

02 AT – 08/10/2023

From Hyperloop to the fit of invariant mass spectra

Luca Micheletti (CERN)



ALICE

- ❑ Hyperloop is the train system for Run3, replacing Run2 LEGO train

 Hyperloop page: <https://alimonitor.cern.ch/hyperloop/>

 Documentation page: <https://aliceo2group.github.io/analysis-framework/docs/hyperloop/>

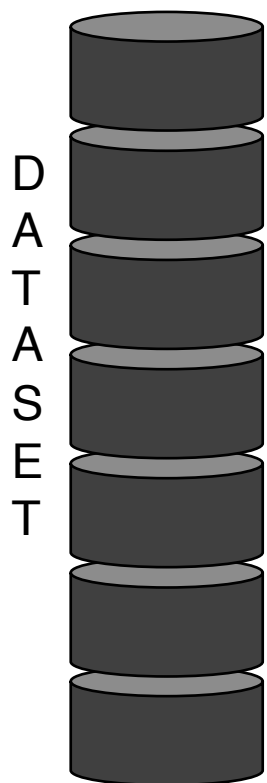
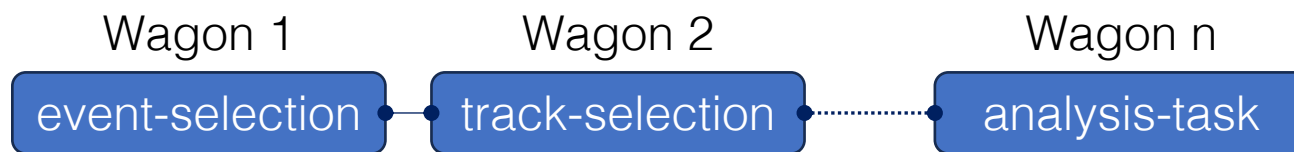
 Mattermost channel: <https://mattermost.web.cern.ch/alice/channels/o2-hyperloop-operation>

- ❑ Hypeloop:

- is fully integrated with O² (configurables, default settings taken from latest versions)
- allows to use Run3 data and Run2 converted datasets
- allows to create **derived datasets** and analyze them
- allows to recover configurations, datasets, software versions ⇒ **reproducibility!**
- produces all the information to **reproduce the train locally**

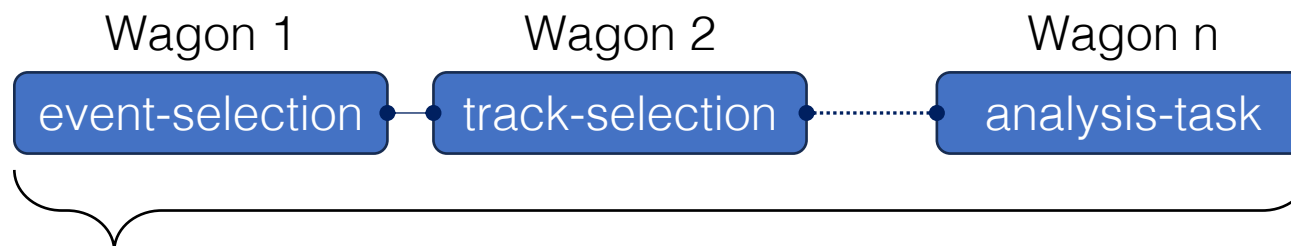
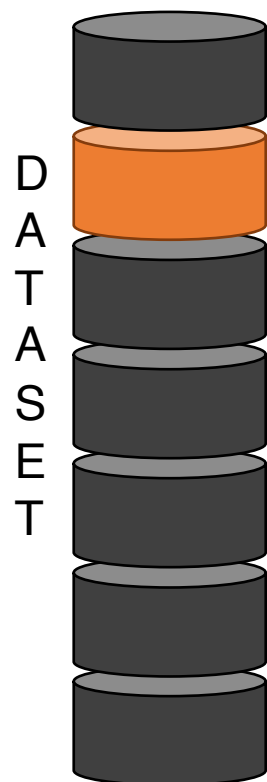
The Hyperloop train system

