

New approaches in the Event Display development for the MPD/NICA experiment

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Introduction

- ▶ Modern experiments in nuclear physics last for years and require enormous human and energy resources.
- ▶ There are various methods for monitoring engineering, network and computer systems of the experiment. As a rule, they have a common name for all – the Event Display and include a whole range of monitoring and control systems.
- ▶ Modern technologies make it possible not to take into account the platform and type of operating system on which the Internet browser is launched. A program written in JavaScript will execute in the same way on every platform, including mobile devices with Internet access.

Modern Web Technologies



- ▶ JavaScript Engine V8 (<https://v8.dev/>)



- ▶ React framework (<https://reactjs.org/>)



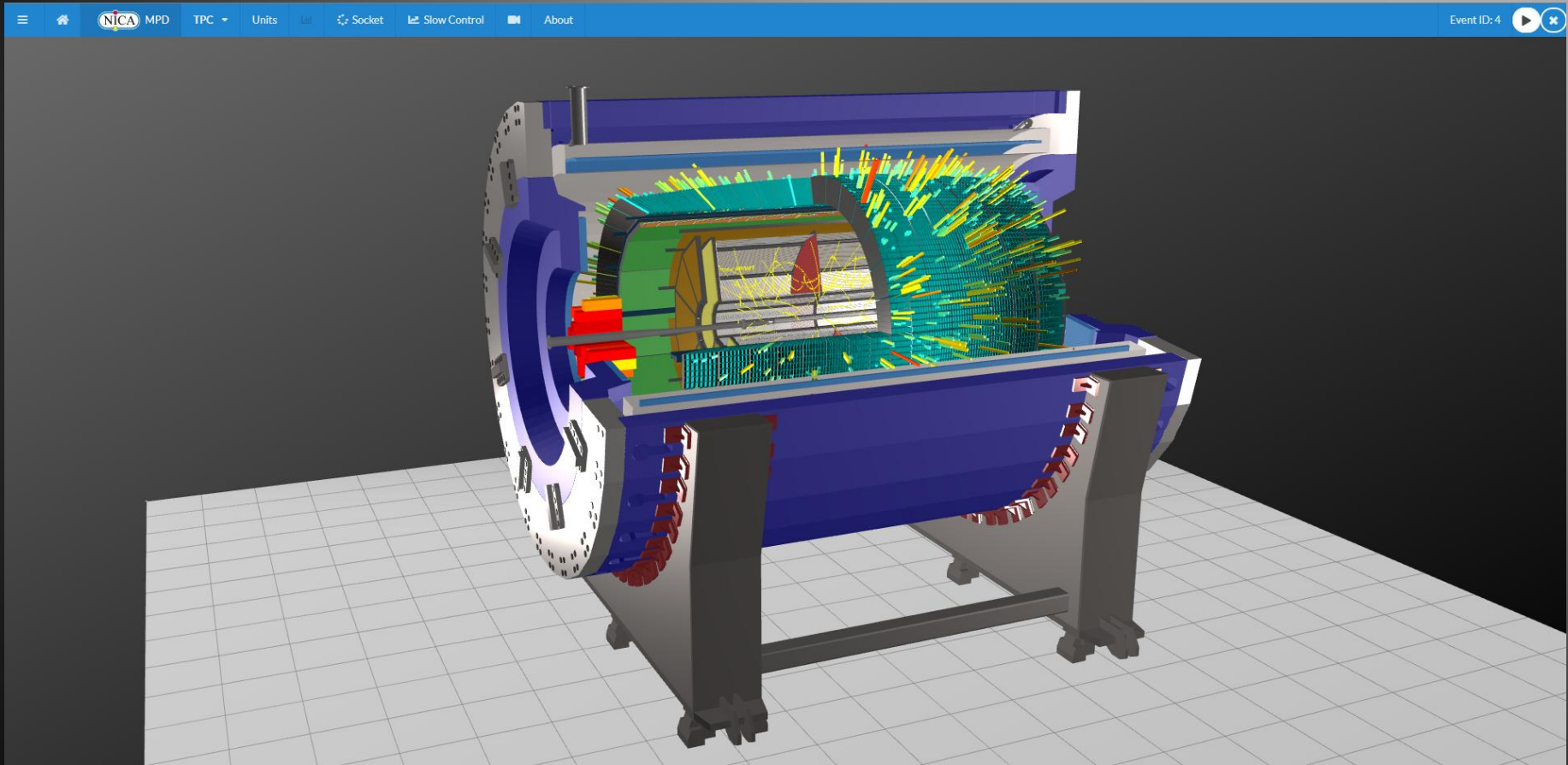
- ▶ WebGL



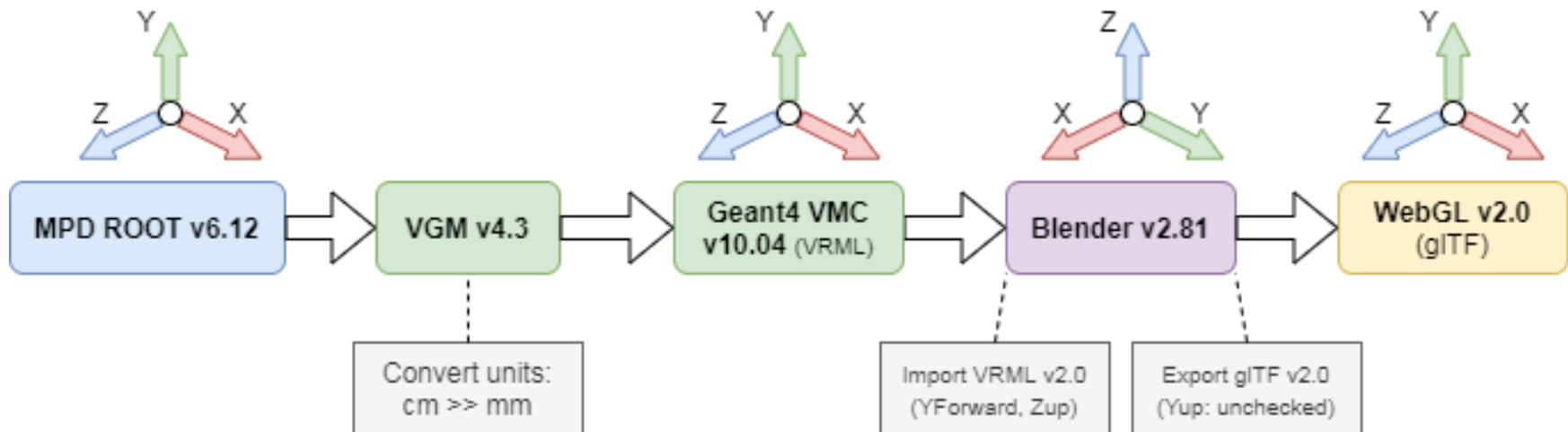
- ▶ NodeJS (<https://nodejs.org/en/>)

- ▶ N-API (C++ addone)

MPD Event Display Server (EDS)



Geometry conversion scheme



MpdRoot - offline software framework for simulation, reconstruction and physics analyses of the simulated or experimental data for MPD experiment;

Virtual Geometry Model (VGM) - geometry conversion tool between Geant4 VMC and ROOT TGeo geometry models;

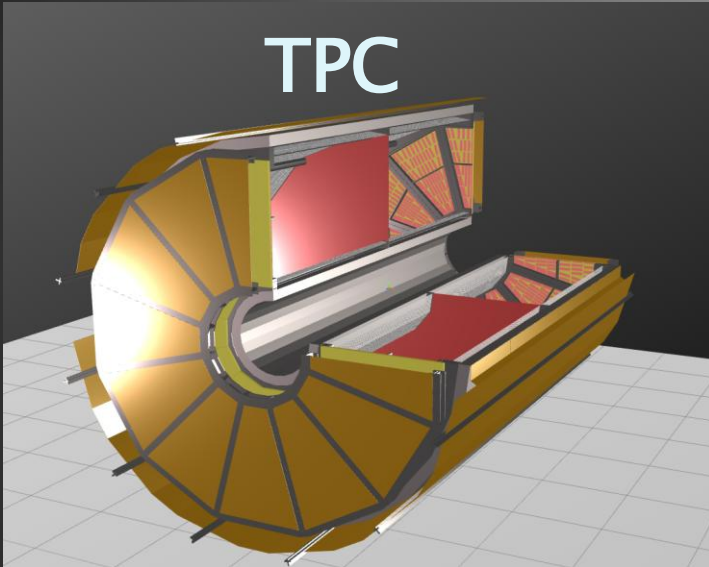
Blender - free and open source 3D creation suite. Starting from v2.81 Blender support plugin for export to gITF format;

