The “VR cave” at Michigan: A Brief History

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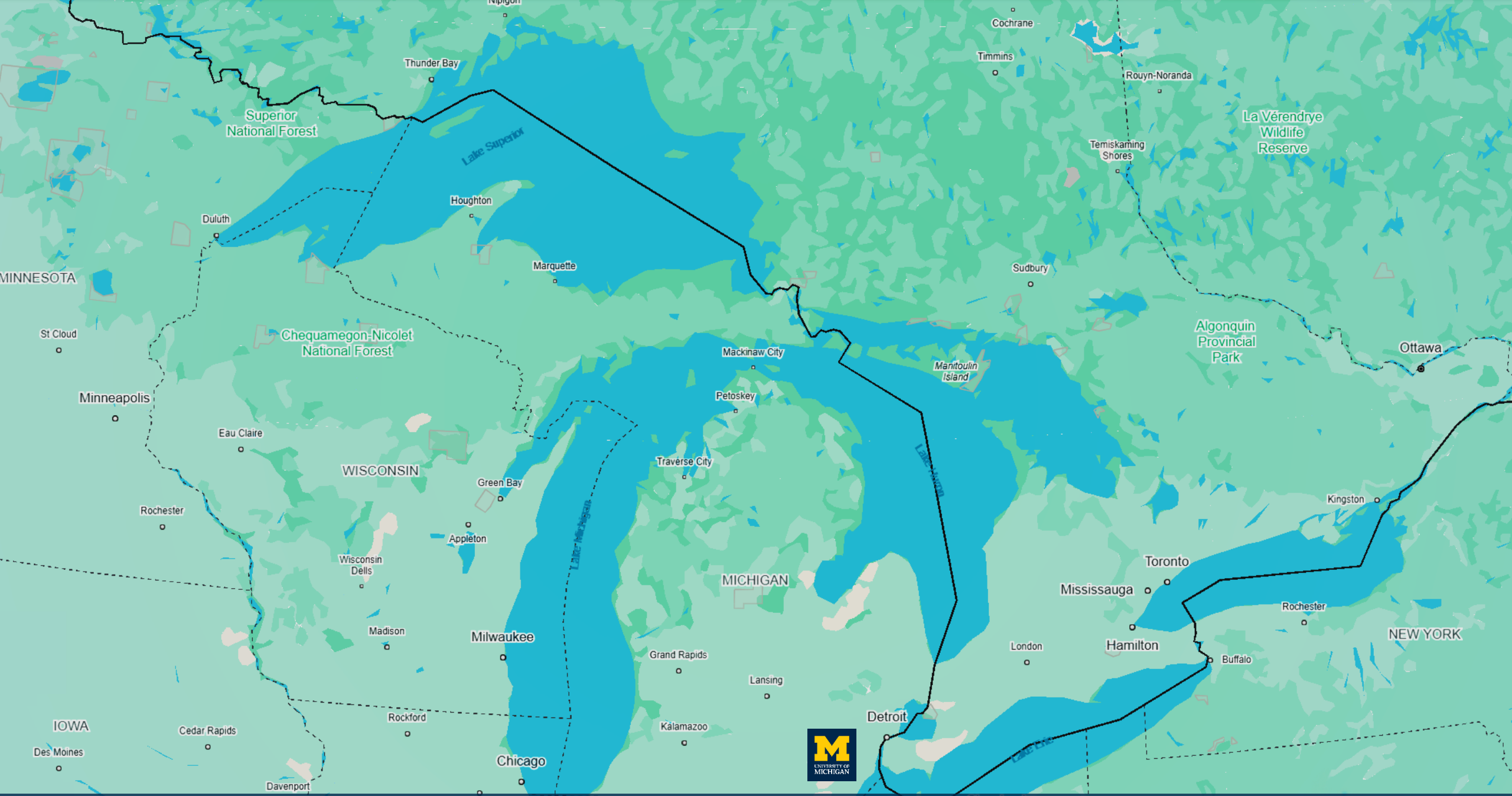
The James and Anne DUDERSTADT CENTER

XR ERA + Media & Learning

6 time-zones west of Central Europe, in the Great Lakes region of North America …



