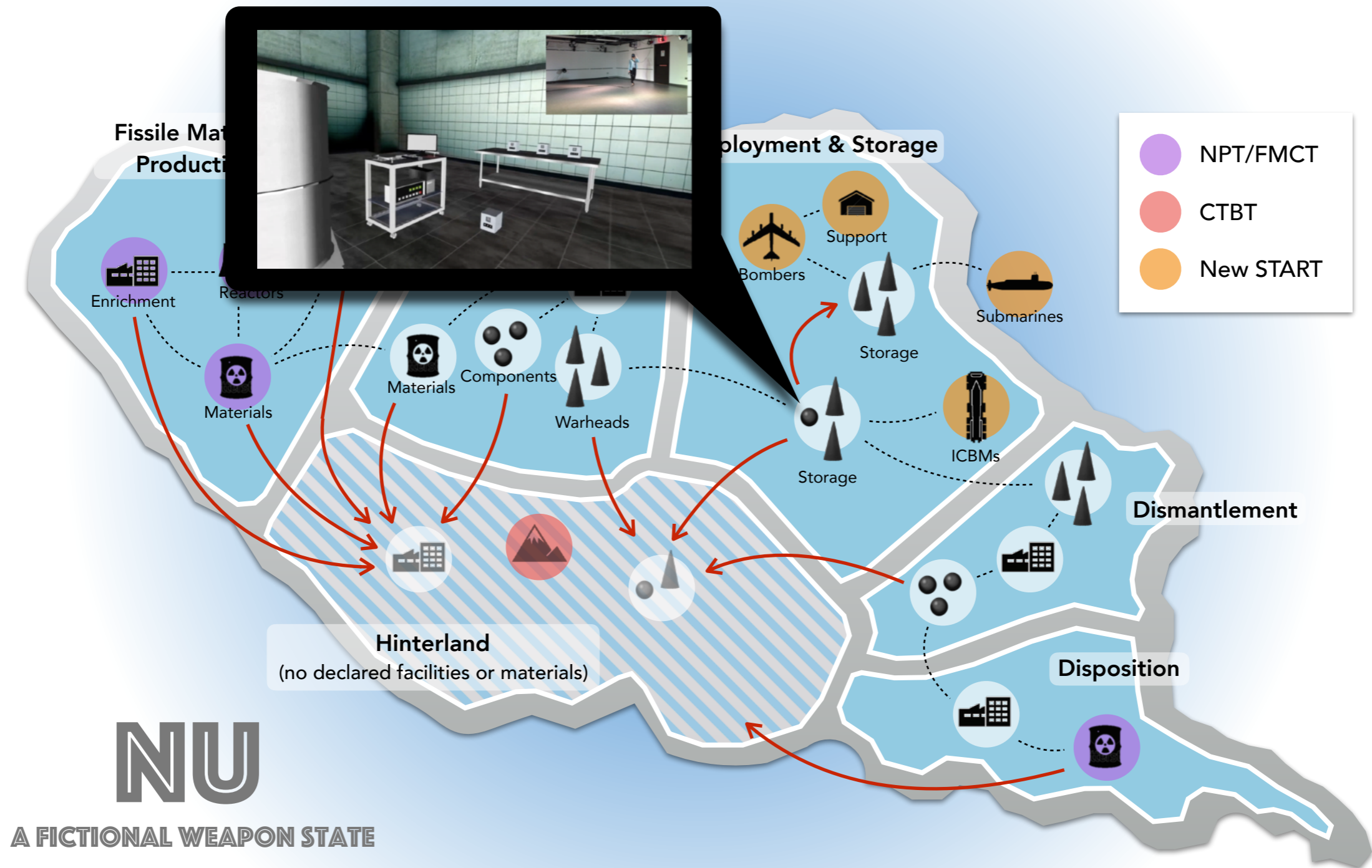
Refining a Verification Approach

MAPPING NUCLEAR VERIFICATION

www.verification.nu



MAPPING NUCLEAR VERIFICATION



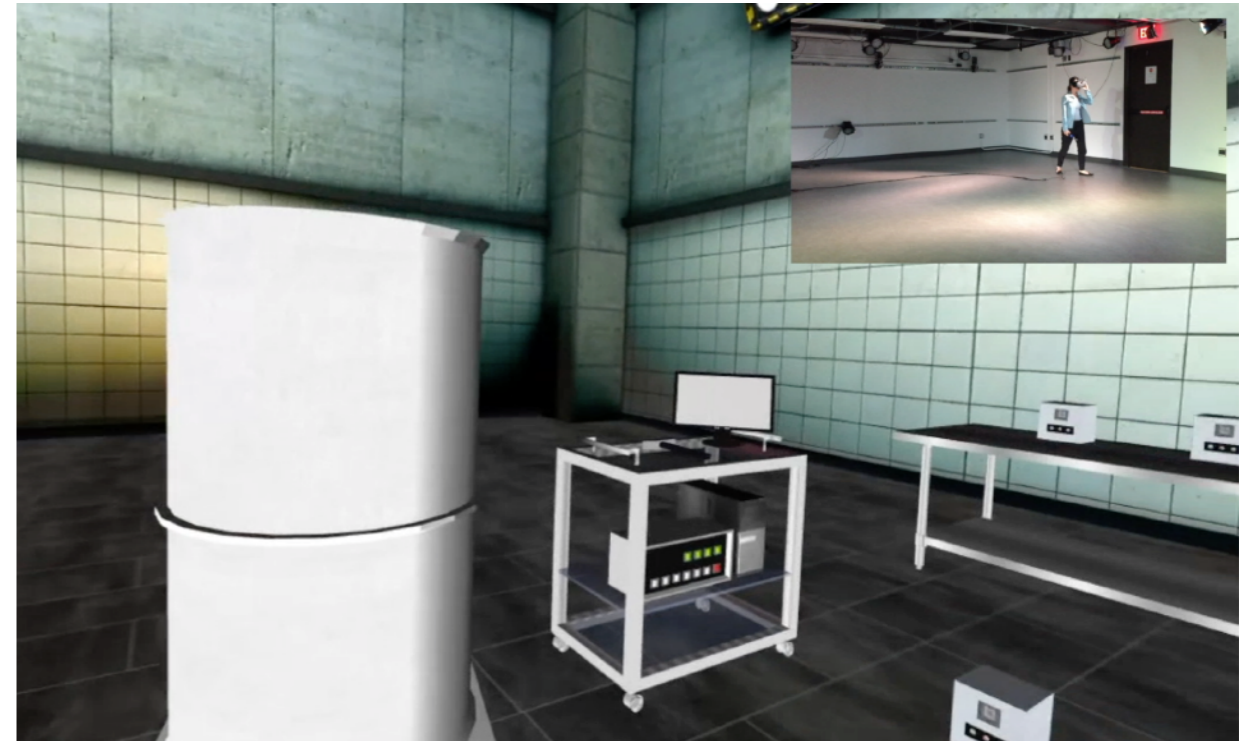
VIDEO

nuclearfutures.princeton.edu/vr



SCENE 1

Buddy tags at a storage site



SCENE 2