VRML - Virtual Reality Modeling Language

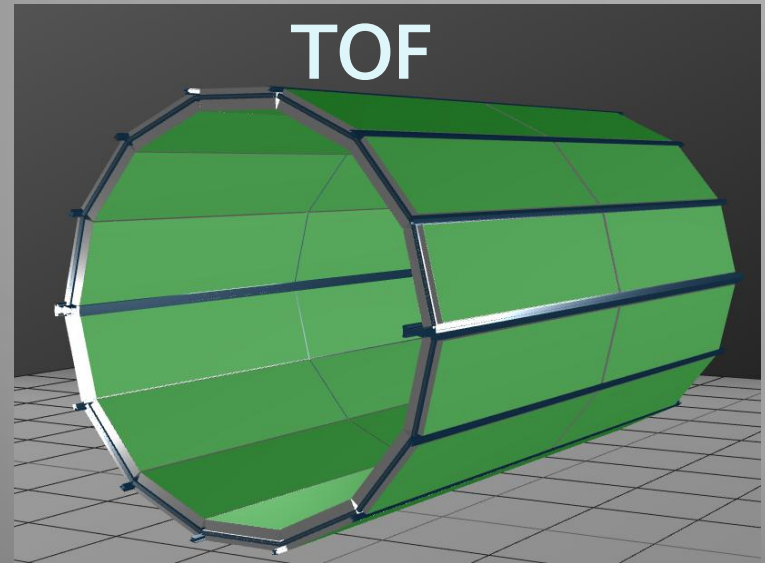
gITF™ - GL Transmission Format from Khronos Group Inc.;

