UCLA College | Physical Sciences Physics & Astronomy

Introduction to CMS VR and VR Spy

Andrew Su

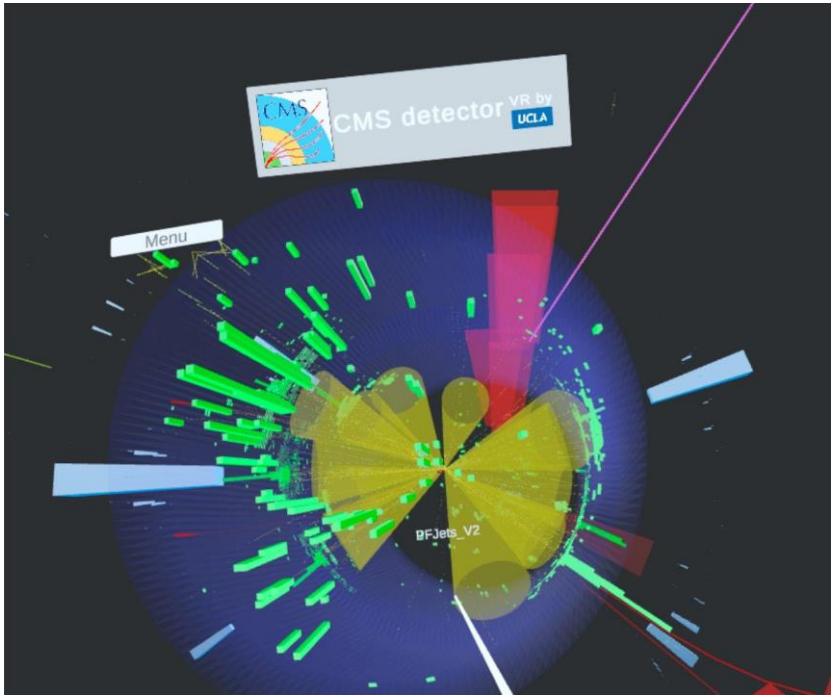
CMS VR

CMS VR - Overview

- Created by Dr. Iqbal at CERN
- Used to explore the Compact Muon Solenoid (CMS) detector at the Large Hadron Collider (LHC)
- Includes:
  - Model of the detector
  - Hallway tour
  - Geographic positioning of CMS in Switzerland