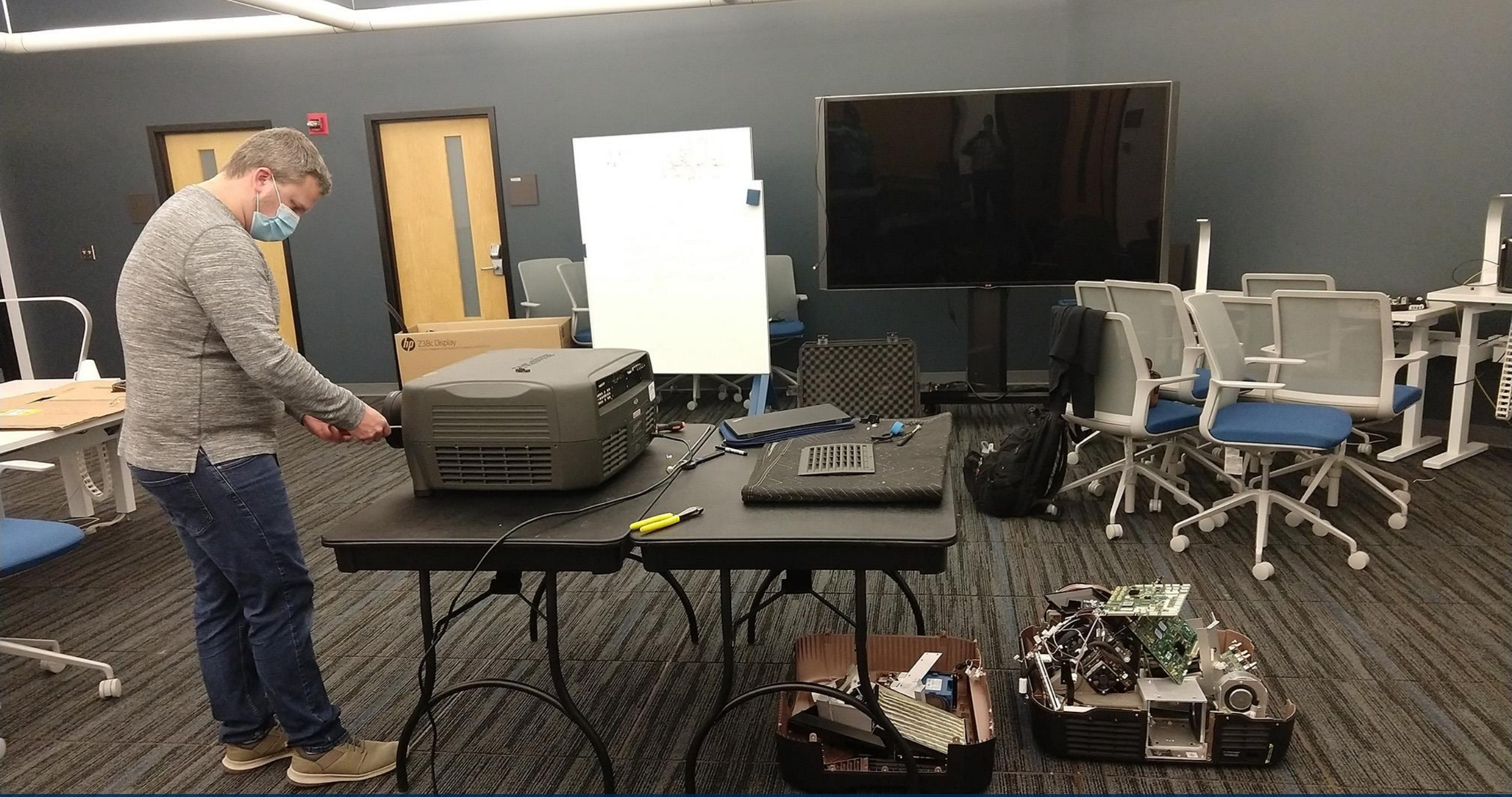
In the southeast corner of the State of Michigan, USA – 70 km west of Detroit


The James and Anne
DUDERSTADT CENTER
• Building opened 1996
• “VR cave” installed 1997

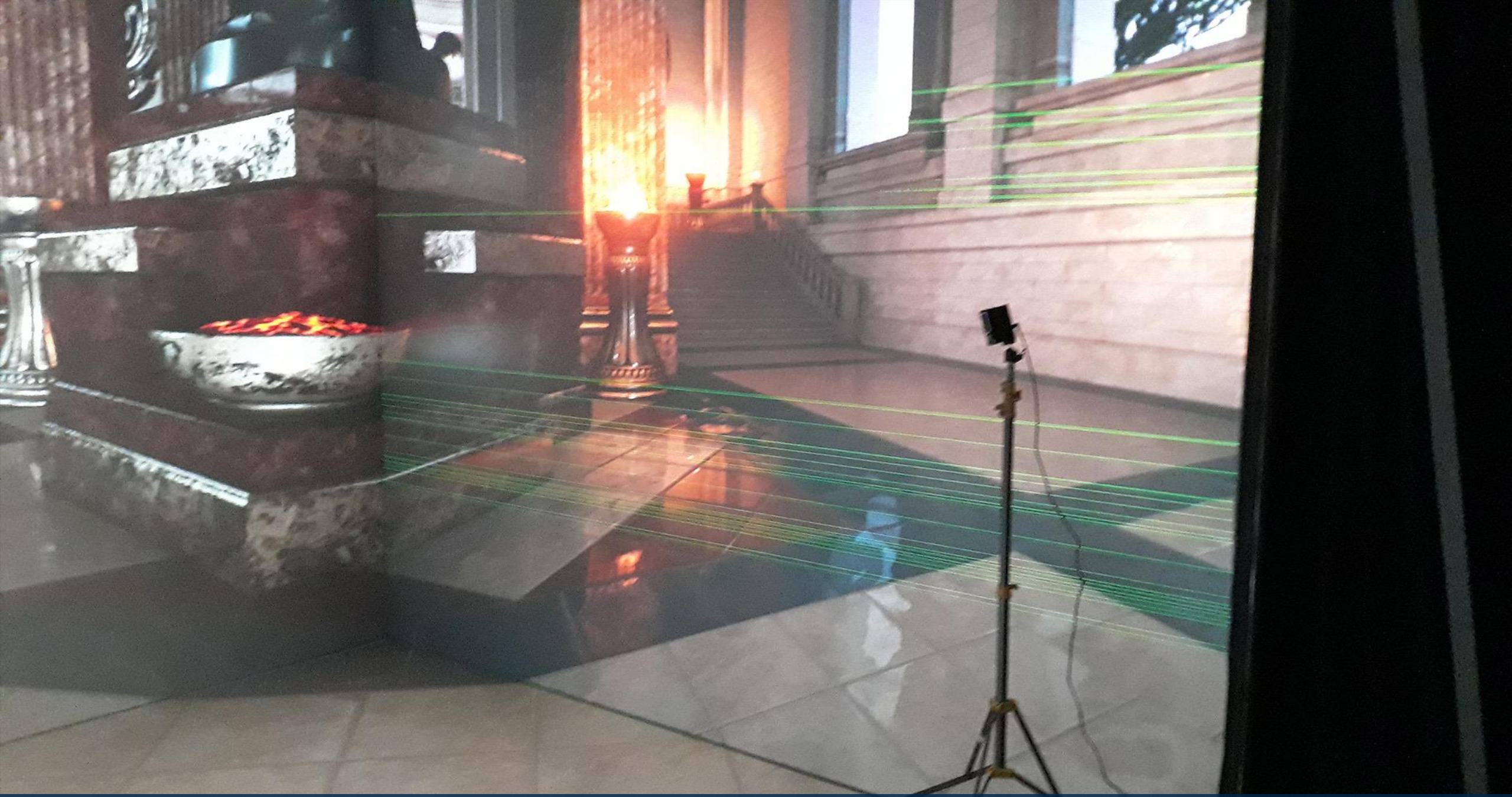
1997: Fakespace Boom – the state of the art for “head-mounted displays”