Detectors in EDS

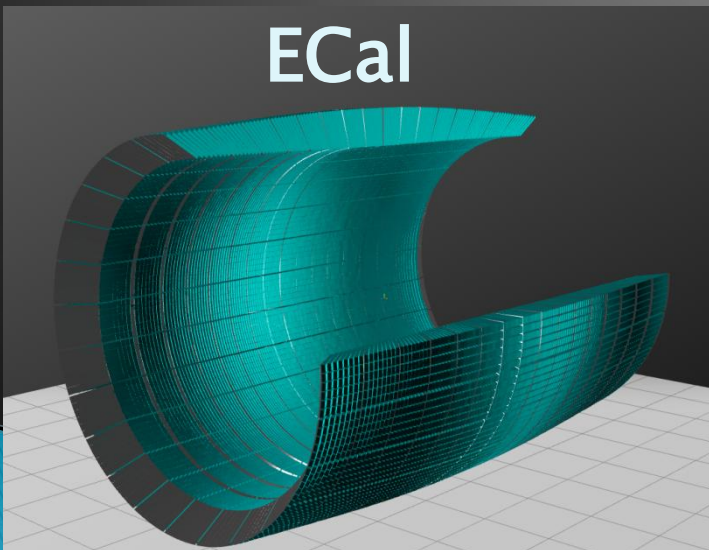
TPC



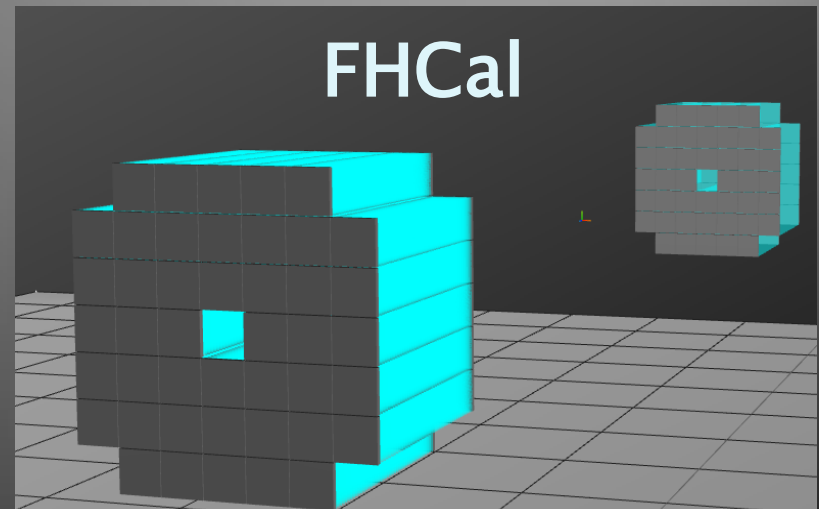
TOF



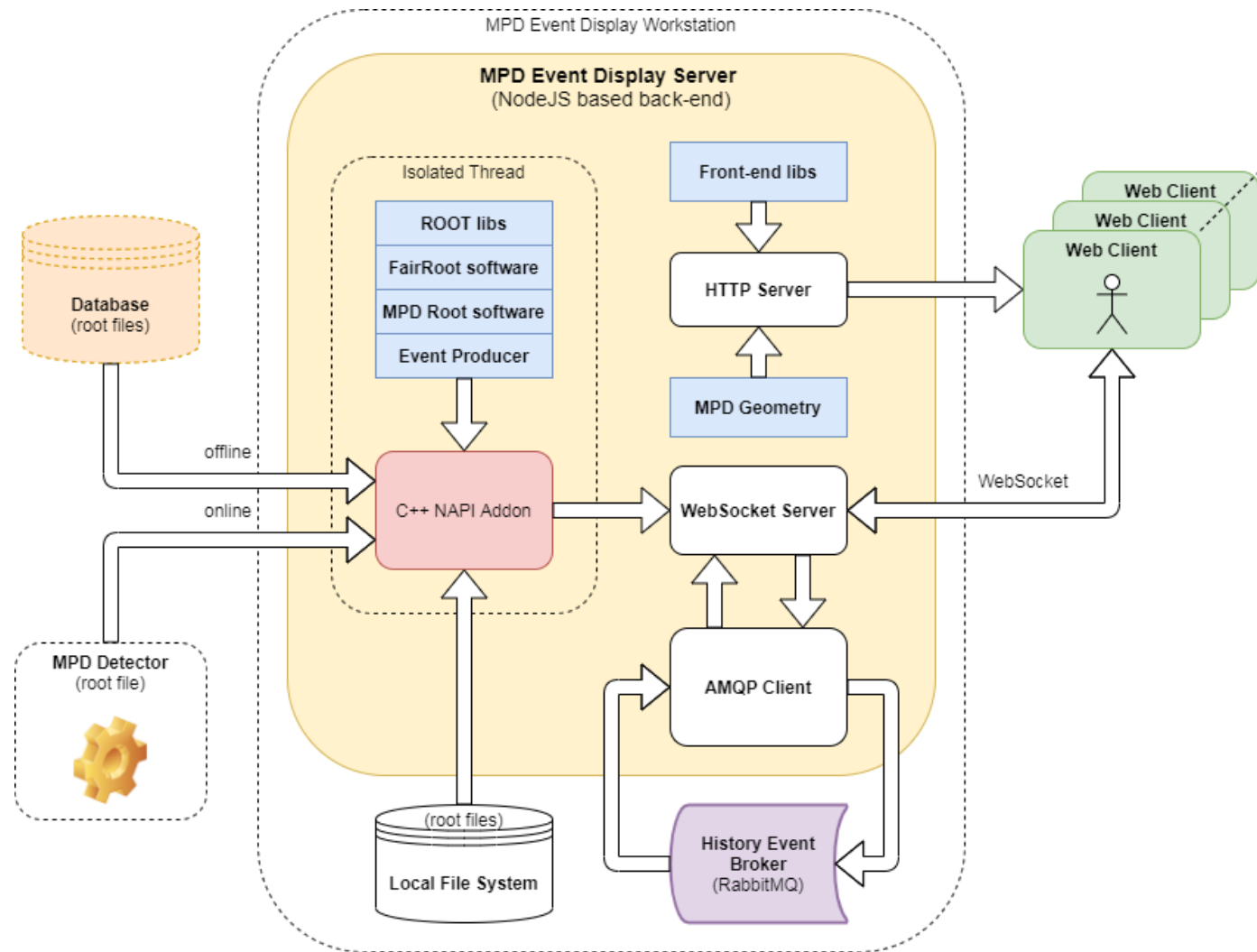
ECal



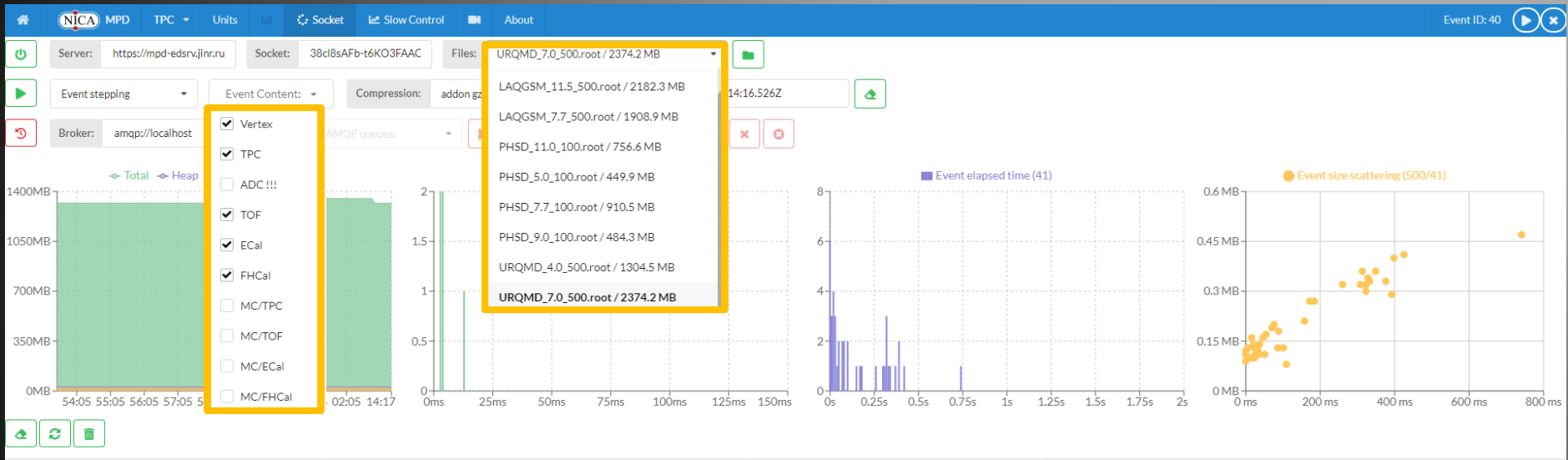
FHCaI



EDS data flow

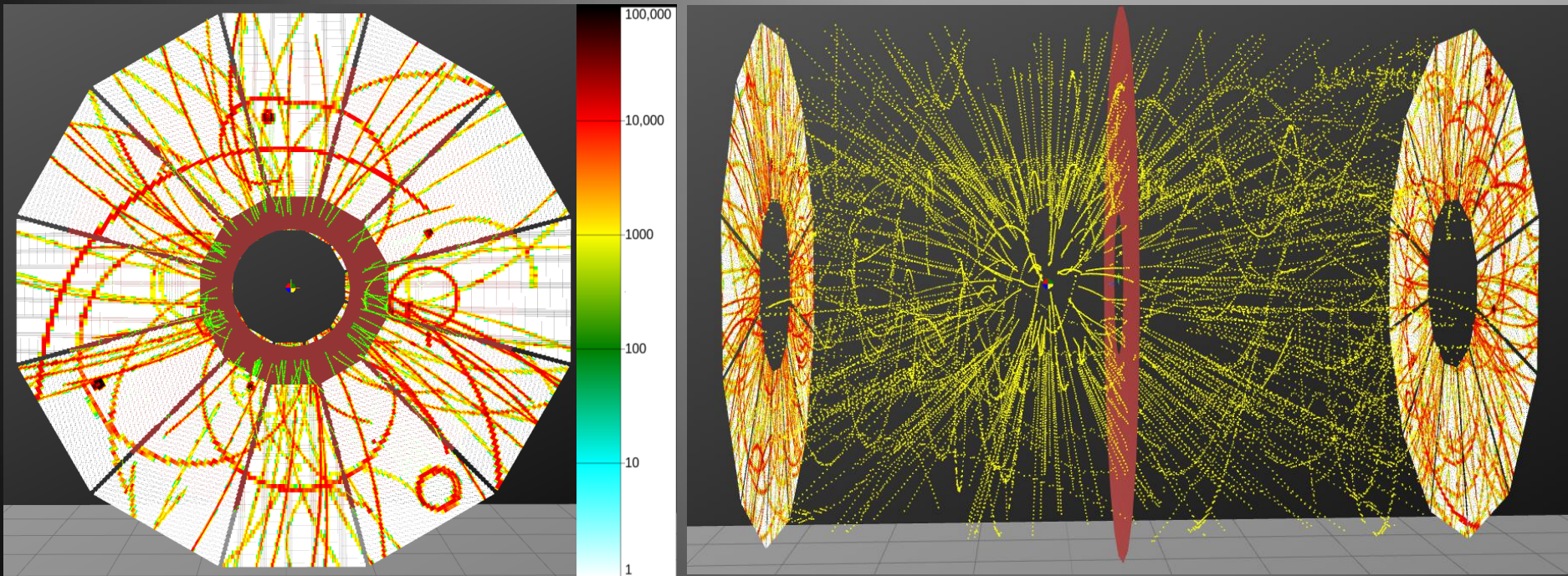


WebSocket Connection

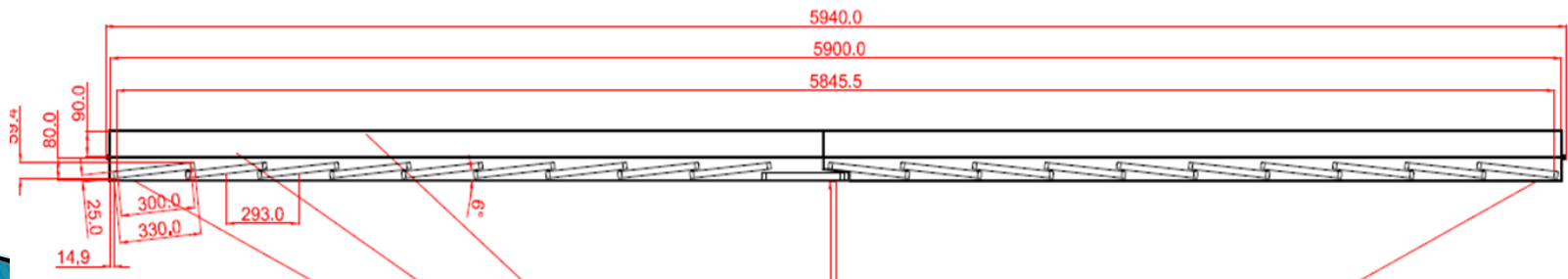
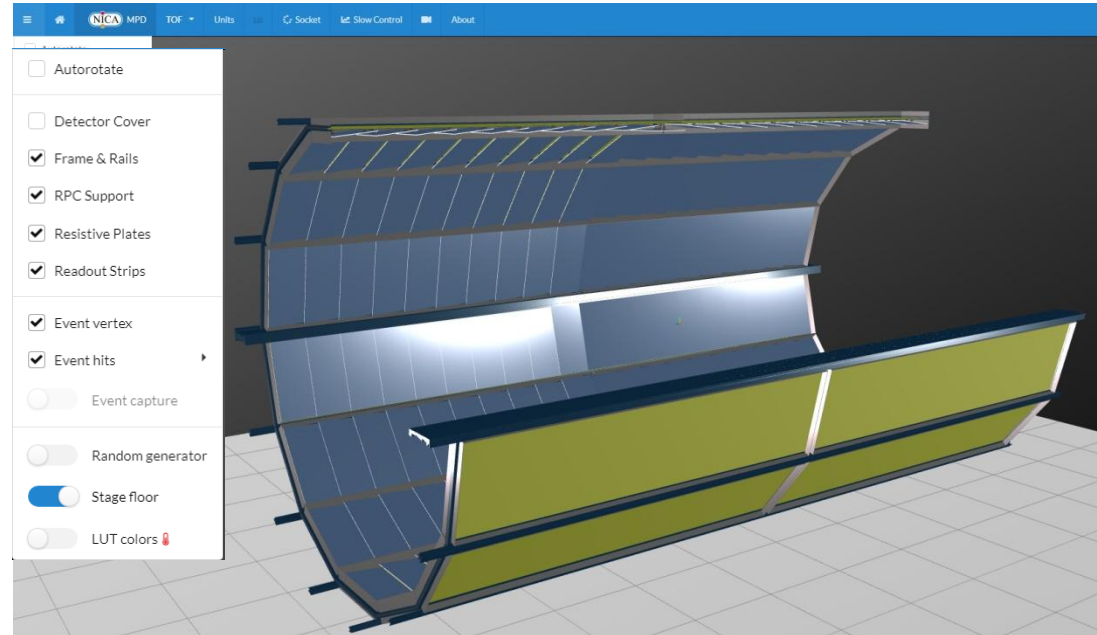
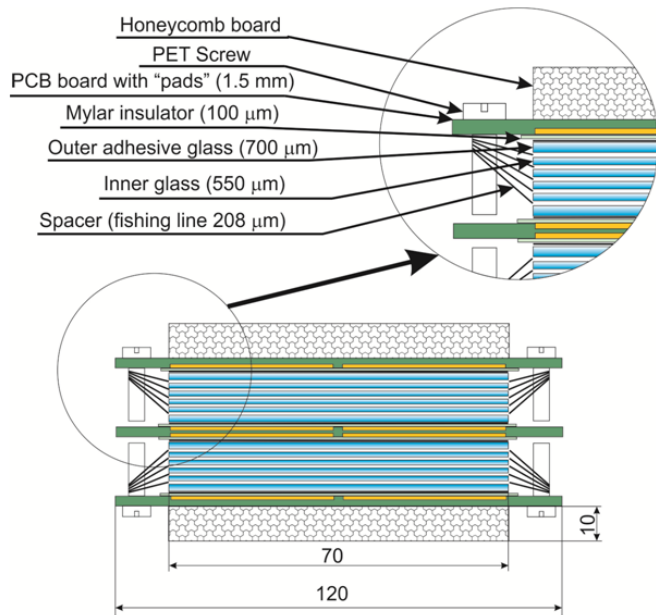


WebSocket Clients		Event Producers				Event Info				Header Info				
