

Software development for particles analysing in pPb collisions at ALICE experiment at energy $\sqrt{S_{NN}}=5.02$ TeV

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What are ROOT and Therminator2?

ROOT – compiler and interpreter of C++ language with specialized libraries usefull for particle physics (mostly math, statistics, display).

Therminator2 – written in C++ (and using ROOT math libraries) Monte Carlo event generator for heavy ion collisions. It includes library of hypersurfaces for different experiments.

Manual setup problems

- Last stable version of Therminator2 was published in 2011, the code became outdated.
- Some parts of Therminator2 code became deprecated and later strictly forbidden by more recent C++ revisions (standards C++2011 and C++2017).
- Manual setup of ROOT may be time consuming.

Authomatic preparation of ROOT and Therminator2 enviroment.

I wrote script that realizes following operations (for Ubuntu and Debian):

- Downloads ROOT and Therminator2 dependencies.
- Downloads and installs ROOT (version compatible with user's OS).
- Downloads Therminator2's source.
- Corrects bugs in Therminator2's source.
- Compiles and installs Therminator2.

```
ROOT and Therminator2 have some dependencies. First let's update your database.
Get:1 http://security.ubuntu.com/ubuntu bionic-security InRelease [83.2 kB]
Hit:2 http://pl.archive.ubuntu.com/ubuntu bionic InRelease
Get:3 http://pl.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Hit:4 http://archive.canonical.com/ubuntu bionic InRelease
Get:5 http://pl.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:6 http://pl.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [246 kB]
Get:7 http://pl.archive.ubuntu.com/ubuntu bionic-updates/main i386 Packages [229 kB]
Get:8 http://pl.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [93.2 kB]
Get:9 http://pl.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [131 kB]
Get:10 http://pl.archive.ubuntu.com/ubuntu bionic-updates/universe i386 Packages [131 kB]
Get:11 http://pl.archive.ubuntu.com/ubuntu bionic-updates/universe Translation-en [58.6 kB]
Fetched 1,135 kB in 2s (491 kB/s)
Reading package lists... Done
You need C++ compiler, cmake, git and some minor utilities and need some dev libraries (with headers etc):
Reading package lists... Done
Building dependency tree
Reading state information... Done
cmake is already the newest version (3.10.2-1ubuntu2).
dpkg-dev is already the newest version (1.19.0.5ubuntu2).
gcc is already the newest version (4:7.3.0-3ubuntu2).
gcc is already the newest version (4:7.3.0-3ubuntu2).
libjpeg-dev is already the newest version (8c-2ubuntu8).
libx11-dev is already the newest version (2:1.6.4-3).
libxext-dev is already the newest version (2:1.3.3-1).
libxf86-dev is already the newest version (2.3.2-1).
libxpm-dev is already the newest version (1:3.5.12-1).
python is already the newest version (2.7.15-rc1-1).
python-dev is already the newest version (2.7.15-rc1-1).
libtbb-dev is already the newest version (2017-U7-8).
binutils is already the newest version (2.30-20ubuntu2-18.04).
git is already the newest version (1:2.17.1-1ubuntu0.1).
libpng-dev is already the newest version (1.6.34-1ubuntu0.18.04.1).
0 upgraded, 0 newly installed, 0 to remove and 21 not upgraded.
=====
==== Downloading ROOT version 6.14.00
-- 2018-07-19 18:18:41 - https://root.cern.ch/download/root_v6.14.00.Linux-ubuntu18-x86_64-gcc7.3.tar.gz
```

What is AliGenQA

AliGenQA is a tool for preparation of reports from experimental data.

Originally it was based on tools developed by Christian Bourjau within the HMTF2 and was later adapted as general generator-level QA in ALICE.

The tool itself is written in Python language and uses AliRoot (which is part of AliEn – ALIce ENvironment) macros.

Environment setup

In order to properly set AliGenQA up user needs AliEn with AliRoot built upon ROOT 5 (newer ROOT 6 is NOT fully backward compatible).