1997: screen resolution 768 × 768 (?); tethered tracking; single primary viewer

2006: screen resolution 1024 × 1024; tetherless tracking; single primary viewer



2021: Frankenstein surgery to resurrect a 15-year-old projector



2023: A 17-year-old projector dying for the 3rd time

2023: New projectors arrive!

2023: And a new sign: MIDEN – Michigan Immersive Digital Experience Nexus

2023: screen resolution 1080 × 1080; tetherless tracking; dual primary viewers

MIDEN

Michigan Immersive Digital Experience Nexus

with due respect to CAVE™, Electronic Visualization Laboratory, University of Illinois @ Chicago
https://www.evl.uic.edu/research/1769

- 10’ × 10’ × 10’ cubic space [10’ = 3.048 m]
- Rear projection on left, front, and right walls
- Front projection on floor
- Frame-sequential stereo

  - Single viewer mode: 2 eyes: Left, Right, Left, Right, …
    - 120 images / second [(60 images / second / eye) × 2 eyes]
    - 2160 × 2160 pixels per surface

  - Dual viewer mode: 4 eyes: Left-A, Left-B, Right-A, Right-B, …
    - 240 images / second [(60 images / second / eye) × 4 eyes]
    - 1080 × 1080 pixels per surface

Advantages of “caves” over head-mounted displays

- 270° horizontal field of view, standing @ center & facing forward
- Lighter headwear
- Less change in image projection with head rotations (only minor shift in parallax), so …
- Less provocative of simulator sickness
- Less disorienting, easier acclimation
- Less isolating, more collaborative – shared experience
- Viewers see natural selves immersed in virtual world
- See and speak with humans, not avatars

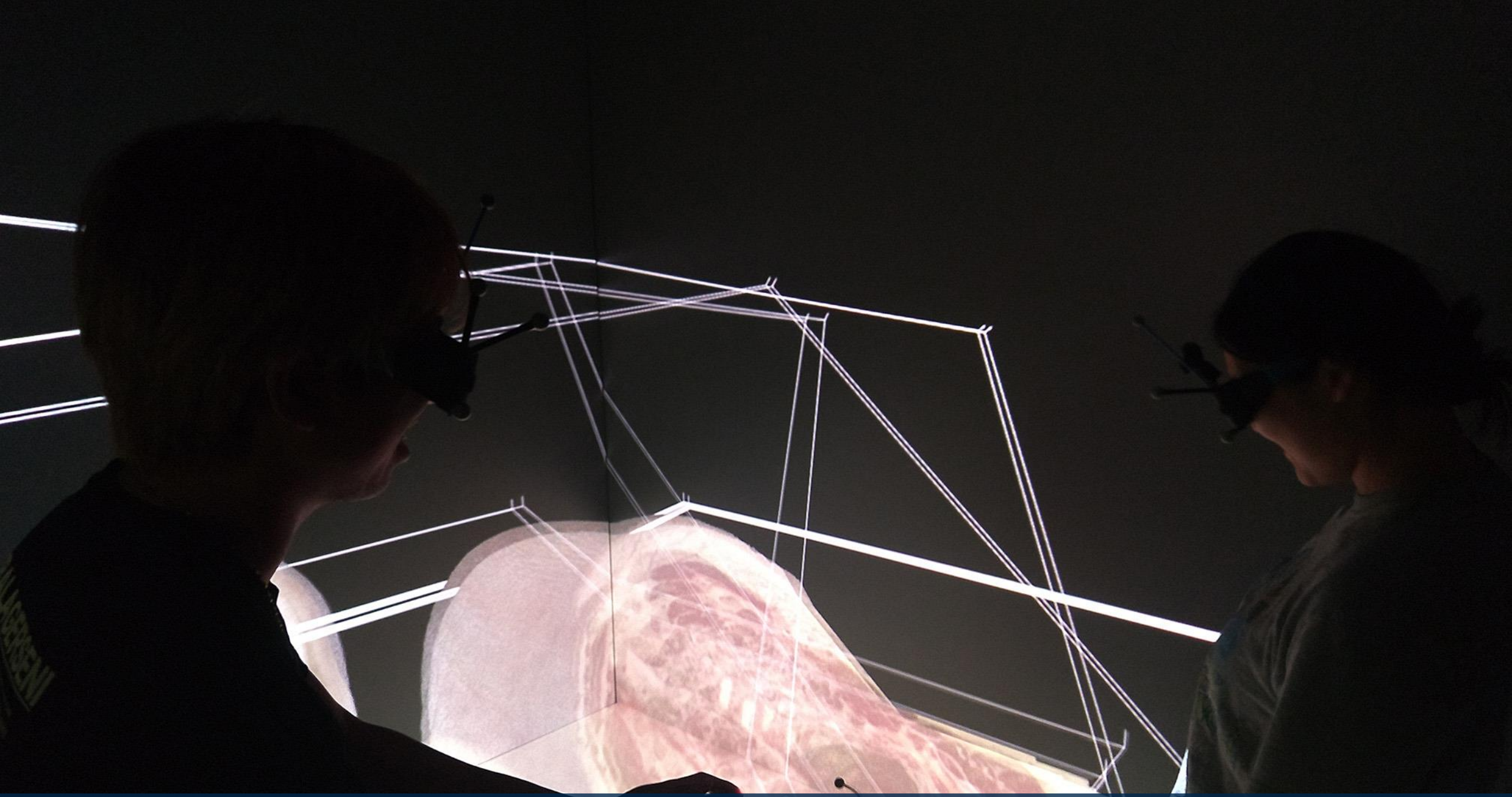
The technology gets out of the way.
Use VR to teach (versus teaching VR).

