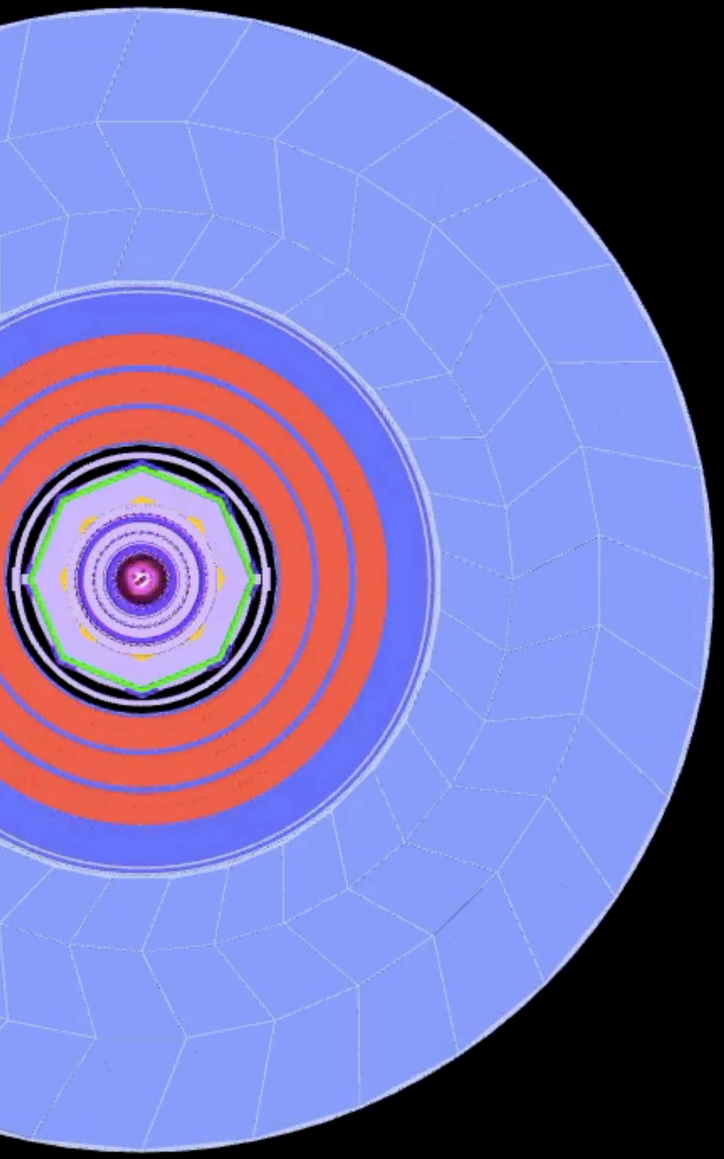

Development of web-based detector display application Tracer for ATLAS Experiment

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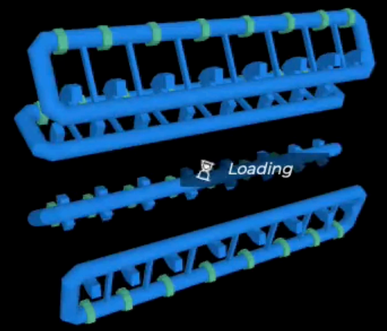
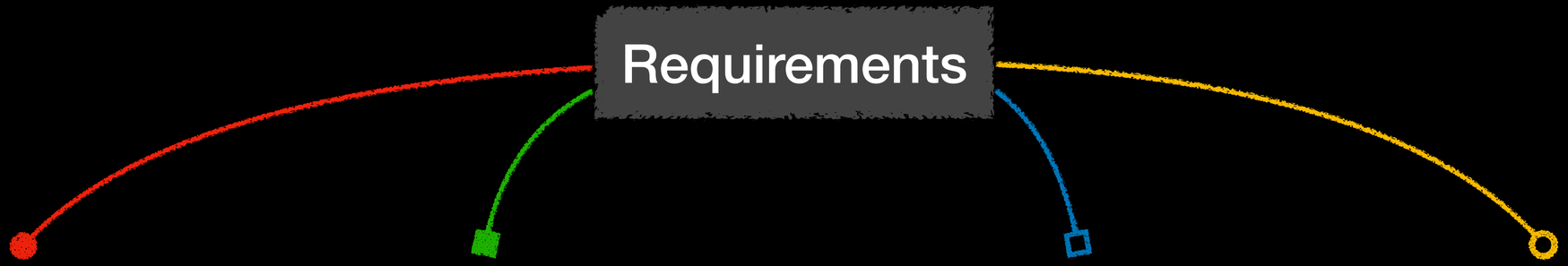
Detector Display Applications