Buddy tags with a possible UID system

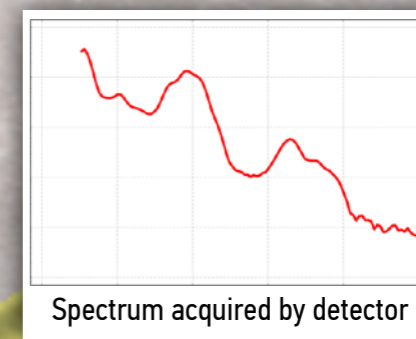
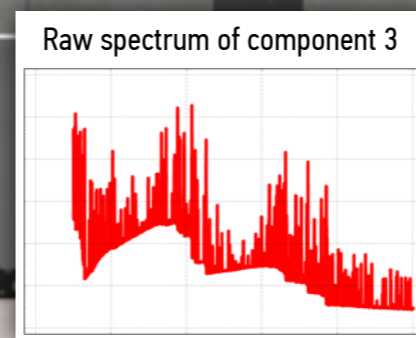
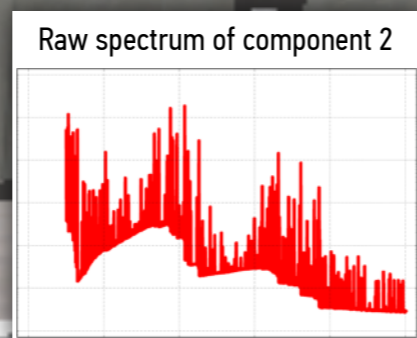
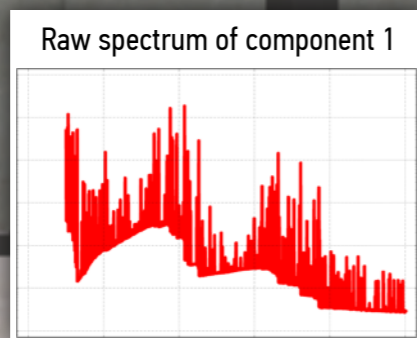
www.youtube.com/watch?v=AMSvrxg-at4 (silent) and *www.youtube.com/watch?v=PVR-ioOoOhg* (sound)