Address	Socket	Source	Interval	Destination	Status	ID	Location	Size	Compression	Title	Version	Date	Author	Pattern
<code>://fff:10.0.36.230</code>	<code>38cl8sAFb-t6KO3FAACS</code>	<code>URQMD_7.0_500.root</code>	<code>stepping</code>	<code>front-end</code>	<code>paused</code>	<code>40</code>	<code>online</code>	<code>99KB</code>	<code>gzip > 2.39</code>	<code>AuAu_Collision</code>	<code>0.0.7</code>	<code>2021-04-16 16:04:45</code>	<code>A.Krylov</code>	<code>mpd</code>

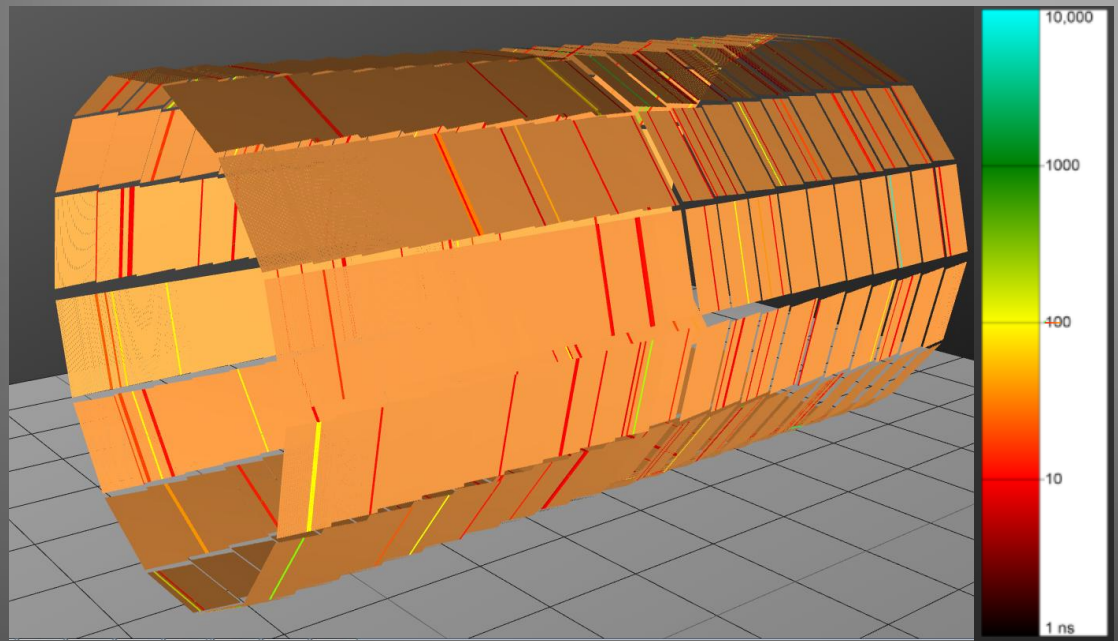
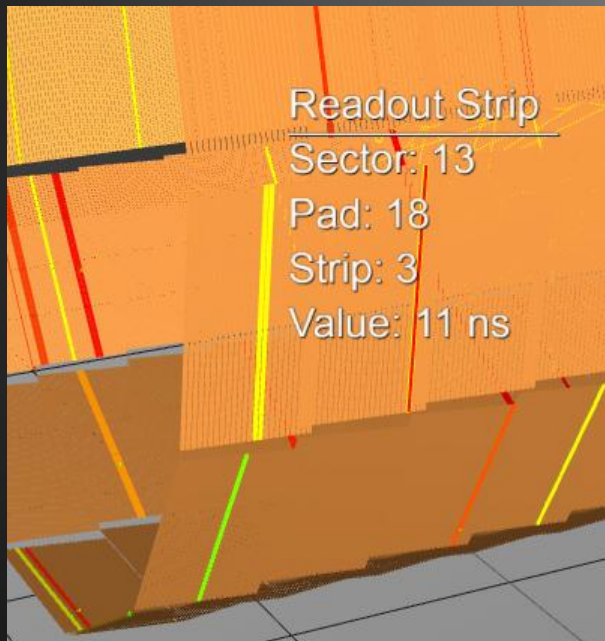
TPC Events in EDS