First-time MIDEN users, within minutes – “flying” through International Space Station (ISS)

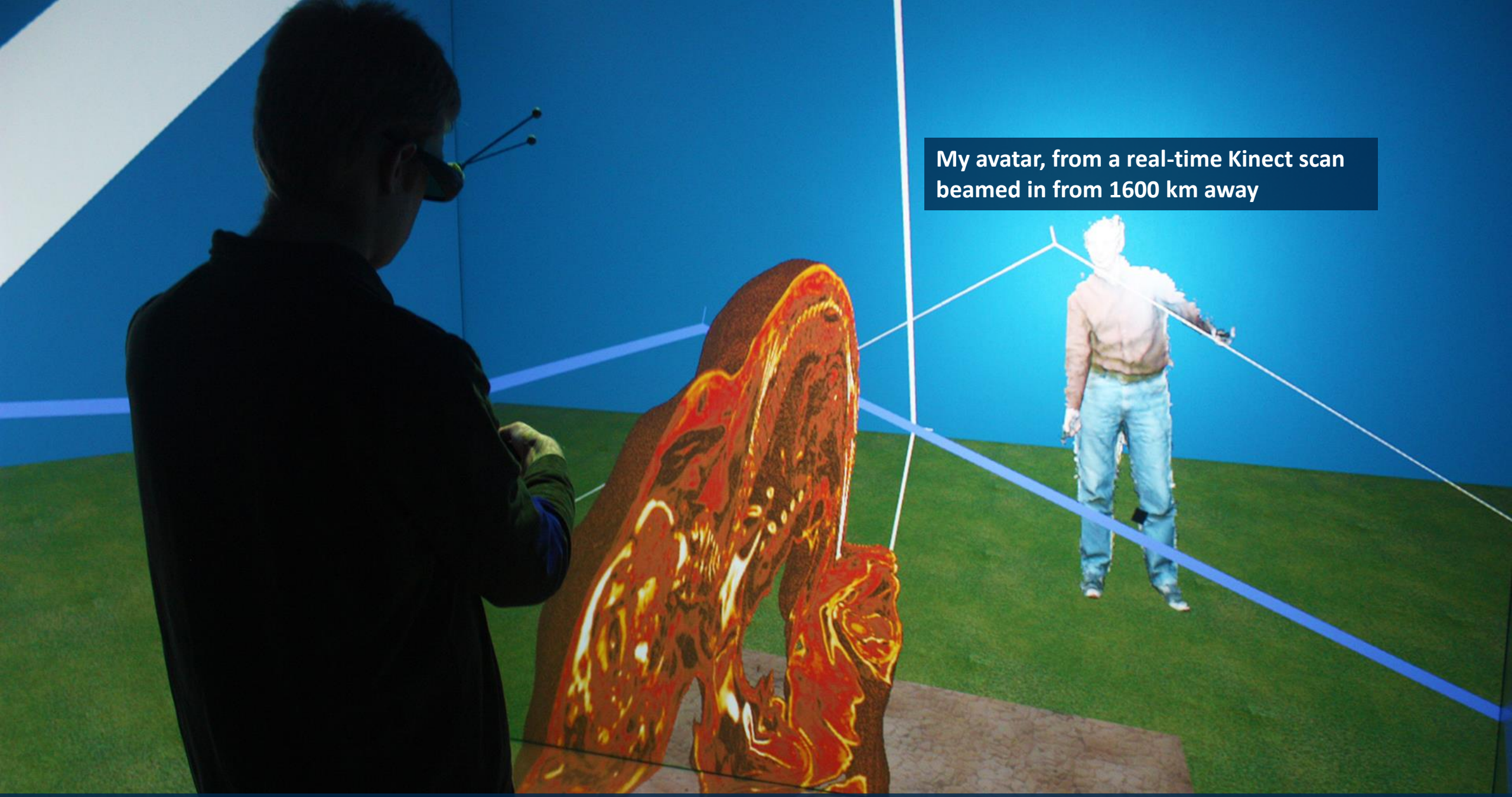
Nursing study: visual cues in assisted-living – for residents with poor eyesight & memory