VIRTUAL RADIATION

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- Radiation signatures of materials are relevant for many aspects of nuclear verification, and it is therefore important to include radiation in our models.
- Several previous efforts with static radiation fields
- Our goal: Quasi real-time treatment of nuclear radiation for multiple/movable components and various types of detectors



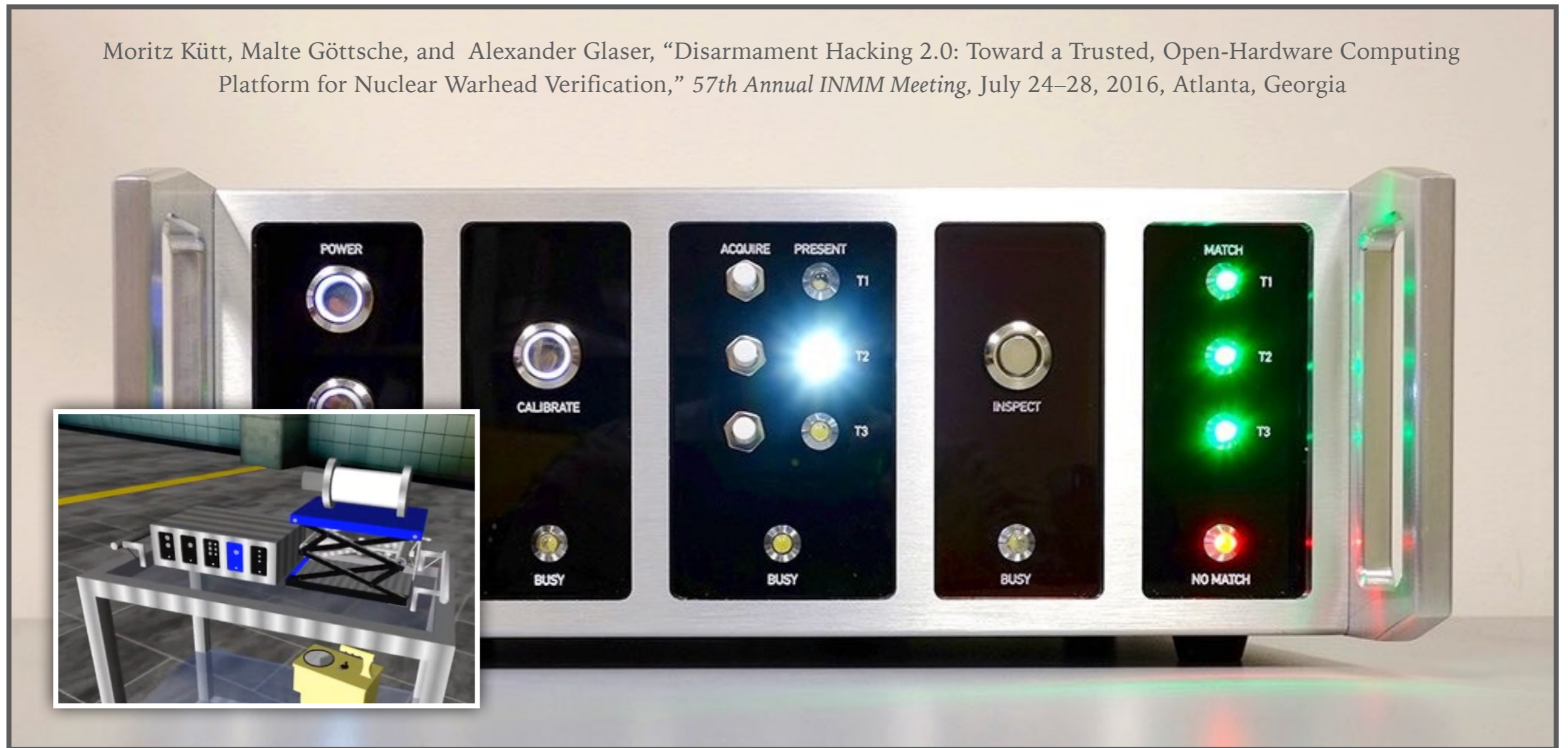
Real-time virtual (gamma) radiation

*with multiple (movable) containerized nuclear components
and selectable inspection systems (based on NaI, HPGe, or other detector types)*