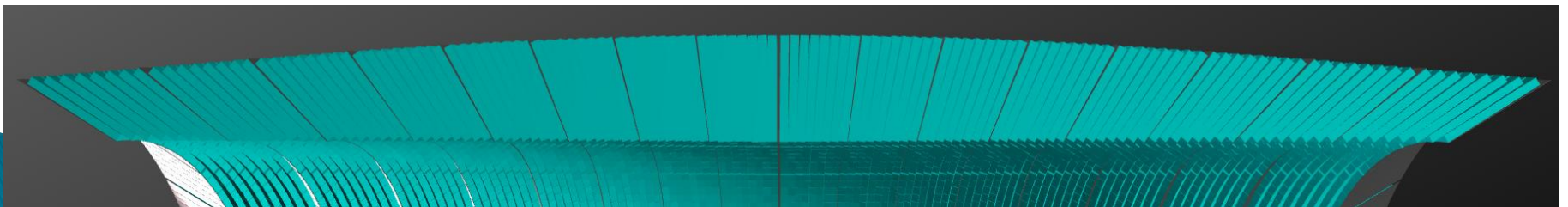
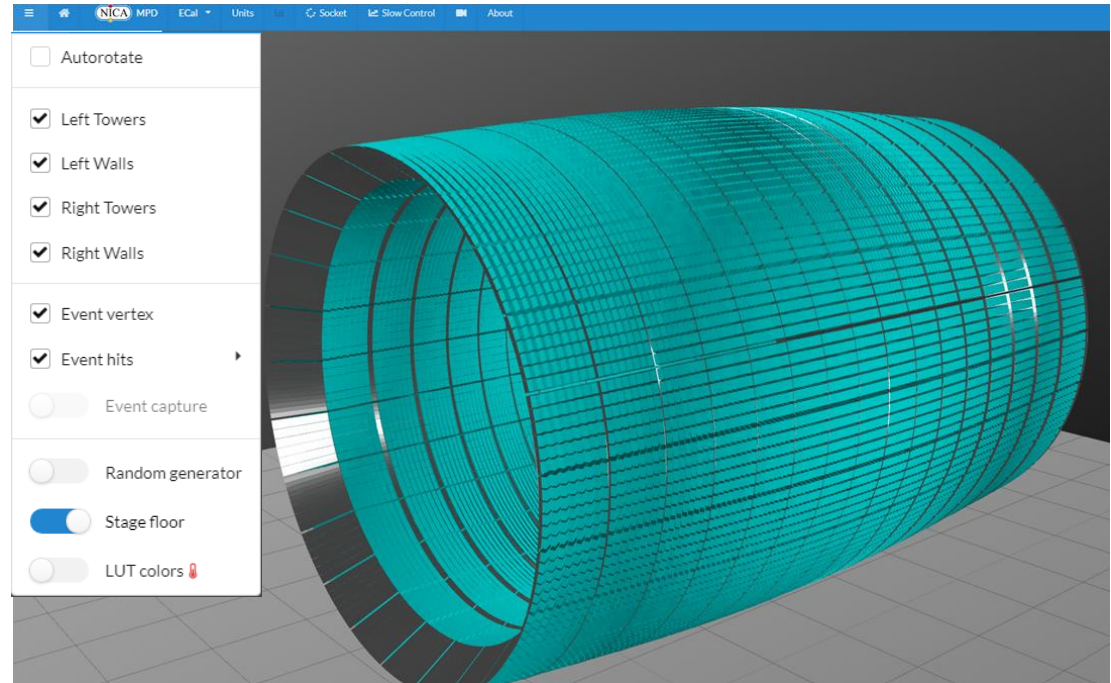
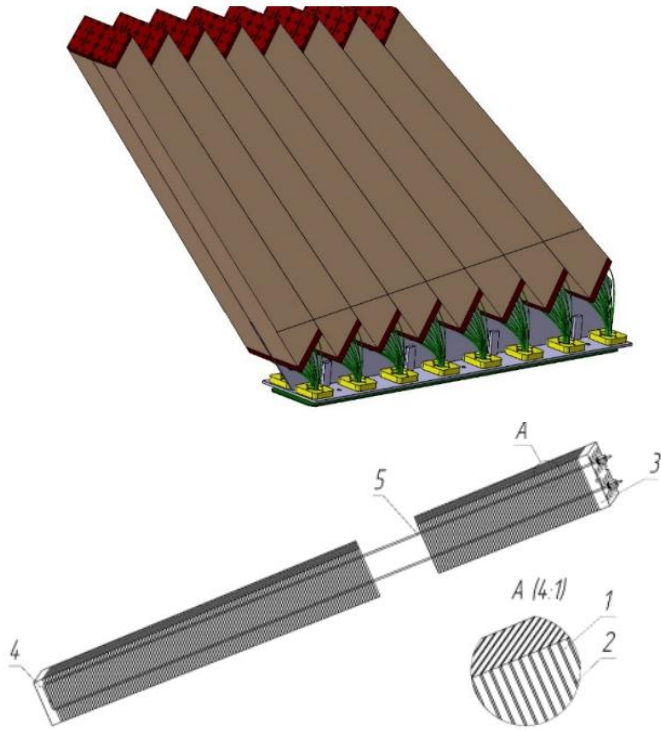
Time of Flight System (TOF)



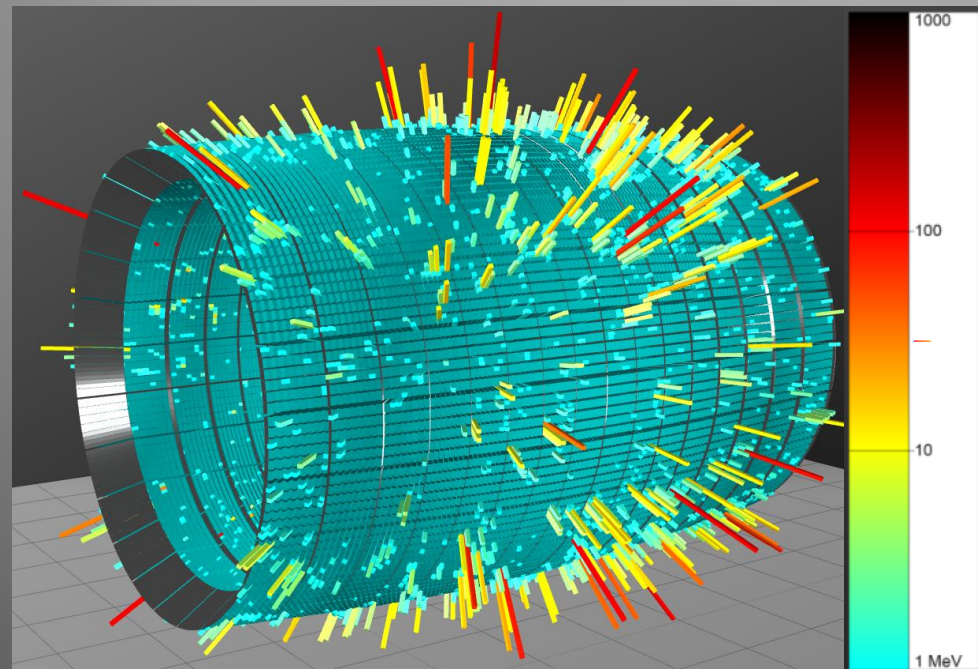
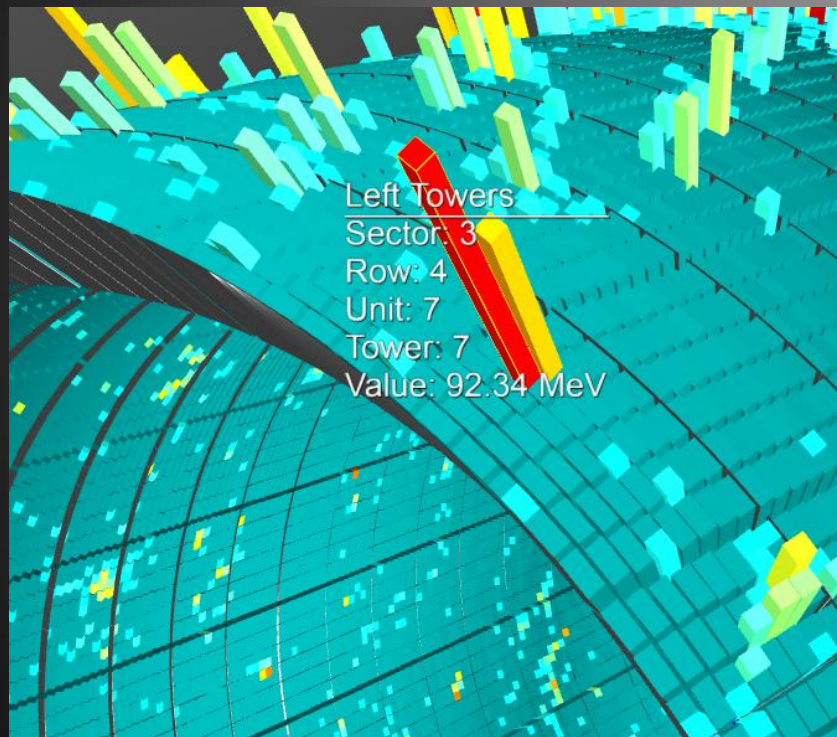
TOF Events in EDS