Architectural assessment: accuracy of simulated lighting and acoustics

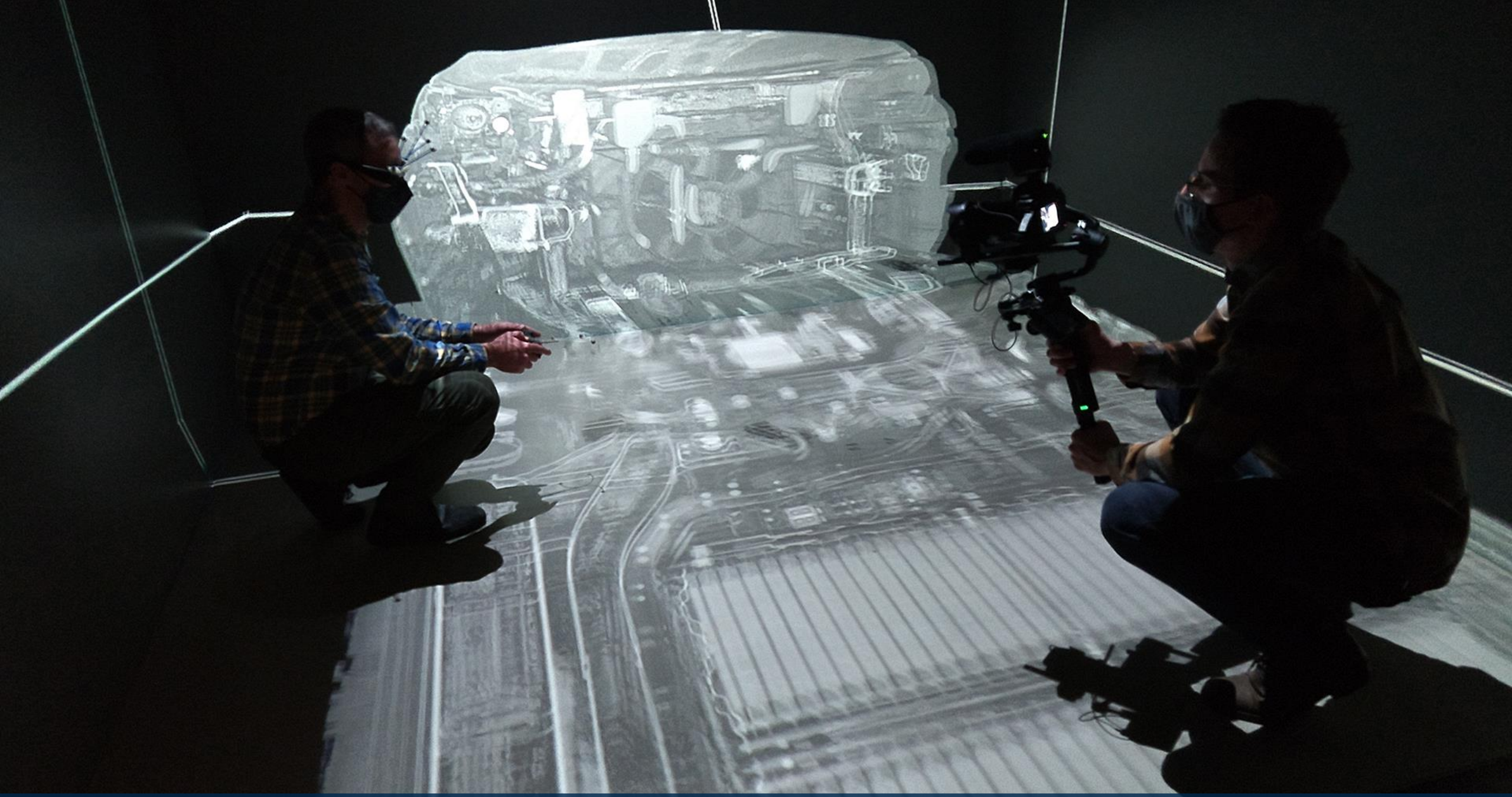
Architecture in context: “Empathy in Point Clouds”, using LIDAR data