Detector Display Applications are softwares that are used to Visualize Detector Components and Events, taking place within Detector



Detector Display can be used in almost any topic where visually representing Detector or Event is needed, like Outreach, Education and Analytics

Requirements to Detector Display Applications



General	Outreach	Education	Analytics
Easy To Use	Attractive	Informative	Data Visualization
East To Run	Innovative	Interesting	Lots of Interactions
East To Access	Fun	Intuitive	informative GUI

...

Selecting Application Type

- Easy to use: we shouldn’t limit users by Platforms, is it Linux, Windows or OS X.
- Easy to run: Users should be able to Run application from any device they have, Mobile, Tablet or PC
- Easy Access, we should use resource that is widely accessible - internet connection and web browsers

3D Application running in browser using Three.JS WebGL Library on OS X

Using Web Application, we can share our application to world, without any downloads or extra steps.

Using Three.JS Web Graphics Library (WebGL), we can create 3 dimensional Web Application.

ThreeJS gives us opportunity to create Web Detector Display Application

Creating universal application Structure based on requirements

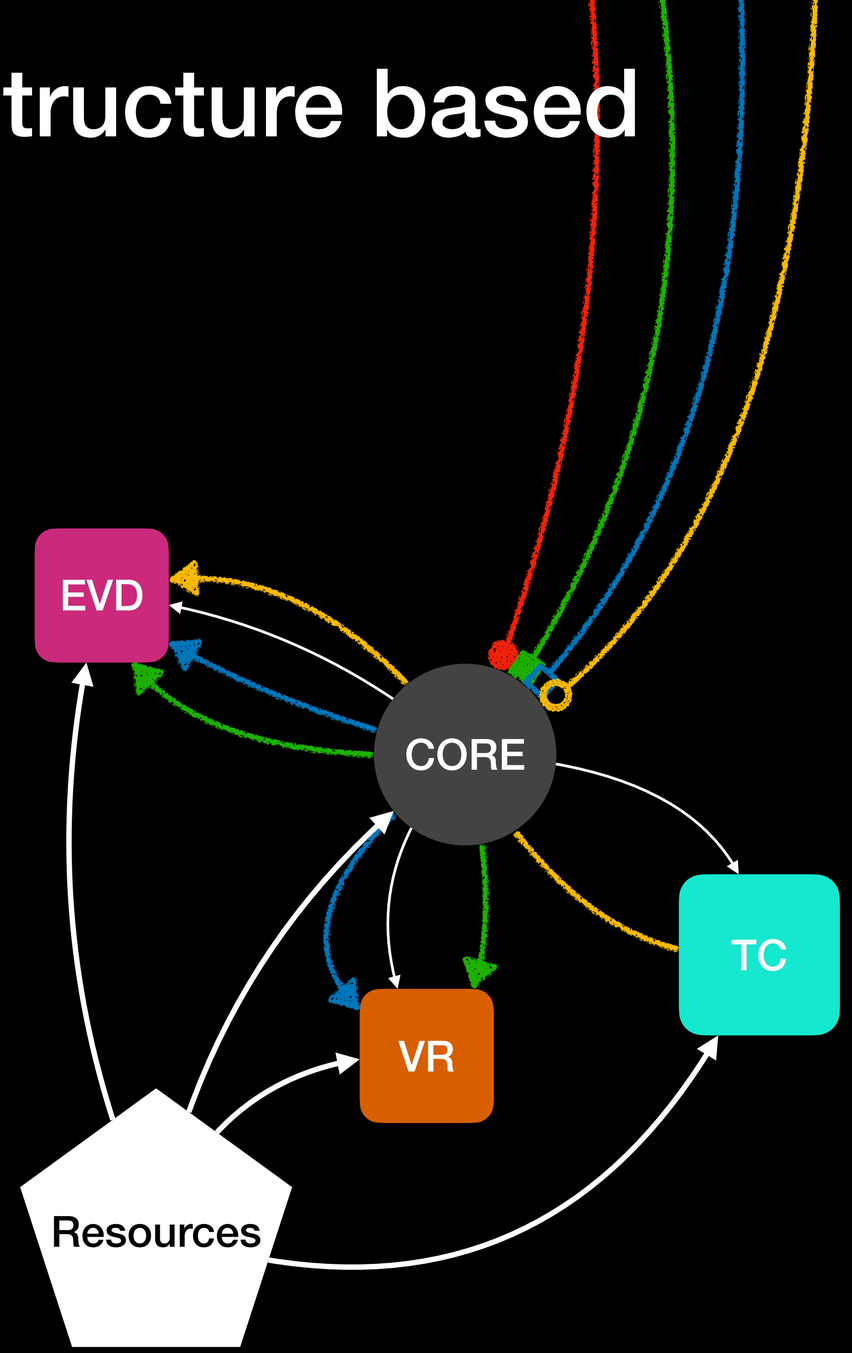
Looking at variety of requirements, Creating one application for all requirements would not be good, because some of requirements had conflicts