Luca Micheletti
08/10/2023
O2AT



The Hyperloop train system

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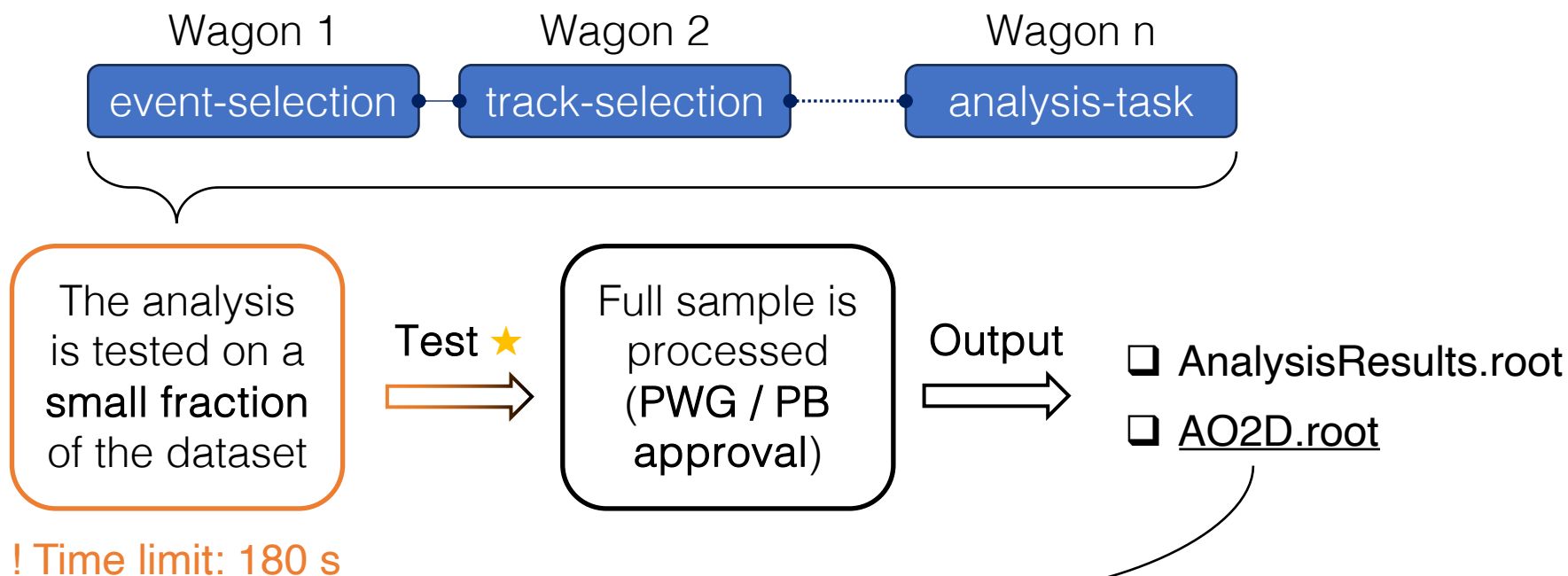
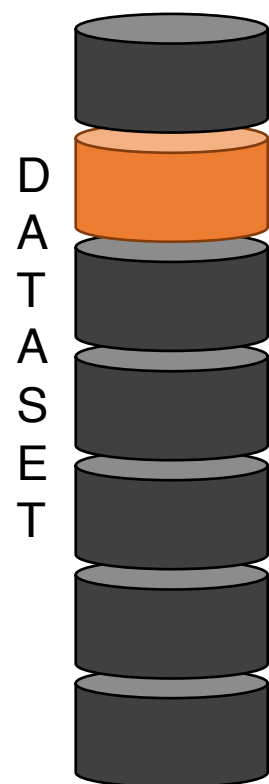