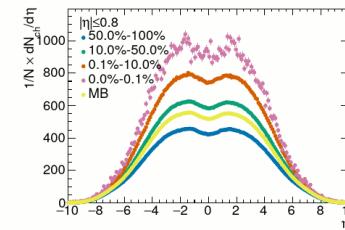
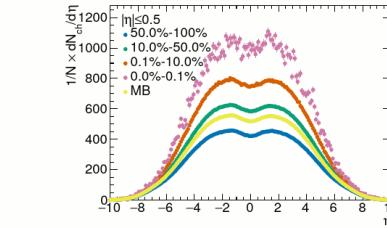
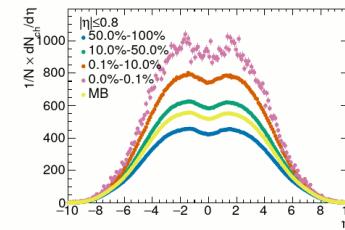
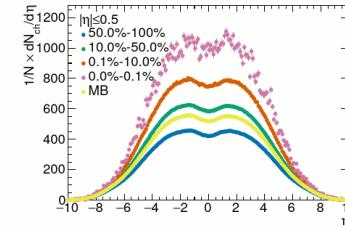
That software works properly only on: Ubuntu, CentOS, Mac OS X and Fedora. Other systems' users need either virtual machine or (in case of some Linux distros Docker).

Access to AliEn requires CERN Account with enabled privileges of access to CERN's git repository.

AliGenQA usage

- In order to use AliGenQA user needs to have active AliEn session. Within that session user may use AliGenQA to download simulation data from CERN server (after authenticating with CERN credentials) and to prepare reports out of this data.
- AliGenQA takes as input simulation data in root format, then it looks for specific data inside root file trees and than segregates it into intermediary root file from which it prepares summary - a pdf file that consists of segregated charts.

$dN/d\eta$



Modifications in AliGenQA

- While preparing output AliGenQA only searches for particular data, that is programmed in its code. In order for it to export data it needs to be added inside script file plotting.py. However while adding support for any particle is easy it requires this data to be included in supplied input file.
- If user tried inputting into AliGenQA file with unsupported data or which lacked some of root trees it would throw an error (without comment what has caused it). Moreover if user tried to download data that already was downloaded AliGenQA would refuse to work properly either.
- This is why I added basic error handling for it - each critical point of it's procedure will inform user what causes problem. Furthermore if error is not critical it would skip that particular step. In case of redownloading file would just use existing file, in case off missing data it would be omitted. Not only errors are more transparent to user, but also user may use AliGenQA with wider variety of input data (at least to a degree).

Modification of AliEn Software

- In order to supply AliGenQA with proper data I needed to modify existing AliEn software. Adding new particle into simulation requires editing its config file (and inclusion of that particle's parameters). However it would affect only simulation output, AliEn software later performs analysis that needs to be modified too.
- Main macro that was easy to locate. However it only passes its arguments into other macros which continue on this behaviour even further. With lack of proper documentation it was very time consuming.
- Each change in code I made was followed by me running simulation in order to check whether my modifications were sufficient. Because of time constraints it was not possible to finish this part.

Summary

- Script for working environment of ROOT and Therminator2 fulfills its objective, other people can set their working environments with minimal workload.
- Group of students were instructed how to use that software and did not need to guess which parts of its long manual are important for their work.
- AliGenqa software was improved, now it works more reliably - If error happens within its execution - user will receive more verbose information on what caused it.
- Part of AliEn software responsible for data generation for AliGenQA was (within time constraints) examined.
- Addition of new particles was partially solved.
- Effects of my work were documented and left for future usage at project's TWiki page:
<http://nica.fizyka.pw.edu.pl/do/view/Main/TeFeNica45>

Thank you for your attention

References:

- Mikolaj Chojnacki, Adam Kisiel, Wojciech Florkowski, Wojciech Broniowski, THER- MINATOR 2: THERMal heavy IoN generATOR 2,
- <https://arxiv.org/abs/1102.0273> Bash Reference Manual,
- https://www.gnu.org/software/bash/manual/html_node/index.html ROOT v6.14 Reference Manual,
- <https://root.cern.ch/doc/v614/> AliGenQA's README.MD file CERN Building ALICE software: ALICE Analysis Tutorial
- Aleksander Szpakiewicz-Szatan Software development for MC data analyzing, <http://nica.fizyka.pw.edu.pl/do/view/Main/TeFeNica45>