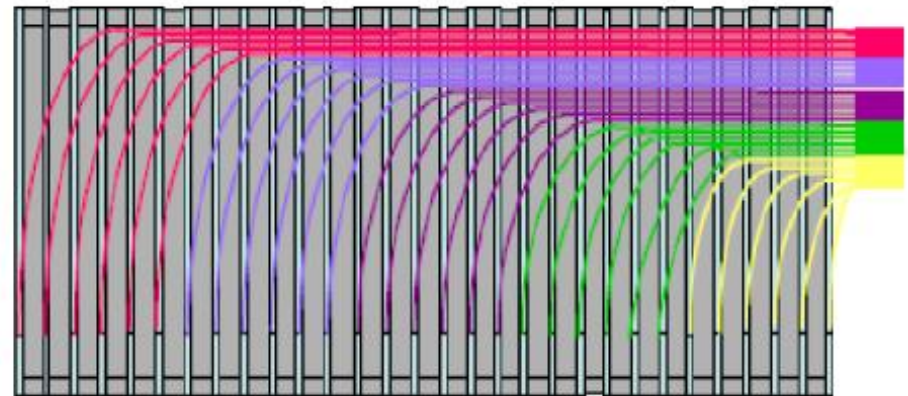
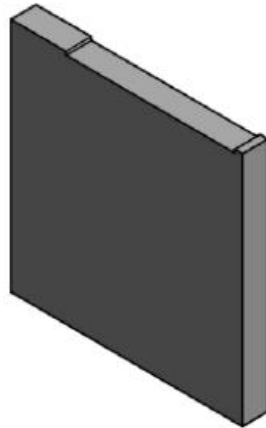
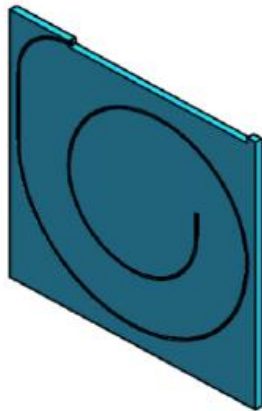
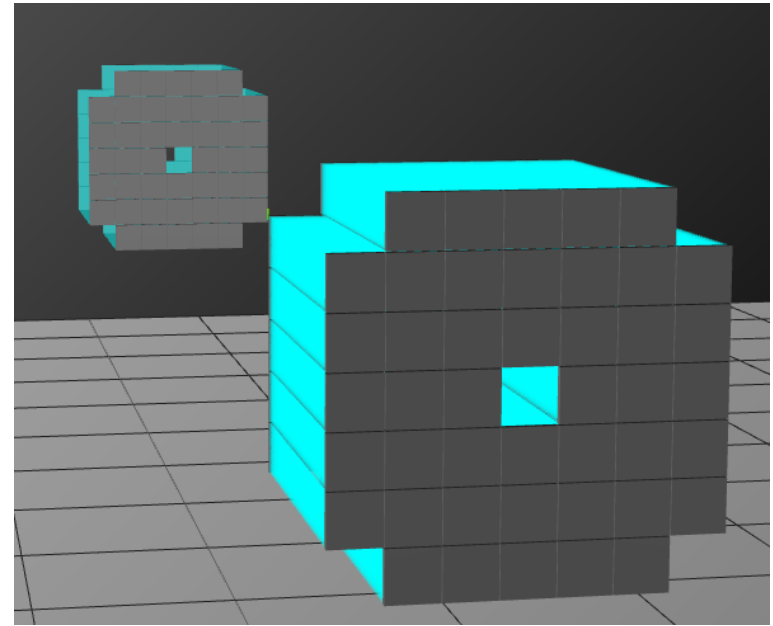
Electromagnetic calorimeter (ECal)



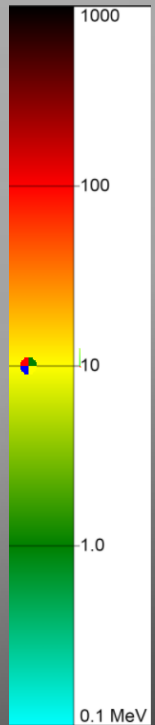
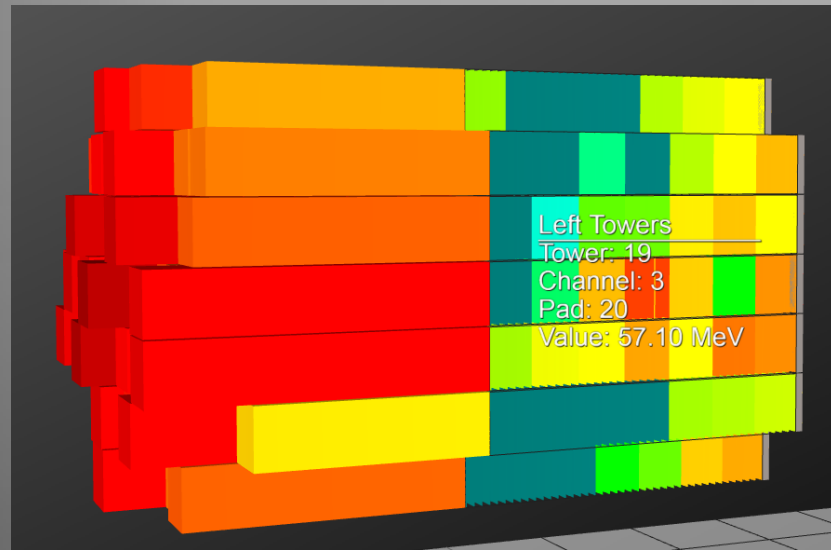
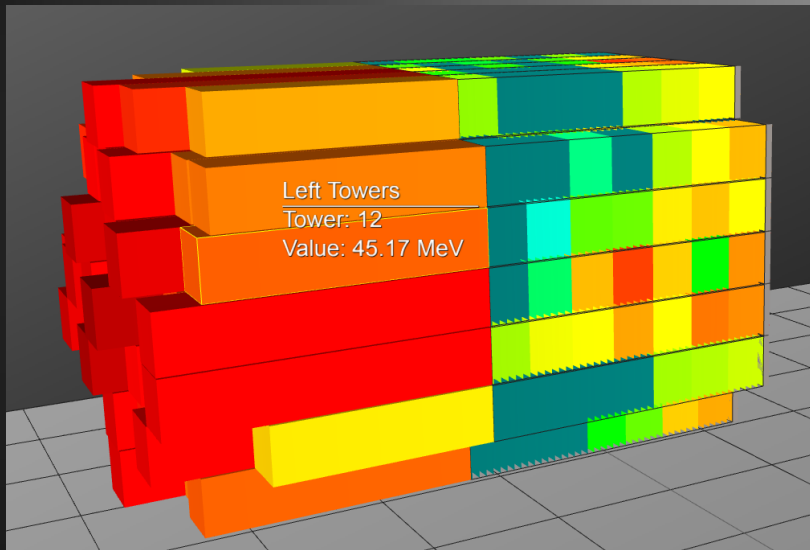
ECal Events in EDS