The analysis
is tested on a
small fraction
of the dataset

! Time limit: 180 s

The Hyperloop train system

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If the output is an **AO2D.root** it can be processed on Hyperloop after requiring the creation of the dataset to the train operators via the **Mattermost** channel

Analysis creation

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08/10/2023
O2AT



Hyperloop analysis window

DQ track skimming									
Analyzers: Imichele,xbai									
Package: O2Physics::daily-20231031-0100-1									
Search wagons by name...									
Wagon	DQ_LHC22m_pass4_muon_e...	DQ_LHC22o_pass4_muon_el...	DQ_LHC22r_pass4_muon_el...	DQ_LHC22t_pass4_muon_el...	LHC22_pass4_lowIR	LHC22o_pass4_minBias_me...	LHC22o_pass4_minBias_small	Last run	
B2JpsiK_TableReader	×	✓	×	×	×	×	×		vs
dq-table-maker-run3-pp-electron	×	×	×	×	×	×	×		vs
dq-table-maker-run3-pp-full-skimmed	×	×	×	×	×	×	×	98206	vs
dq-table-maker-run3-pp-muon	×	×	×	×	×	×	×	121737	vs
dq-table-maker-run3-pp-muon-skimmed	×	×	×	×	×	×	×	92375	vs
dq-table-reader-run3-pp-electron	×	×	×	×	×	×	×		vs
dq-table-reader-run3-pp-muon	×	×	×	×	×	×	×	121737	vs
dq-table-reader-run3-pp-muon-skimmed	×	×	×	×	×	×	×	108793	vs
ppfilter	×	×	×	×	×	×	×	124861	vs
ppFilterReduceMaker	×	×	×	×	×	✓ !	✓ !	124861	vs

Hyperloop analysis window

DQ track skimming

Analizers: Imichele,xbai

Package: O2Physics::daily-20231031-0100-1

JIRA : PWGDQ-86

Search wagons by name...

or newer tags ☐ Future tag based on pull request [Learn more](#)

Wagon list

Wagon	DQ_LHC22m_pass4_muon_e...	DQ_LHC22o_pass4_muon_el...	DQ_LHC22r_pass4_muon_el...	DQ_LHC22t_pass4_muon_el...	LHC22_pass4_lowIR	LHC22o_pass4_minBias_me...	LHC22o_pass4_minBias_small	Last run
B2JpsiK_TableReader	×	✓	×	×	×	×	×	
dq-table-maker-run3-pp-electron	×	×	×	×	×	×	×	
dq-table-maker-run3-pp-full-skimmed	×	×	×	×	×	×	×	98206
dq-table-maker-run3-pp-muon	×	×	×	×	×	×	×	121737
dq-table-maker-run3-pp-muon-skimmed	×	×	×	×	×	×	×	92375
dq-table-reader-run3-pp-electron	×	×	×	×	×	×	×	
dq-table-reader-run3-pp-muon	×	×	×	×	×	×	×	121737
dq-table-reader-run3-pp-muon-skimmed	×	×	×	×	×	×	×	108793
ppfilter	×	×	×	×	×	×	×	124861
ppFilterReduceMaker	×	×	×	×	×	✓ !	✓ !	124861

Dataset list

Datasets and Settings

Hyperloop analysis window

DQ track skimming

Analyzers: Imichele,xbai

Package: O2Physics::daily-20231031-0100-1

Search wagons by name...