Instead of single application, we created Application Cluster, named Tracer where sub-systems were based on one, Core application, making full application ecosystem with shared engine - Tracer Core

Shared core, application cluster structure gave us possibility to easily create, update and maintain sub-systems, based on different or new requirements

Currently Tracer Core has 2 Working and 1 Under Development Subsystems:

- Tracer EVD - Event Display Application
- Tracer TileCal - Detailed Tile Calorimetery Display for Atlas TileCal team
- ⋆ Tracer VR - Virtual reality headset / Google Cardboard Application



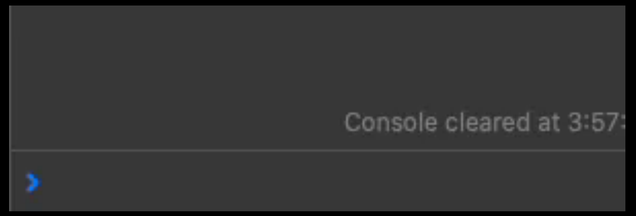
Tracer Core

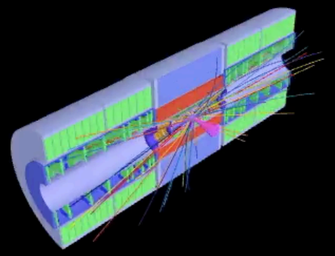
Tracer Core is main module of Tracer Application System

Tracer Core Containes 6000+ lines of Vanilla Javascript code and uses minimal amount of libraries that are simple like Jquery and ThreeJS just to maintain low spec device, cross-browser and platform support.

