Resume

The problem description and actuality. ATLAS is detecting more than 600 million event per second. Event displays are invented to visualize this processes in order to ease analyzing for humans. They serve several tasks:

1. Physical analysis and scientific research.
2. Education activity.
3. Distribution and popularization of scientific achievements to the masses.

Event display reflects jets, tracks and missing transverse energy. There are few event displays for ATLAS detector data: Virtual Point One (VP1), Atlantis, and HYPATIA. However, the above-mentioned systems do not find a wide use in outreach / education, since the system in this field is necessary to meet the following parameters:

1. Must be accessible on every type of device.
2. System must be available for any operating system user.
3. Application must not force users to use another framework in order to work with event display.
4. The system should not force the user to install any kind of software package.

WebGL feets all the above mentioned requirements, allowing to include 3D models into the web application, Three.js in another way is the library which eases code writing on WebGL.

Hense, developing Three.js based event display for ATLAS detector is actual task.

Scientific innovation.

1. Comparatively analyzed the current ATLAS detector events displays and in the result was obtained the list of the parameters which must but interpreted.
2. Comparatively analyzed the results of event interpretation to Atlantis (widely used event display in ATLAS experiment) with graphic comparision method.
3. In order to research the consequences of data deviation, 5 hypotheses have been formed and studied, 2 of which are corroborated.

Practical significance.

1. Methodic software for interpreting physical parameters has been processed.
2. A software implementation was created based on Three.js library.
3. Physical parameters interpretation programming code was included into ATLAS Tracer, interactive web tool developed for ATLAS Outreach group.

1st chapeter explains what is the task of nuclear physics today, where nuclear physics is used and then and the nuclear physics projects and research organizations are discussed, such as: High Energy Accelerator Research Organization (KEK), J-PARC (Japan Proton Accelerator Research Complex), JAEA (Japan Atomic Energy Agency), Facility for Antiproton Ion

Research (FAIR), International Thermonuclear Experimental Reactor (ITER), LHC (Large Hadron Collider), ATLAS.

2nd chapter deals with physical processes in ATLAS detector, their charachteristic parameters and ATLAS detector subtetector systems working principle. In the same chapter event displays: VP1, Atlantis, HYPATIA, iSpy are discussed and their functionalities, event visualization are describes. Also in this chapter is compare analysis of physical parameters interpreted by the event displays, the result of this analysis are two lists of the integration parameters:

1. For jets: Storegate key, E_T, E, η, φ, P_T, isGood, isBad, isUgly, hecf, n90cells, quality, qLAr, jvf, Time, Clus Time.
2. For tracks: φ, η, P_T, P, t_L, θ, charge, e/μ, chi2, numDoF, numPixelHits, numSCTHits, numTRTHits.

3rd chapter decribes the method of processing of physical parameters. It also discusses how ATLAS Tracer software works and all its basic functional parts are described, including:

1. Select - Serves the discovery of the existing geometric object on the screen when pressing the cursor on the screen.
2. Interpretation of Jets – Consists of two parts, one of which serves the creation of the jet cone geometry and adding into 3D secene, and the second option to display parameter of selected jet on the user's screen.
3. Interpretaton of Tracks – like interpretation of jets, it is divided into two parts, where the first creates geometry of the cylinders which represents track and adding them into the scene, while the second displays parameters of selected track.
4. Additional functions – Functions that are used to extract, save and modify the data from XML files.

Chapter also contains program code of interpretation module of ATLAS Tracer.

4th chapter explains compare analysis method and its principle. Chapter also describes compare analysis of jet cone height, rotaion angles and diameter, also track rotation angle and length displayed in ATLAS Tracer software and well known software in ATLAS experiment, Atlantis and the results are represented as charts and graphs, from which we can conclude:

1. Angle deviation (on average: 19%) of tracks is much less than the deviation of the length (on average: 36%).
2. The closed the tracks are in ATLAS Tracer to the collision center the less the difference is.
3. On the side view tracks have deviation, while on side view diviation is 0%.
4. Deviation in jet rotation angle is less than deviation in height and diameter. Jet rotation angle deviation on front view is less than on side view.

5. Deviation of the jets height is in between 69%-100%, the deviation of the eviations is 19%.

Based on this conclusions is formed 5 hypotheses;

1. Difference in track length is caused by the fact that the vectors (track cylinders) in Atlantis are connected to the center, while in Tracer track vectors are just line between two points.
2. The difference between the diameters of Jet can be caused by the inaccuracy of the jet interpreter method in tracer, because in nine cases there is a large system error (25% - 160% on the front and 33% -3696% on the side).
3. The use of incorrect geometric formulas in interpreting the rotation angles in the tracer causes a large deviation.
4. The difference between jet rotation angles may be caused by the jet rotation on front view in Atlantis using only one angle (φ), while the second angle of rotation (θ) is ignored, while on side view is opposite situation object is rotated only by the θ but φ is ignored. In Tracer jet cone is rotated using both rotation angles.
5. Scale testing – the same ATLAS detector part (TRT) is used to accurately place screen shots on each other, but TRT sizes in Atlantis and Tracer may be different what causes the differences in general.

After examination 1st amd 4th were confirmed as true and rest were rejected.