Wagon list

Wagon
B2JpsiK_TableReader
dq-table-maker-run3-pp-electron
dq-table-maker-run3-pp-full-skimmed
dq-table-maker-run3-pp-muon
dq-table-maker-run3-pp-muon-skimmed
dq-table-reader-run3-pp-electron
dq-table-reader-run3-pp-muon
dq-table-reader-run3-pp-muon-skimmed
ppfilter
ppFilterReduceMaker

Dataset list

DQ_LHC22m_pass4_muon_e...	DQ_LHC22o_pass4_muon_el...	DQ_LHC22r_pass4_muon_el...	DQ_LHC22t_pass4_muon_el...	LHC22_pass4_lowIR	LHC22o_pass4_minBias_me...	LHC22o_pass4_minBias_small	Last run
✗	✓	✗	✗	✗	✗	✗	
✗	✗	✗	✗	✗	✗	✗	
✗	✗	✗	✗	✗	✗	✗	98206
✗	✗	✗	✗	✗	✗	✗	121737
✗	✗	✗	✗	✗	✗	✗	92375
✗	✗	✗	✗	✗	✗	✗	121737
✗	✗	✗	✗	✗	✗	✗	108793
✗	✗	✗	✗	✗	✗	✗	124861
✗	✗	✗	✗	✗	✗	✗	124861

Datasets and Settings

Receive emails if test wagon fails: Only user who enabled the wagon

Enabled datasets in DQ track skimming

- DQ_LHC22o_pass4_muon_electron ✗
- LHC22o_pass4_minBias_medium ✗
- LHC22o_pass4_minBias_small ✗
- DQ_LHC22r_pass4_muon_electron ✗
- DQ_LHC22t_pass4_muon_electron ✗
- DQ_LHC22m_pass4_muon_electron_new ✗
- LHC22_pass4_lowIR ✗

Enable dataset: All datasets

☐ Data ☐ MC

Done

- Different datasets can be added to the analysis from the list provided by DPG

Hyperloop analysis window

DQ track skimming

Analizers: Imichele,xbai

Package: O2Physics::daily-20231031-0100-1

Search wagons by name...

Wagon	DQ_LHC22m_pass4_muon_e...	DQ_LHC22o_pass4_muon_el...	DQ_LHC22r_pass4_muon_el...	DQ_LHC22t_pass4_muon_el...	LHC22_pass4_lowIR	LHC22o_pass4_minBias_me...	LHC22o_pass4_minBias_small	Last run
B2JpsiK_TableReader	×	✓	×	×	×	×	×	
dq-table-maker-run3-pp-electron	×	×	×	×	×	×	×	
dq-table-maker-run3-pp-full-skimmed	×	×	×	×	×	×	×	98206
dq-table-maker-run3-pp-muon	×	×	×	×	×	×	×	121737
dq-table-maker-run3-pp-muon-skimmed	×	×	×	×	×	×	×	92375
dq-table-reader-run3-pp-electron	×	×	×	×	×	×	×	
dq-table-reader-run3-pp-muon								
dq-table-reader-run3-pp-muon-skimmed								
ppfilter								
ppFilterReduceMaker								

PWG-DQ

- Create board
- Issues
- Reports
- Releases
- Components

PROJECT SHORTCUTS

Add a link to useful information for your whole team to see.

+ Add link

PWG-DQ / PWGDQ-86

DQ track skimming

Edit Add comment Assign More Open

Details

Type: Analysis
Priority: Major
Component/s: PAG-JPSIZEE, PAG-QuarkoniumtoMuMu
Labels: None
Run 3 analysis: Yes
Data Set: LHC18q
Public Result: Yes
To do list: EMPTY

Wall time consumed: 123y 144d (based on 38 trains)
CPU time consumed: 18y 177d (based on 22 trains)
Input data read: 6.082 PB (input) | 5.736 PB (read)
Output produced: 16.75 TB (total) | 16.45 TB (still on disk) | 16.45 TB (derived data on disk from 15 trains)
Number of train runs: 38

Description

This is a Jira ticket for the skimming of the AO2D to reducedAO2D

Resolution: Unresolved

JIRA : PWGDQ-86

❑ On Hyperloop analyses are created via **JIRA** ticket

❑ Once created the analysis is automatically added and the user can find among **My Analyses**

❑ Hyperloop allows to test locally the analysis in case it fails (💣)