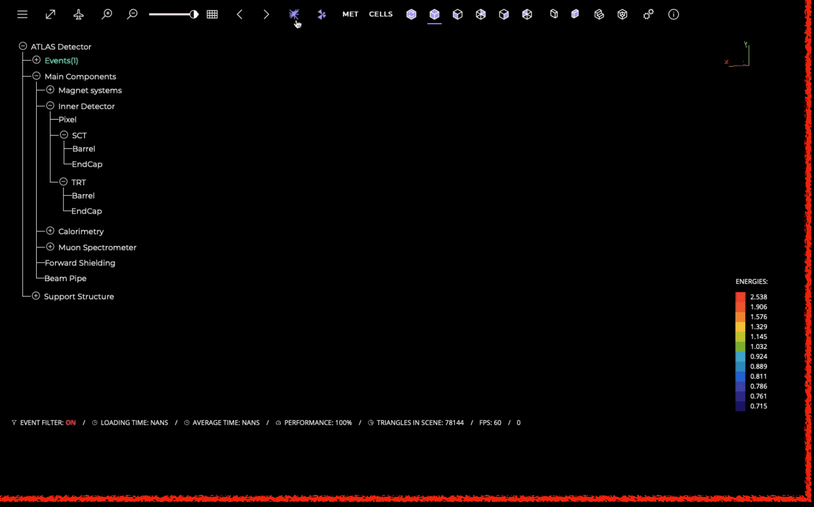
Core Engine is Class Interface combining over 20 different classes with 70+ functions. This functions are passed to all sub-system applications and almost every function can be modified to sub-system needs!

Using tracer core engine interface is easier than Hello World!





Core is collection of different type of functions that are automatically implemented in all sub-systems, like Fly mode, ParticleAnimation, Auto-Rotation, Click Selection, Geometry loading and much more!

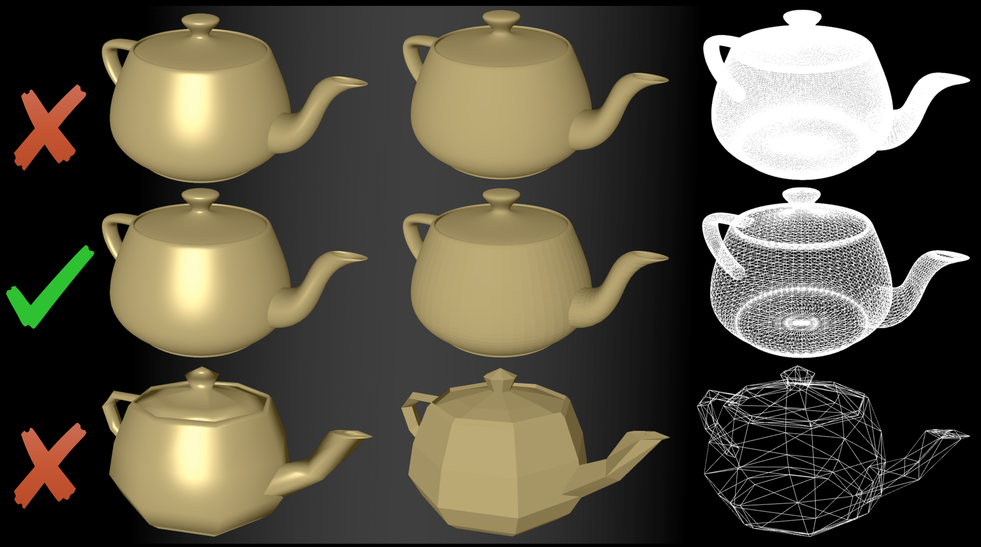


Golden Line between Requirements and Possibilities - Tracer Core

WebGL and browser facet limitations for geometry loading

Problem: Atlas Detector has very complex architecture with lots of complex shaped objects, that have lots of Facets in 3D Model state. Breaking facet limitation, results to browser crash, that mean's Application is not working. Atlas detector's facet complexity is so high, that it's almost impossible to load full detector in browser.

