Event Display in JUNO Experiment

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Outline



Overview of Event Display Event Display based on ROOT in JUNO Event Display based on Unity in JUNO Detector Visualization Event Reconstruction **Unity V.S. ROOT Future Plan**

Event Display



Visualization of the experiment in High Energy Physics, showing the detector structure and the event hits, for reconstruction algorithm improvement and physics analysis.

JUNO Experiment



Jiangmen Underground Neutrino Observatory (JUNO)

Reactor neutrinos experiment, using Inverse Beta Decay(IBD) to measure the neutrinos mass hierarchy



Event Display Based on ROOT



SERENA (Software of Event display with Root EVE for Neutrino Analysis)



Current Event Display Scheme in JUNO Offline

Components to display

Event control SERENA@hep.sysu.edu.cn 3D Eve Display 2D Projection Histograms 🗌 Check Test Event control Browser Eve Eve Files Viewer 1 1 🌲 Hide Actions Viewer 1 🚞 🔽 Viewers Pre Next 🚞 🔽 Scenes 🛅 🔽 Event Charge ---- 🔁 🗖 LiquidScintillator 🗆 -- 🧰 🔽 Equator 🗖 Time 💼 🗖 WaterPool 🗖 Animation -🗀 🔽 CD_PMT 🗖 TCut= 0 🖨 ns EC_CONE - 🚞 🔽 Sim Rec Difference 🗖 ?<u>....</u> 💼 🔽 Sim Track 🔳 0,0 <T< 150,0 Style | Guides | Clipping | Extras | Start 'iewer] TStep= 5.0 ns Update behaviour Event Loop 🔲 Ignore sizes 🔽 Reset on update ve view Update Scene Home Camera Home Max 5000 🔷 Max HQ draw time: Inner Max LQ draw time: 100 🖨 Random TH1 test Clear Color 📕 🔻 Backgrond Color -Light sources: 🔽 Тор 🔽 Bottom Help 🔽 Left 🗹 Right 🔽 Front 🔽 Specular Point-size scale: 1.0 Line-width scale: 1.0 🖨 🗖 Wireframe line-widt 1.0 **∢** [

PMT Hits distribution



GUI of SERENA

Components to display

Event control SERENA@hep.sysu.edu.cn 🗖 Check Test 3D Eve Display 2D Projection Histograms Browser Eve Viewer 1 1 ᆗ Eve Files Hide 📄 🔽 WindowManager Viewer 1 Actions Pre Next 📄 🔽 Viewers Cenes Event Charge 🗀 🗖 LiquidScintillator 🗆 Time Equator 🗖 📄 🗖 WaterPool 🗖 Animation ----- 🔁 🔽 CD_PMT 🗖 TCut= 10 1 ns REC_CONE Sim Rec Difference 🗀 🖬 Sim Track 📕 0.0 <T< 150.0 la Ira Start BoxSet] TStep= 5.0 ns TEveElement Event Loop Show: 🔽 Self 🔽 Children ☑ UseTrans 🔲 EditTrans Palette controls Home ✓ Interpolate Max ▼ Show default value | Inner Fix color range Underflow: Cut 🔽 🖛 🗸 Random TH1 test Overflow: Clip -Backgrond Color Main range: -80 -18 Help 4

PMT Hits distribution



GUI of SERENA

What is Unity



A renowned game engine

- Unity allows developers to target more devices very easily.
- Not just for game, it can be also used for education, simulation, visualization and so on.

More than twenty platforms are supported by Unity.





Application in HEP based on Unity



CAMELIA (Cross-platform Atlas Multimedia Educational Lab for Interactive Analysis)

Software for analysis, learning and exploration of real LHC events Demonstration for ATLAS experiment



Event Display Based on Unity



Data Flow in JUNO Experiment for Event Display

Geometry File -> Detector structure

Event & MC truth File -> PMT hits and simulation info

Reconstruction File -> Reconstructed vertex and energy

Detector Visualization





Detector Visualization





Event Hits



AcrylicBall

Color means the hits number of the PMT

Drag the slider to change the time

33.5

Input the event number

8

Draw Hit

/ 206.6 ns

Event Hits



AcrylicBall

Color means the hits number of the PMT

Input the event number

Input the event number

Draw Hit

1 ns

Drag the slider to

change the time

0

Event Hits





Reconstruction Point



RecVertex Located in (-2.6,-13.2,10.8) Rec energy is 1.62605 MeV

Recontrution Point

1082.9 /1082.9 ns



Draw Hit

Multiplatform



Test in different platform

The software has successfully run in the following platform:

Windows 8.1

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WebGL

Scientific Linux 7.2

macOS 10.12

Web (Google Chrome 58.0)

Unity v.s. ROOT



ROOT(SERENA)

Easy to input and output the data in root file format. Well developed for now. (Geometry, Event, Mc truth and Reconstruction)

Integrated in JUNO offline as a part of JUNO offline. Plugin is needed if users want to display remotely. Visual effect is limited by ROOT.

Unity

Easy to transplant other platform like windows, Linux, mac, web. Built as a client, which can be run in user's own PC without JUNO offline. More fancy visual effect is available as a game engine.

Need the data conversion when loading a root file.

Future Plan



Development for Event Display based on Unity

- Data encapsulation
- MC truth Display
- Top tracker Display
- More user friendly GUI
- Shortcut and help documentation
- Detail model (like the structure of PMT)
- Histograms
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First version may be released in the autumn of 2017.

Summary



Two event display systems have been built for JUNO. The one based on ROOT is approaching full functionality. The other one based on Unity is basically available.

Event Display with Unity is strongly transplantable and able to realize more fancy effect easily.

More functions will be added in the Event Display system soon.