INFORMATION BARRIER EXPERIMENTAL (IBX) 1/2

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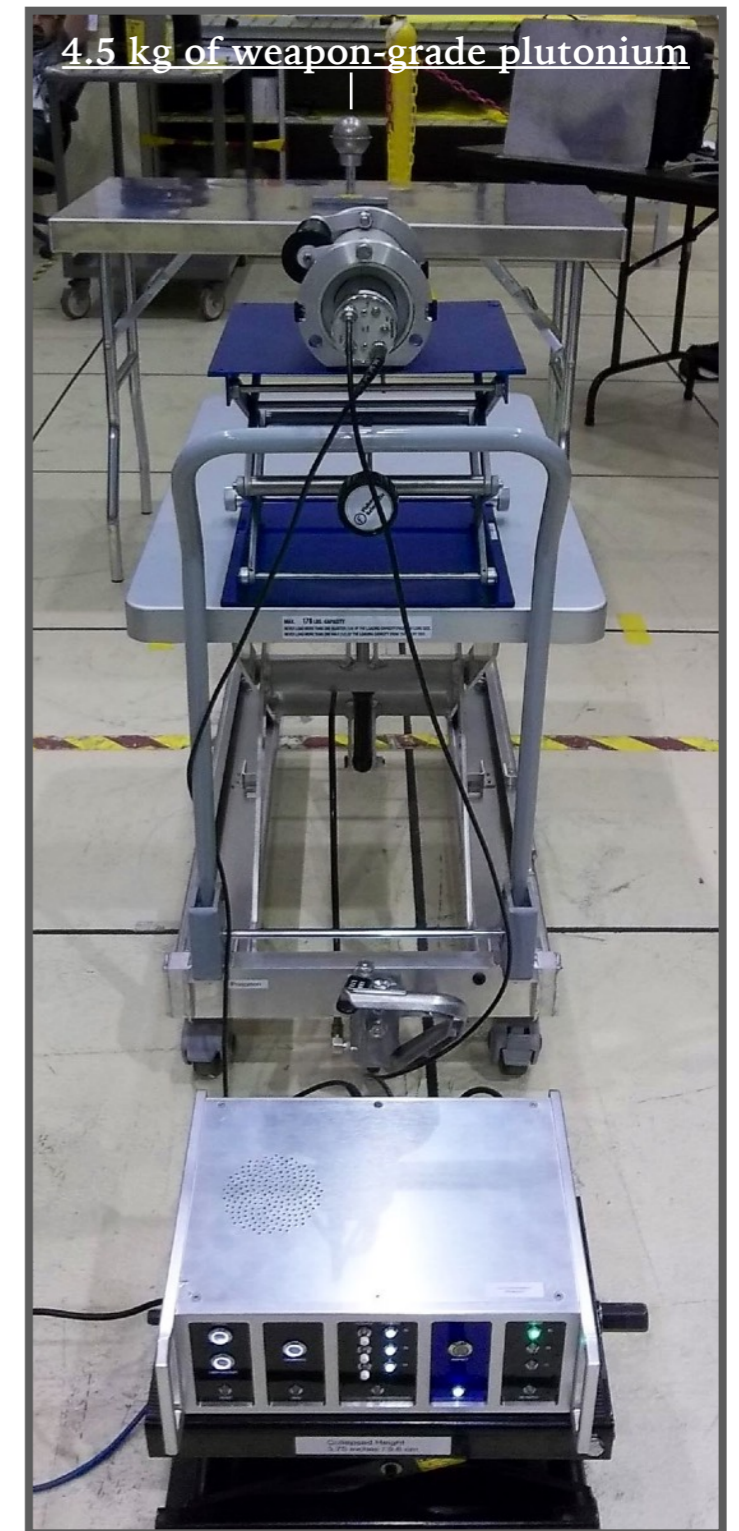
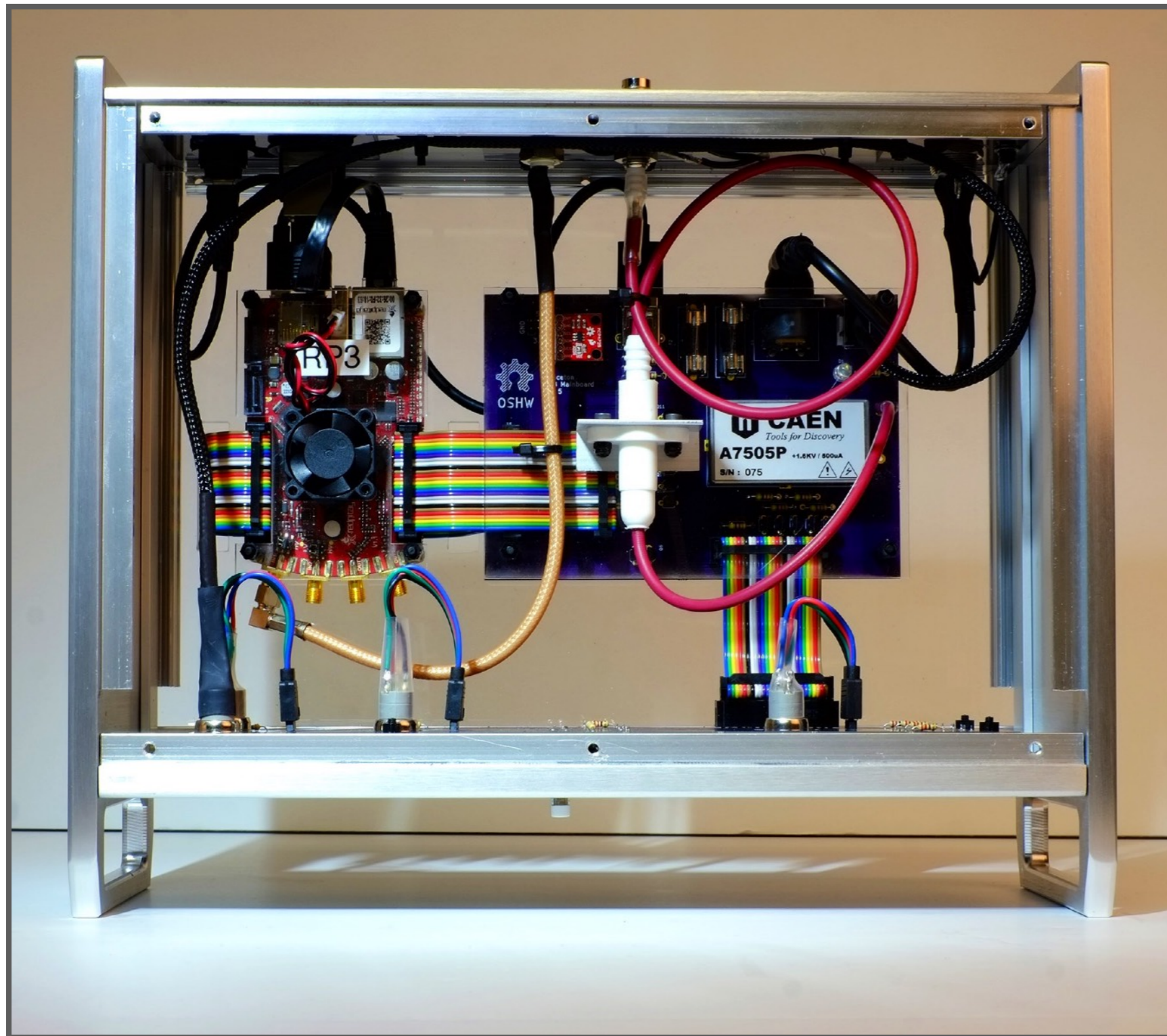
Moritz Kütt, Malte Göttsche, and Alexander Glaser, “Disarmament Hacking 2.0: Toward a Trusted, Open-Hardware Computing Platform for Nuclear Warhead Verification,” *57th Annual INMM Meeting*, July 24–28, 2016, Atlanta, Georgia