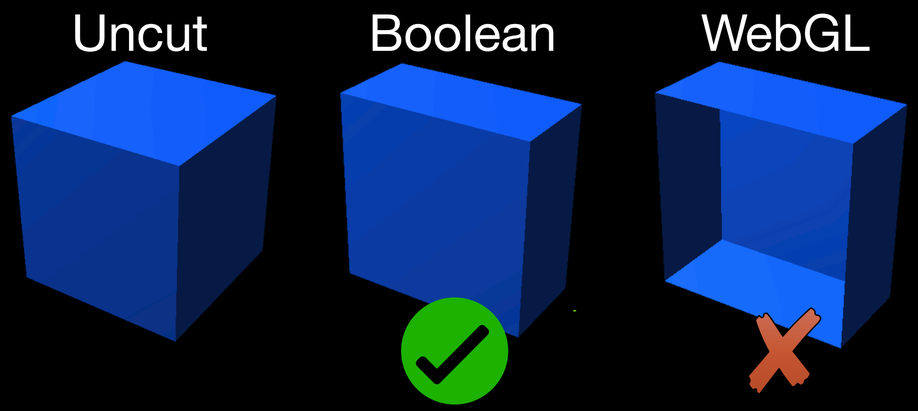
Solution: Modifying 3D Models of Atlas detector and Simplifyng them, greatly decreased amount of facets. because 3D model of Atlas detector were so complex, we had to simplify each component of detectorby hand, giving 60FPS performance on medium specification GPU devices.

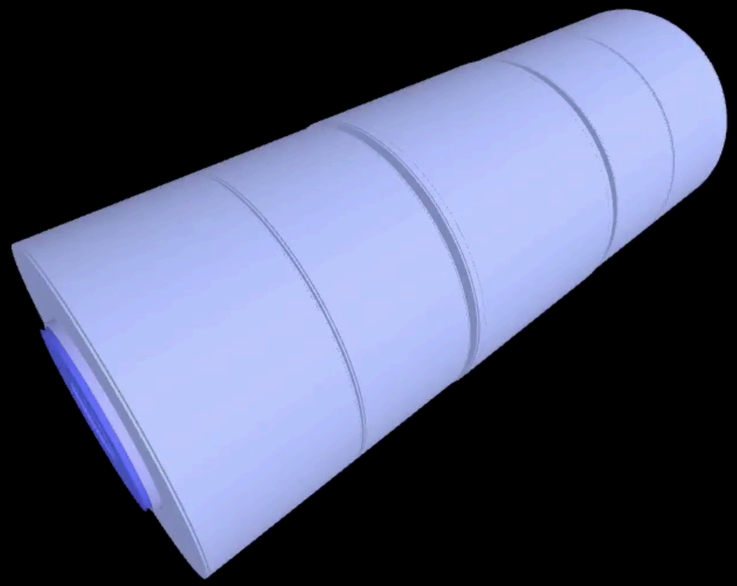


Golden Line between Requirements and Possibilities - Tracer Core

WebGL and Boolean Cuts

Problem: Clipping geometry, and slicing it in different parts, can be very useful for interactions and visual representations of detector, but Applying Boolean cut on loaded geometry is almost impossible for ThreeJS. Instead of Filling clipped plane, ThreeJS leaves clipped part open, showing insides of detector, when planes should be present.