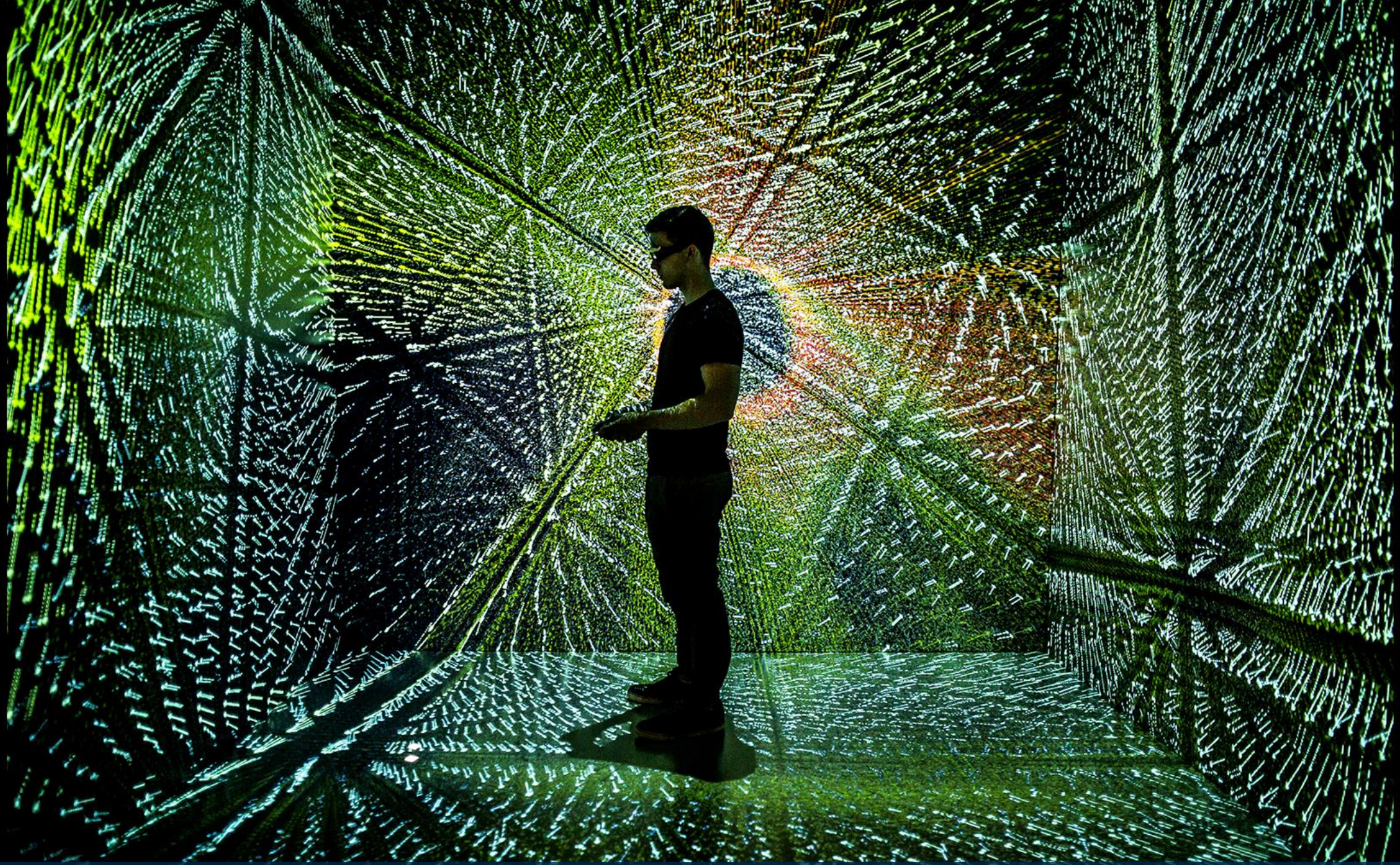
Physiology: slicing through volumetric data from the USA NIH “Visible Human” project



Physiology: slicing through CT-scan of mummified baby mammoth “Lyuba” (Люба)

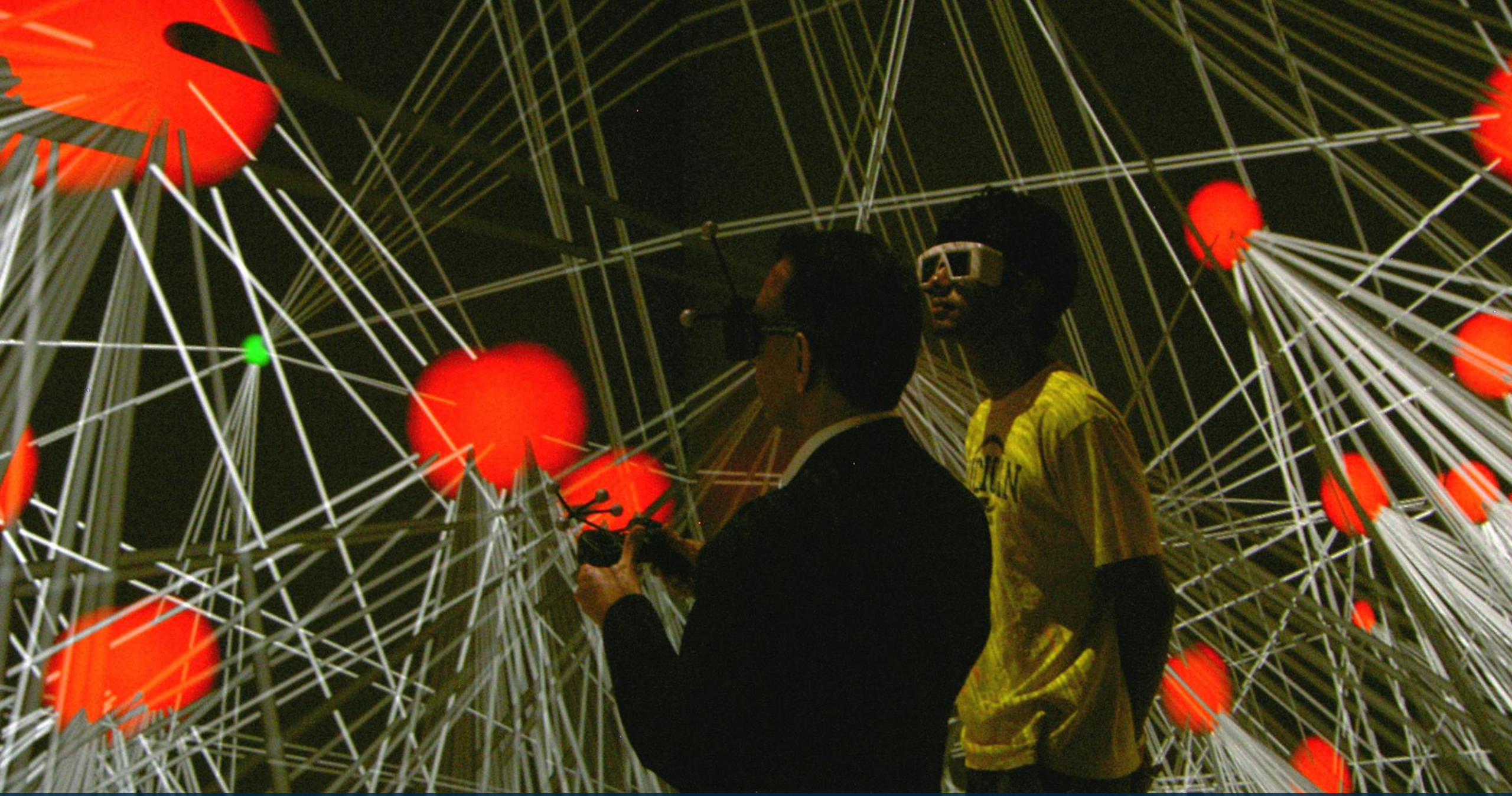


Mechanical engineering: slicing through CT-scan of a Chevrolet Volt



Mechanical engineering: fuel intake velocity vectors in an internal combustion engine