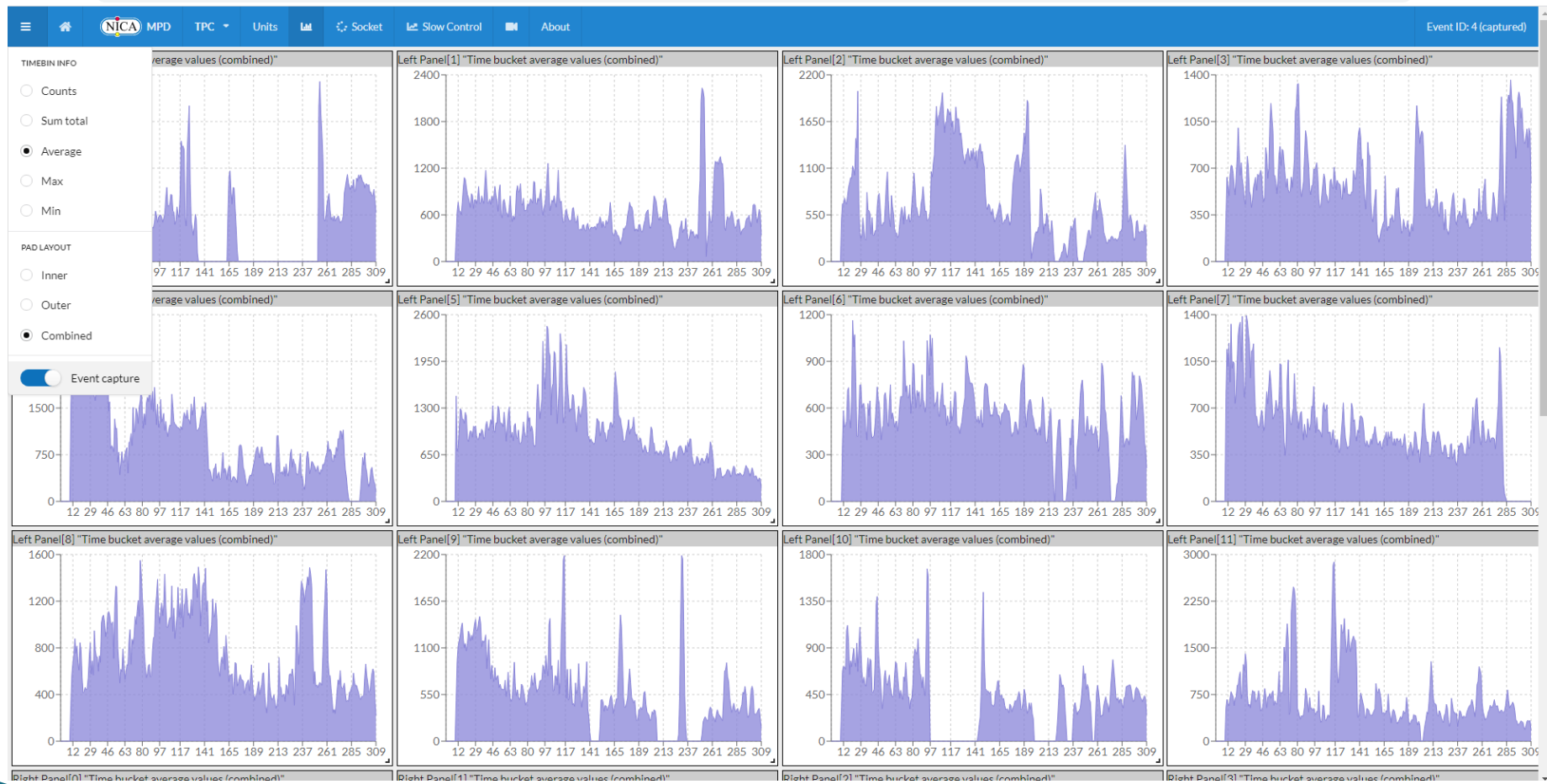
Forward Hadron Calorimeter (FHCaI)



FHCal Events in EDS



Event Info



Conclusion

- ❑ The stable prototype of the Web interactive Event Display for the MPD detector is released and it has been tested on all major platforms and browsers, including mobile devices <https://mpd-edsrv.jinr.ru/>
- ❑ The interactive graphics part based on WebGL allows showing more than 120K active sensors and 3D objects from different detectors in one scene without exceeding and annoying delays including mobile devices.
- ❑ C++ Node API Add-on makes it possible to read ROOT data files on the server side of the Event Display directly in native code without any cost-sensitive transformation.
- ❑ Message broker based on local RabbitMQ package allows synchronizing data flow from different sources with minimal delay (less than 25ms) even for large size events and keeps event history in the internal queues.

What to do next?

- ▶ Add to the Event Display Server Fast Forward Detector (FFD);
- ▶ Make agreement in ROOT data format for simulated events acceptable by Event Display;
- ▶ Add interactions with MPD database;
- ▶ Add slow control and engineering information for all detectors and other facilities;

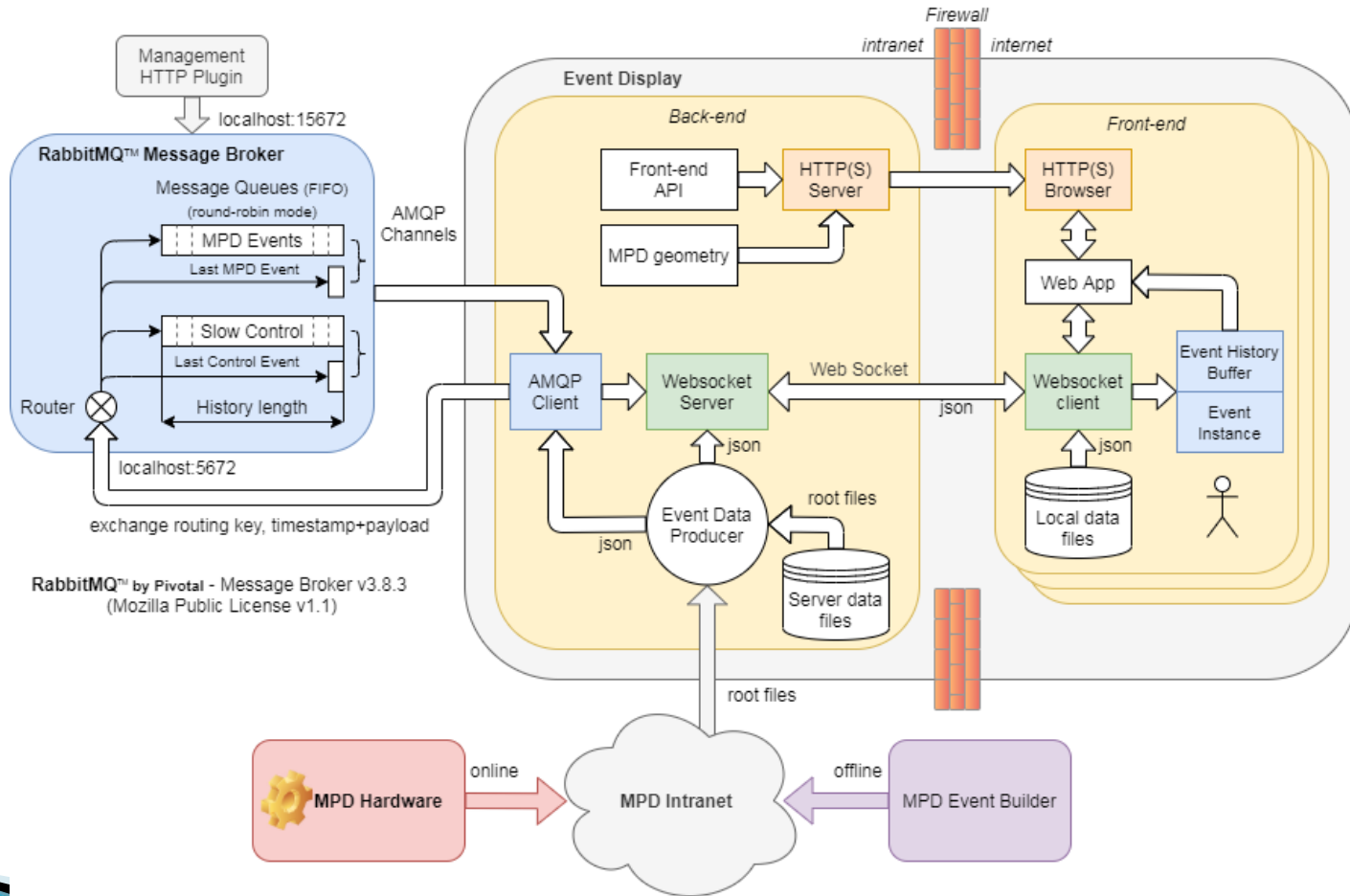
Thank you for your attention!