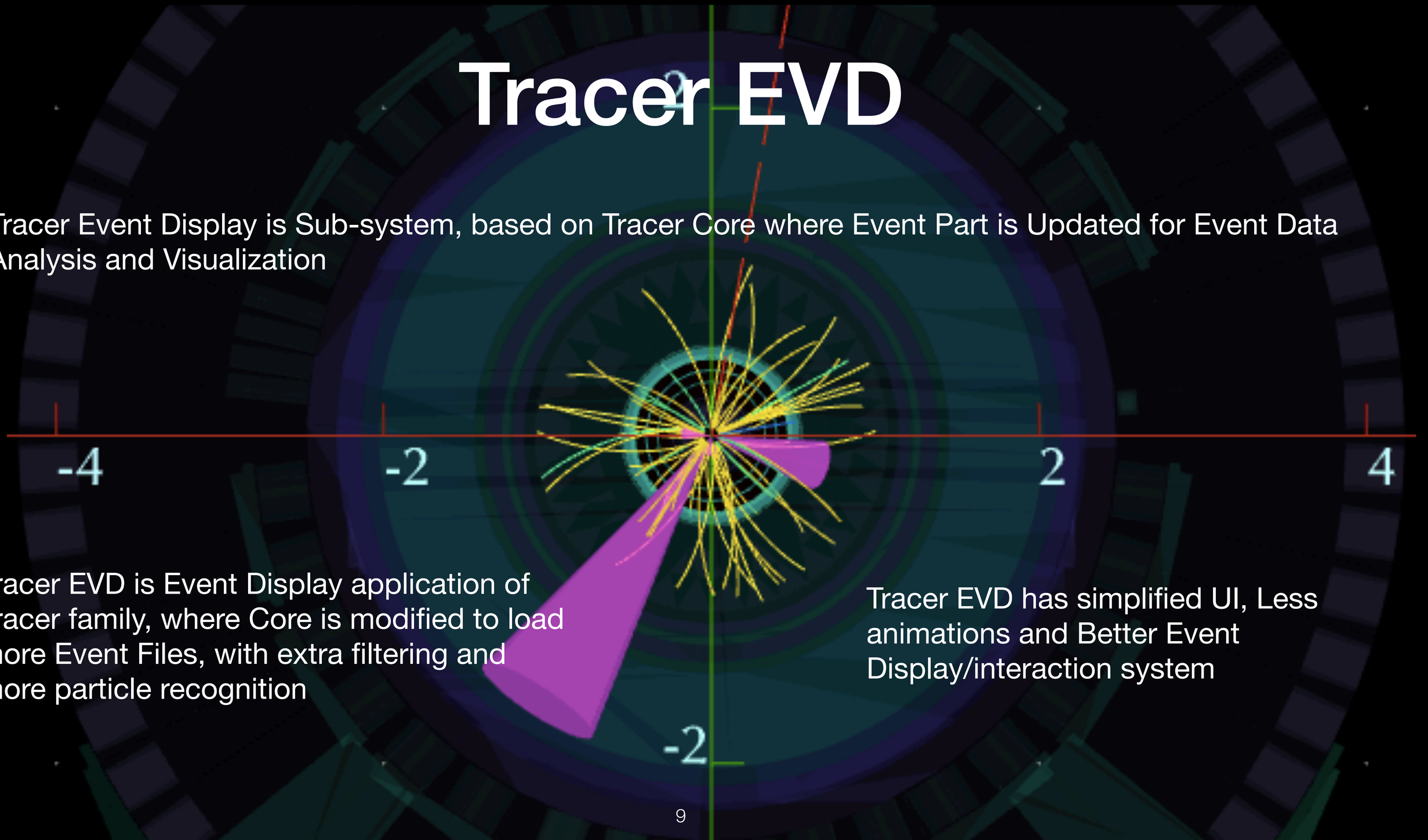




Solution: To solve problem of boolean cuts, workaround was must! Instead of Clipping geometry in the middle, we have special model of clipped geometry that we can load, when Cut method is called.

Tracer EVD

Tracer Event Display is Sub-system, based on Tracer Core where Event Part is Updated for Event Data Analysis and Visualization



Tracer EVD is Event Display application of Tracer family, where Core is modified to load more Event Files, with extra filtering and more particle recognition