Biochemistry: visualizing protein structures



Bioinformatics: visualizing diseases and gene regulation

Art meets cosmology: visualizing a toroidal multiverse with black holes and worm holes

Dual-viewer technology overview – 4 more slides, if time allows

[I have a separate 20-minute presentation on just the technology]

New cabling at computer

- Single-viewer mode
  - 2 DisplayPorts (currently disconnected)

- Dual-viewer mode
  - 4 DisplayPorts
  - 4 DisplayPort-to-HDMI adapters
  - 4 HDMI-to-HD-SDI adapters

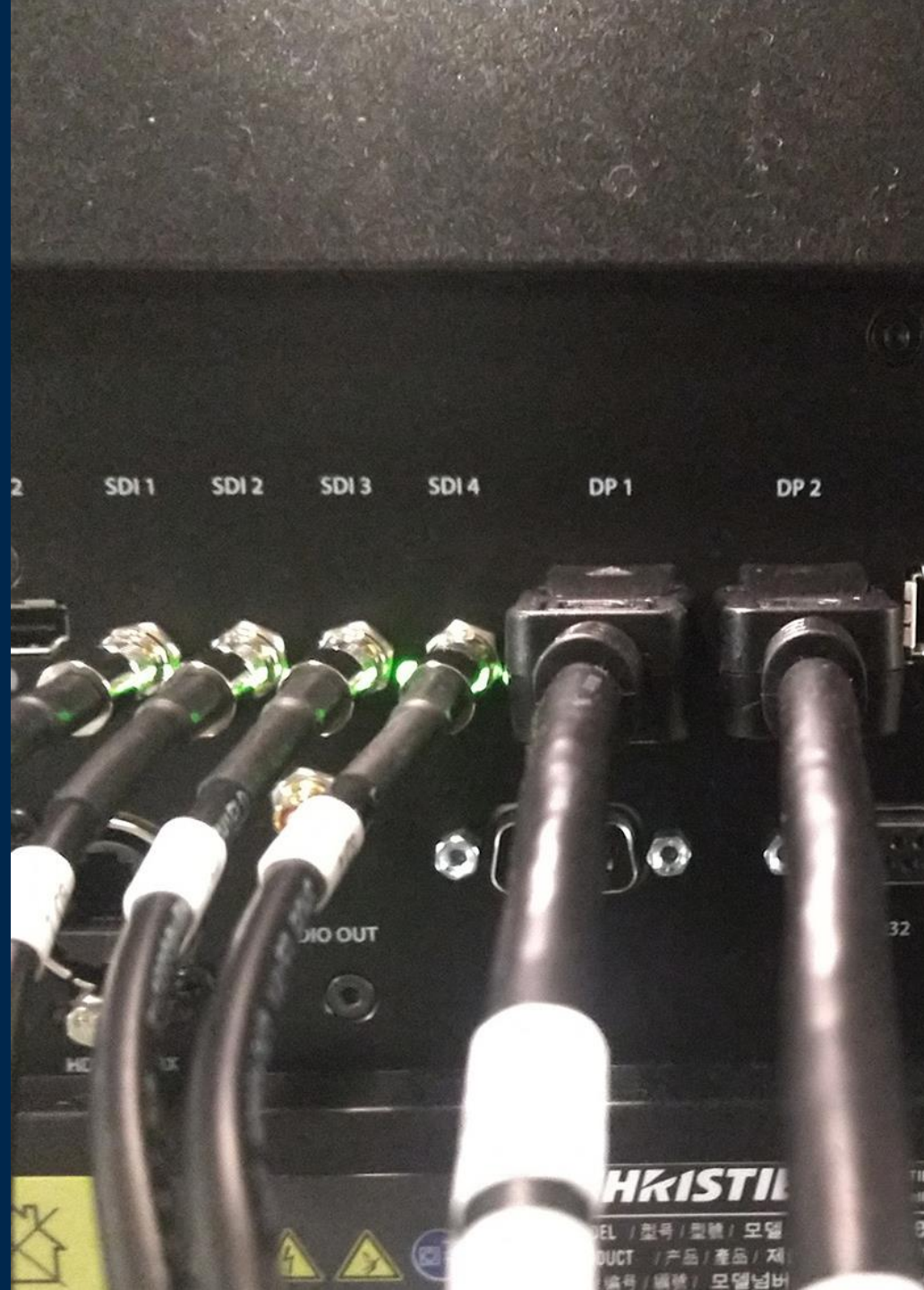
- In either case, each port appears to the computer as a separate display – 2 or 4 displays.