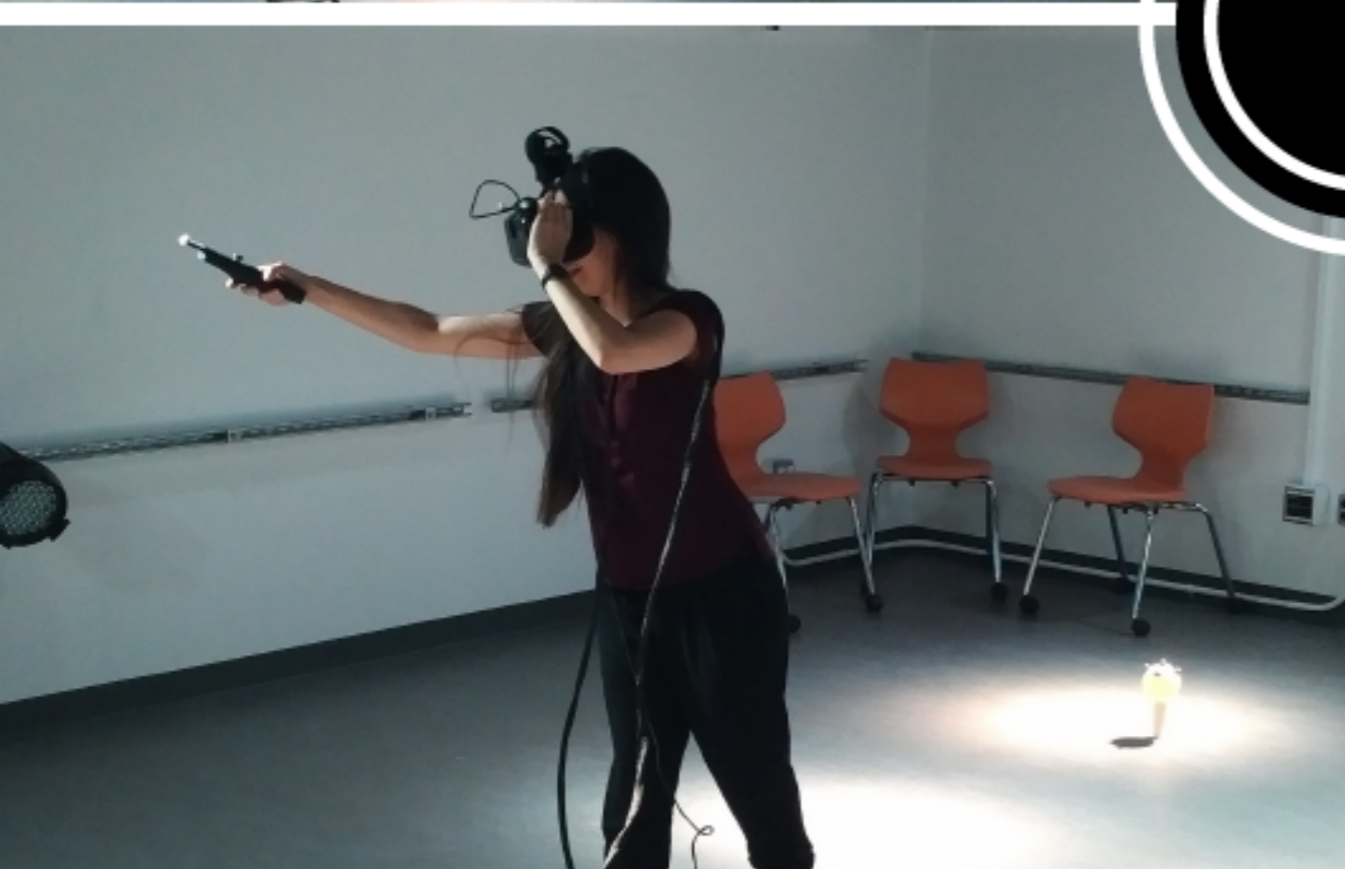


- Built in Spring 2016 at Princeton University (as part of a final course project)
- Uses template-matching approach with open-source software

INFORMATION BARRIER EXPERIMENTAL (IBX) 2/2

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NEXT STEPS / WAY FORWARD

- Virtual reality offers an exciting new pathway to support experts and governments in developing and refining verification approaches for nuclear arms control
- In particular, collaborative VR exercises may offer environments to explore new concepts for addressing verification challenges (especially those relevant for onsite inspections); VR exercises can therefore lay the basis for live exercises and new policy initiatives
- We hope to hold VR exercises to both engage students on arms-control issues and develop best practices for more formal government exercises

MORE

nuclearfutures.princeton.edu/vr

www.verification.nu (coming early 2017)