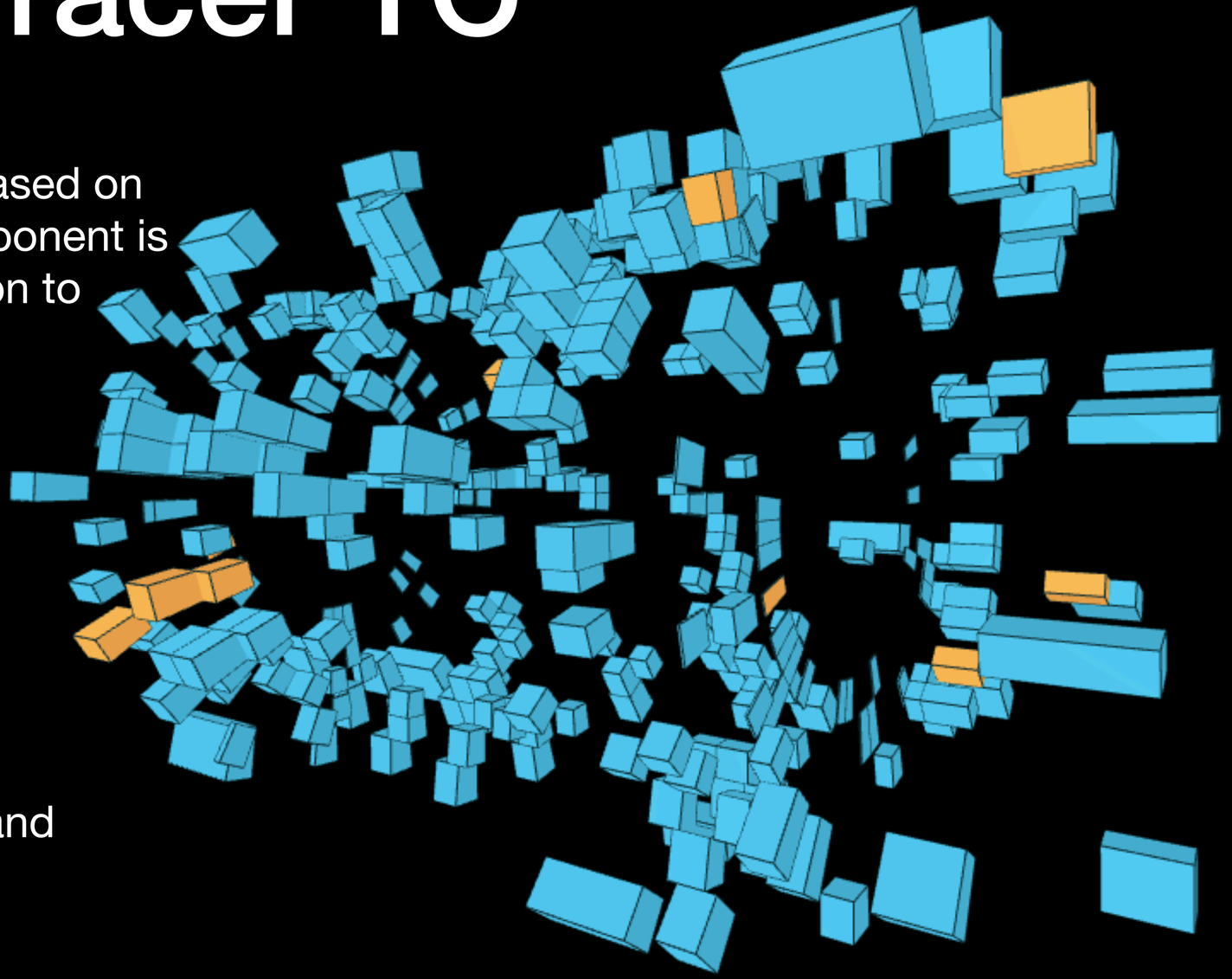
Tracer EVD has simplified UI, Less animations and Better Event Display/interaction system

Tracer TC

Tracer Tile Calorimeter is Sub-system, based on Tracer Core where Tile Calorimeter Component is Extended and users have more interaction to each cell of Tile Caloriemeter

Tracer TC is Application that visualizes Event’s going on in Tile Calorimeter.

Tracer TC has modified GUI to fit requirements of Tile Calorimeter Events and Modular Cell and Layer structure



Tracer VR

Tracer Virtual Reality is Sub-system Under Development, based on Tracer Core where All interactions will be using VR headset, Head direction and Bluetooth Controller.

