

Ideas for future VR development at UCLA

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Ideas for VR in Physics Demonstrations

- Often good VR starter projects
- Already underway:
 - VR Fields (Omri, Rin)
 - Structures in topological quantum computing (Aryan)
- Gravitational motion in solar systems, globular clusters, galaxies
- Optics e.g. image formation
- Wave functions of electrons in atoms (shells)
- Special Relativity, e.g. simultaneity, past & future light cones

Ideas for VR in high-energy particle physics

- VR Spy (CMS) Study visualization of secondary vertices created by long-lived particles that travel away from the center, then decay
- VR Spy (CMS) Study the reconstruction of muon particles from basic hits in muon detectors
- CMS VR and VR Spy (CMS upgrade) Create visualization for the newly upgraded detector being built in mid-2026 onward
- G4 VR Extend simulation to other detectors such as GAPS, a balloon experiment looking for anti-deuterons in cosmic rays (Prof. Ong), or XLZD the proposed ultimate dark matter detector (Prof. Kamaha)

Ideas for VR in data analysis visualization

- New types of displays, e.g.:
 - “Art gallery” of 2D plots, walk around them
 - Multiple cubes of data for additional dimensions (4, 5, 6, ...)
 - Using opacity and color for additional dimensions
- Multi-user displays so people can discuss them as a group
- Survey other types of VR such as proprietary packages and borrow ideas from them
- Adapt to PyROOT (Python-based ROOT), Mathematica, or other data analysis packages

Other ideas for VR development (science)

- Motion of stars around the Milky Way central black hole (Andrea Ghez, Tuan Do group)
- Plasma physics – many 3D quantities, such as density, temperature, velocity, magnetic field, electric field. We saw some VR simulations from Lisbon but haven't built on them.
- Survey VR for medical imaging to get ideas about how to make 3D plots more effective using opacity and color

Other ideas for VR development (technology)

- Browser-based WebXR - no specific headset app needed. There are performance issues, but how severe are these?
- Higher-resolution, but expensive, headsets, such as Apple Vision Pro \$3500, Samsung Galaxy XR \$1800
- Is there any relevant science use case for Augmented Reality (AR)?

Various ways to get involved:

- Programming knowledge is a must, ideally C++/C#. Take classes!
- Discuss with us your own ideas – many of our VR apps were suggested by students, especially as first projects
- Start an Upsilon Lab project and form a team
- Find other professors who might be interested, e.g.
 - Paolo Alves for plasma physics
 - Tuan Do for the Galactic Center group
 - Zhongbo Kang for nuclear theoretical physics
 - Christopher Gutierrez for condensed matter physics