New cabling at projector

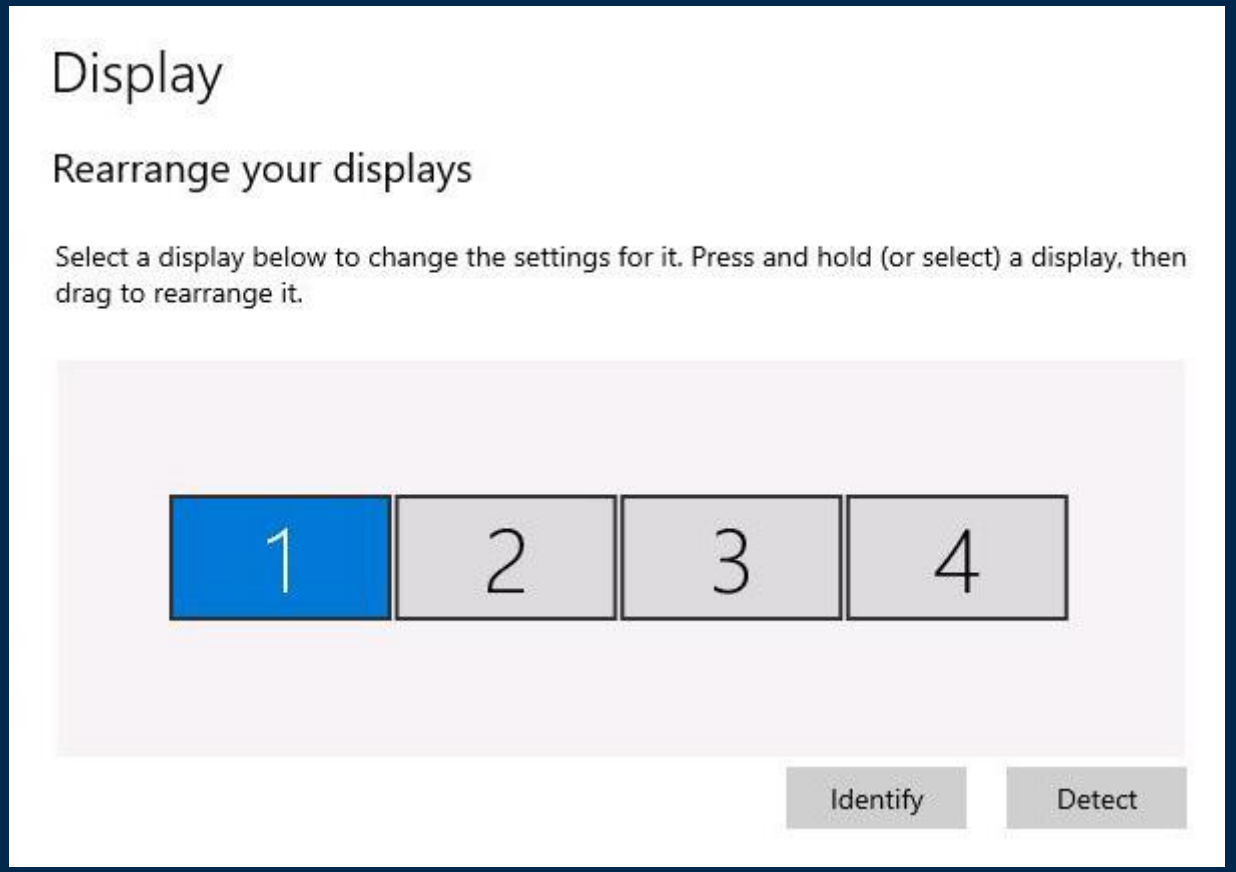
- Single-viewer mode
  - 2 DisplayPorts

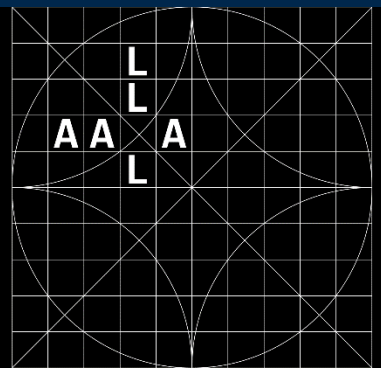
- Dual-viewer mode
  - 4 HD-SDI ports

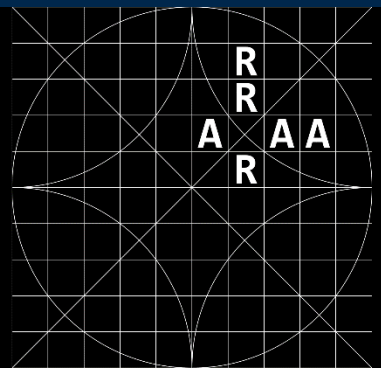
- In either case, the projector cycles through all inputs, one at a time for “frame sequential stereo”, 60 cycles per second.

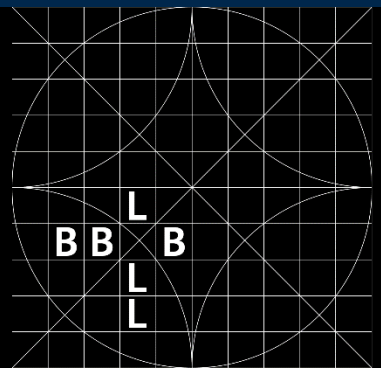


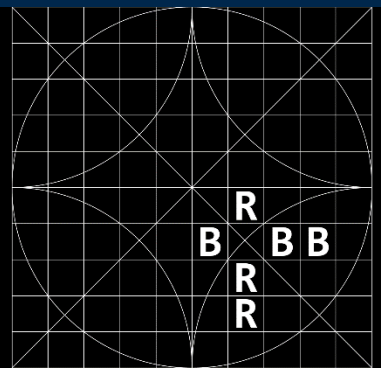
Dual-viewer display setup in MS Windows: 1 display per eye











Dual-viewer test grid – each eye thru 3D glasses sees 1 quadrant