Tracer VR is Virtual Tour like application, where users will be able to fly around Atlas detector and listen to useful information about different components of detector

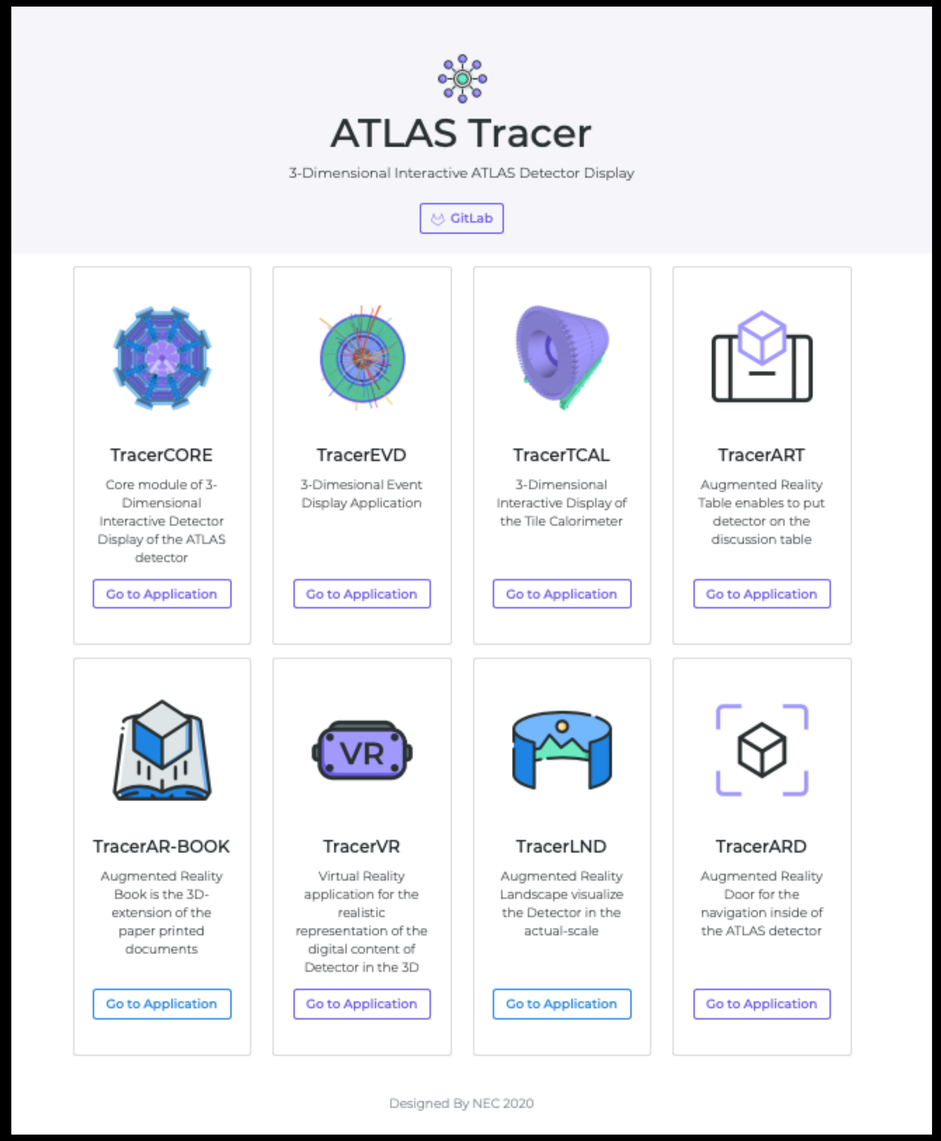
Tracer Framework and Resources

Making Application Cluster gave us possibility to combine resources, used by different applications and make them work on single resource like geometry.

In Tracer Framework Resources, we only have 1 Geometry model that is loaded by all Sub-Systems. This way Application Conserves Storage and Deployment time

Tracer framework has special GUI that allows users to start any Sub-System Application with one click

Setting up framework in Cluster like systems are big deal, because otherwise system would be distributed and resource sharing would not be easily manageable



Thanks for your attention!

Author: Levan Khelashvili

See all applications at:
tracer.web.cern.ch