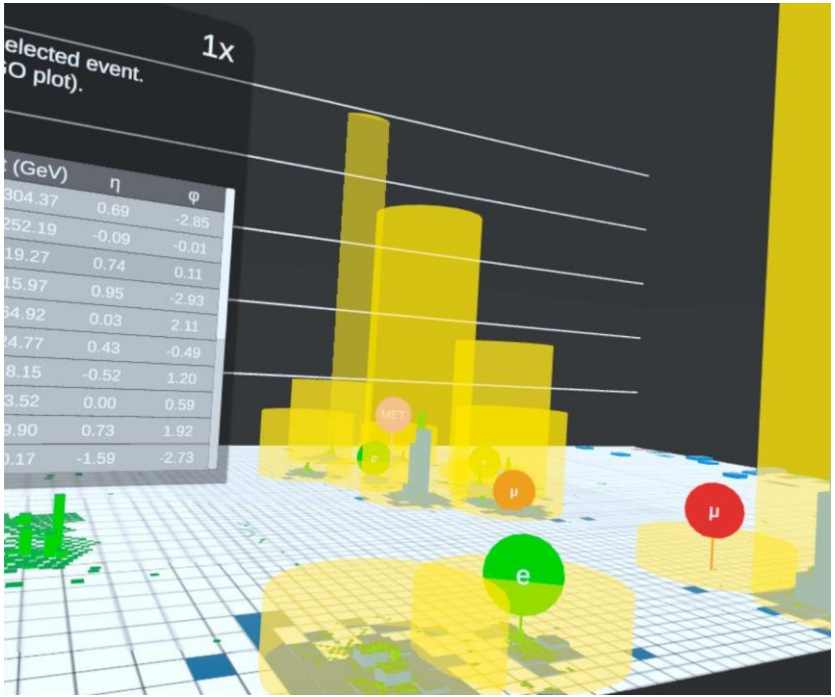
VR Spy

VR Spy - Purpose & Scope



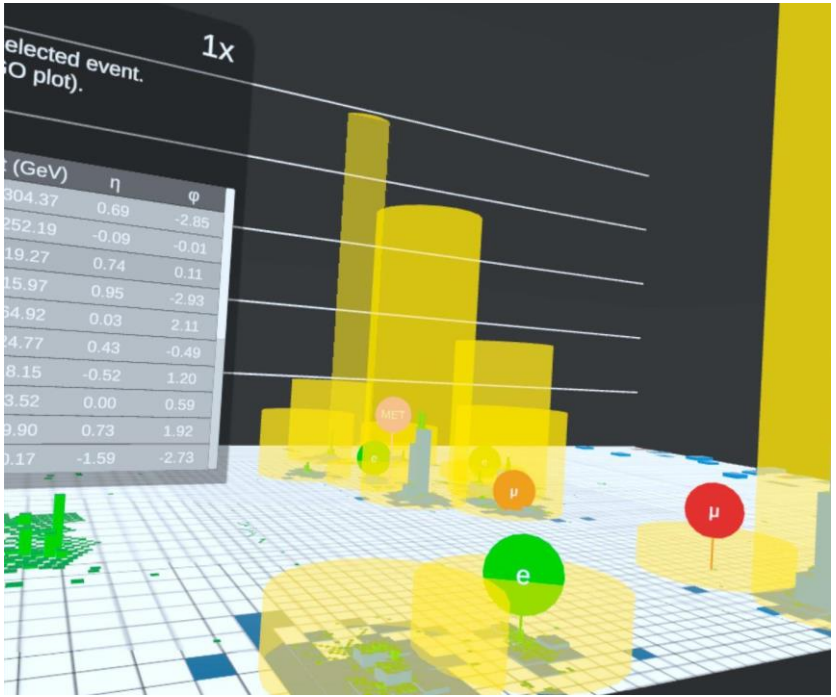
- Display collision events from the CMS Detector at the LHC
- Tool for researchers to survey events and quickly gain insight into key phenomenon

VR Spy - Timeline of Development (1/2)



- Started by Joseph Malham and Ethan Hsu in 2023
- Taken over by Andrew and Nathan in 2024
- Version 2.1 released in Feb 2025
  - Lego plot
  - Hovering data labels
- Version 2.2 released in May 2025
  - Multiple events
  - Updated menus
  - Highlighted subitems

VR Spy - Timeline of Development (2/2)



- Version 2.3 released in July 2025
  - Lego plot additions
  - Updated menus & useful controls
  - Dynamic track resizing
- Version 2.4 released in November 2025
  - Animations
  - Error-scaled vertices
  - Lego plot improvements

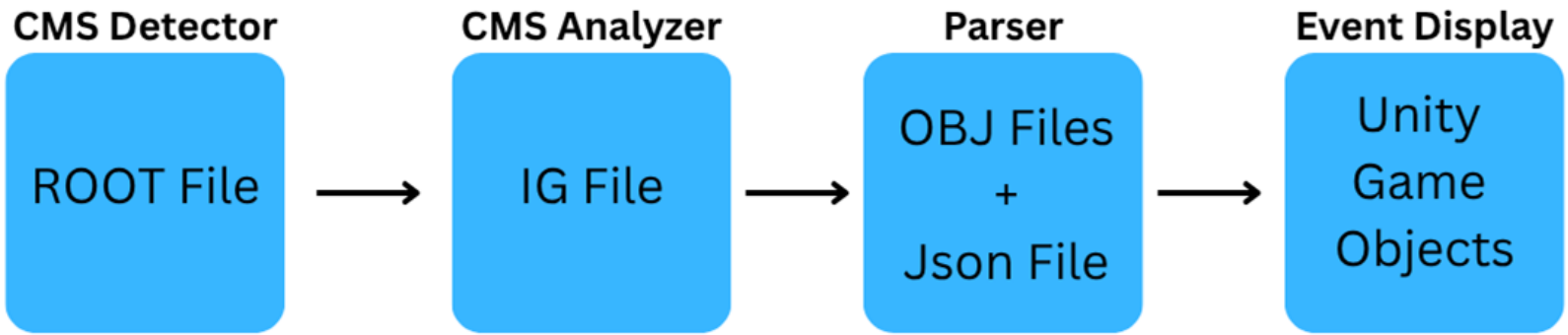
VR Spy - Key Features

- Energy Leaderboard
- Lego Plot
- Data Cuts
- Multiple events
- Subitem highlighting
- Error-scaled vertices

VR Spy - Implementation & Usage

Implementation:

- Event Display: built using C# in Unity
- Companion Parser: built using C#, command-line interface



VR Spy - Implementation & Usage

Usage:

1. Generate IG file from CMS Analyzer
2. Plug in headset & use our companion parser to upload OBJ files
3. Run custom scene in the application

```
┌─[andrewsu@MacBook-Pro-83] - [~/Downloads/Research/UCLA_CMS_VR/VR-Spy-Companion/VR Sp
y Companion/bin/Debug/net8.0] - [2025-11-04 04:10:38]
└─[0] ./VR\ Spy\ Companion ~/Downloads/Research/UCLA_CMS_VR/IGDATA/ig_files/SphaleronR
ECO.ig
0) /Users/andrewsu/Library/Application Support/Temp/IGtoOBJGenExtraction/Events/Run_1
Enter ID # of desired path:
0
[####################] 100% Processing Event_10
All events processed!
Total Execution Time: 5450 ms
OBJ Files written to: /var/folders/g6/_vsf49ls6kz6q__2x5d275gm0000gn/T/tmpP65Pz9.tmp/S
phaleronRECO

Press ENTER to continue and move files from your device and onto the Oculus Quest
```

VR Spy - Future Plans

- Expert/Explorer Modes
- Error scaled CSC Hits
- Improved menus with multiple parameter sort
- Rendering speed optimizations
- Music

Thank You