Development team:

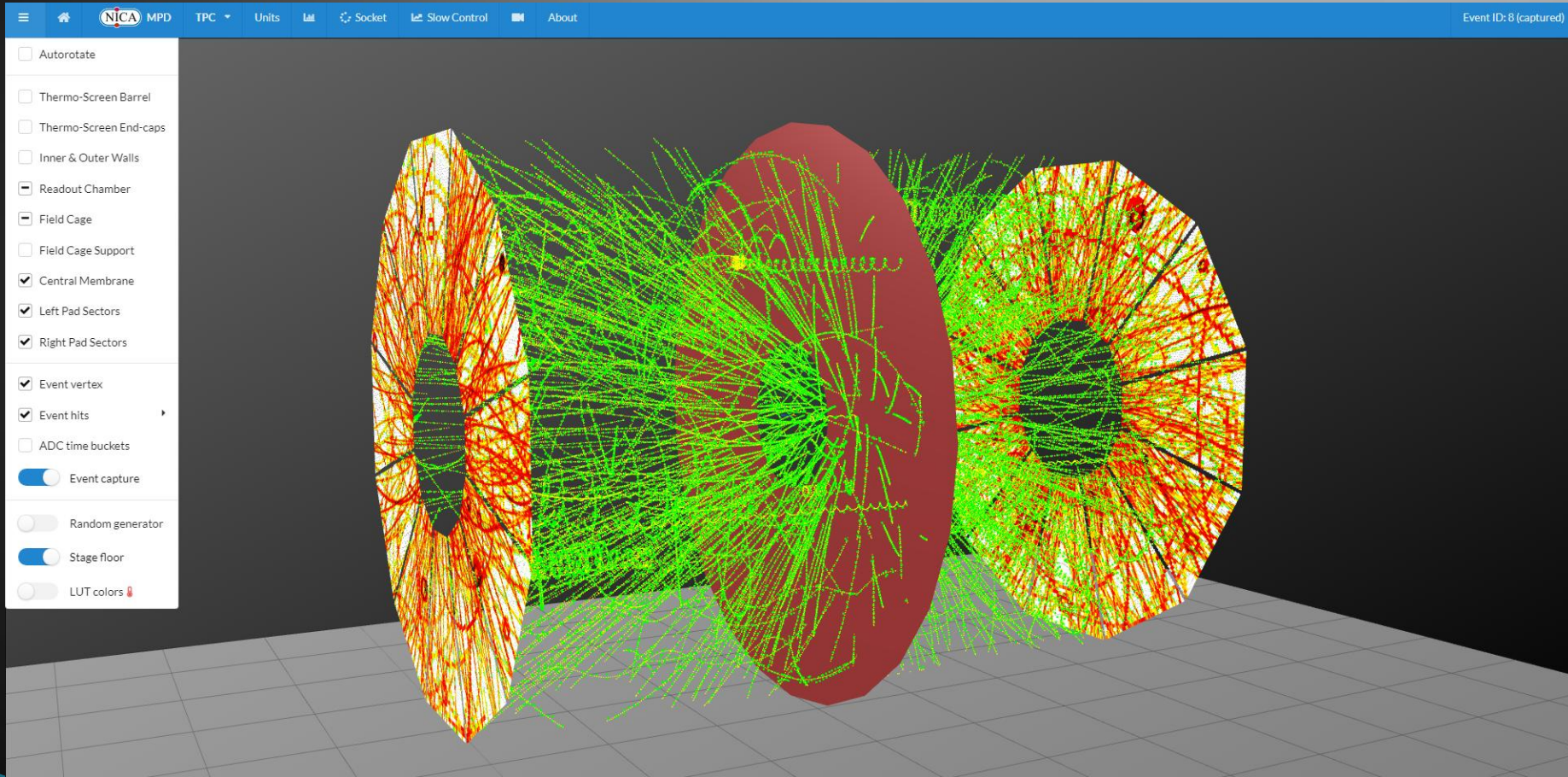
- ▶ O.Rogachevsky, V.Krylov, A.Krylov, A.Bychkov, V.Voronuk,
A.Moshkin

The work is supported from RFBR grant №18-02-40102

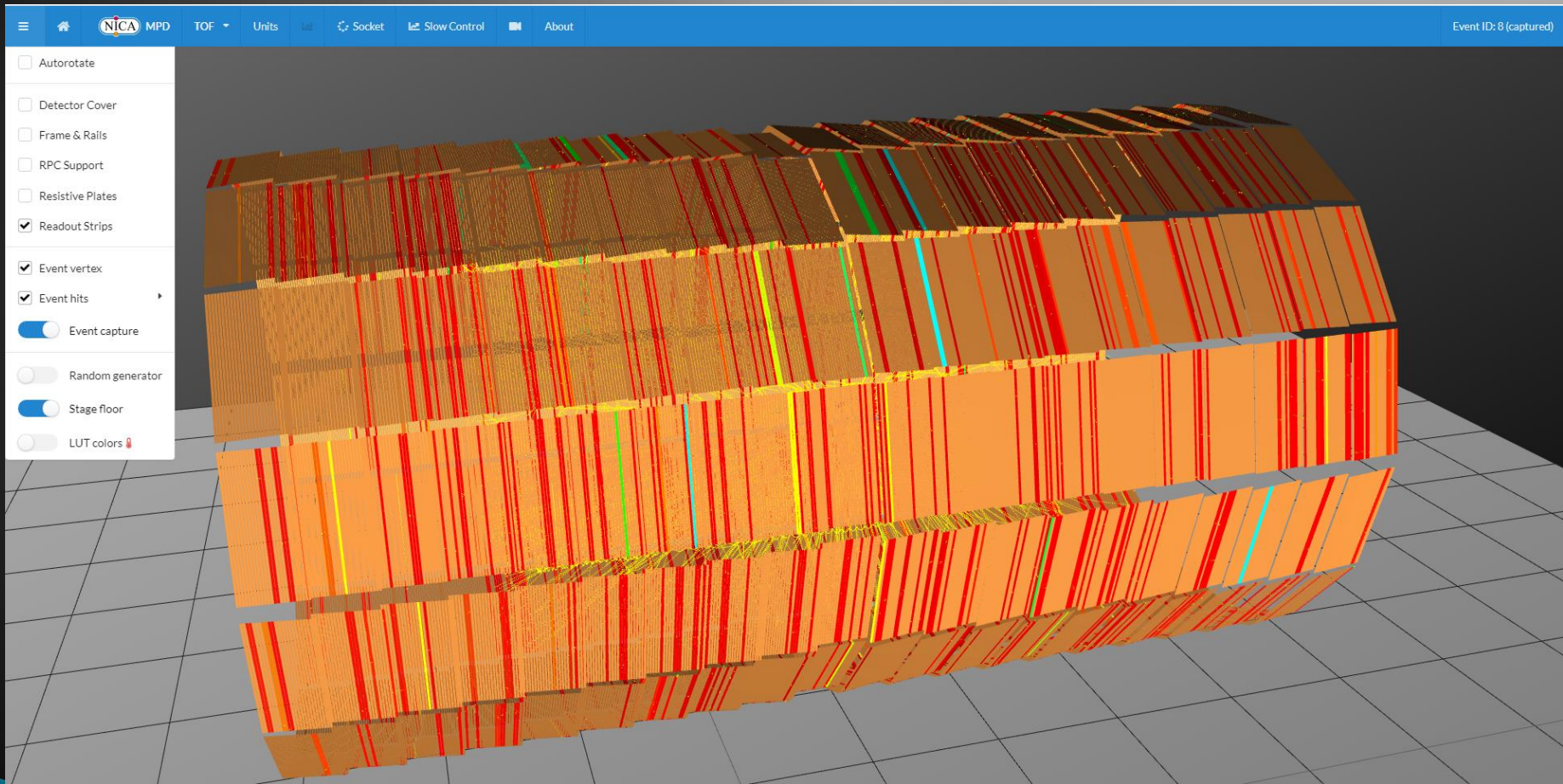
EDS Message broker



TPC huge event



TOF huge event



ECal huge event