Wagon	PbPb_2023_cpass0...
dq-table-maker-run3-PbPb-muon	✗
dq-table-maker-run3-pp-muon	✗
dq-table-reader-run3-PbPb-muon	✓ 💣
dq-table-reader-run3-PbPb-muon-skimmed	✗
dq-table-reader-run3-pp-muon 	✗

❑ Hyperloop allows to test locally the analysis in case it fails (💣)

Wagon	PbPb_2023_cpass0...
dq-table-maker-run3-PbPb-muon	✗
dq-table-maker-run3-pp-muon	✗
dq-table-reader-run3-PbPb-muon	✓ 
dq-table-reader-run3-PbPb-muon-skimmed	✗
dq-table-reader-run3-pp-muon 	✗

[Test 131222](#) 

General

Test

Package tag

Dataset

Enabled by

Test status

Start Time

End Time

[O2Physics::daily-20231031-0100-1](#)

[PbPb_2023_cpass0_QC](#)

lmichele

Failed  [\(output\)](#)

01 November 2023 at 10:28:29 CET

01 November 2023 at 10:29:08 CET

❑ Hyperloop allows to test locally the analysis in case it fails (💣)

Wagon	PbPb_2023_cpass0...
dq-table-maker-run3-PbPb-muon	✗
dq-table-maker-run3-pp-muon	✗
dq-table-reader-run3-PbPb-muon	✓ 
dq-table-reader-run3-PbPb-muon-skimmed	✗
dq-table-reader-run3-pp-muon	✗

Test 131222 

General

Test

Package tag

O2Physics::daily-20231031-0100-1

Dataset

PbPb_2023_cpass0_QC

Enabled by

lmichele

Test status

Failed  (output)

Start Time

01 November 2023 at 10:28:29 CET

End Time

01 November 2023 at 10:29:08 CET

❑ The output of the test contains all the information to perform locally the same analysis

❑ Download all the **files** locally (or on LXPLUS)

Filename
 <u>configuration.json</u>
<u>download.log</u>
<u>dpl-config.json</u>
<u>env.sh</u>
<u>full_config.json</u>
 <u>input_data.txt</u>
<u>performanceMetrics.json</u>
<u>profile.linux-perf.txt</u>
<u>status.json</u>
<u>stderr.log</u>
 <u>stdout.log</u>
<u>wn.xml</u>

- **configuration.json**: has the setting of all the analysis wagons
- **input_data.txt**: has file list processed
- **stdout.log**: has all the information of the processing (crucial to reproduce)

stdout.log

```
PACKAGE = VO_ALICE@O2Physics::daily-20231017-0200-1
Acquiring lock and downloading input files from /alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050 at Wed Nov 1 09:37:59 CET 2023
Acquired lock and started downloading at Wed Nov 1 09:37:59 CET 2023
Finished downloading at Wed Nov 1 09:38:05 CET 2023
```

This job will run over the following files:

```
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/633/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/637/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/082/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/328/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/259/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/636/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/617/A02D.root
/home/alitrain/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/430/A02D.root
```

You can directly access these files with the following URLs (while they are cached):

```
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/633/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/637/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/082/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/328/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/259/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/636/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/617/A02D.root
http://alimonitor.cern.ch/train-workdir/testdata/LFN/alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/430/A02D.root
```

The corresponding ALiEn paths are:

```
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/633/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/637/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/082/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/328/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/259/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/636/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/617/A02D.root
alien:///alice/cern.ch/user/a/alihyperloop/jobs/0019/hy_191050/AOD/430/A02D.root
```

O2 job script starts at Wed Nov 1 09:38:05 CET 2023

O2 is taken from: /cvmfs/alice.cern.ch/e17-x86_64/Packages/O2/daily-20231017-0200-1

O2Physics is taken from: /cvmfs/alice.cern.ch/e17-x86_64/Packages/O2Physics/daily-20231017-0200-1

Running on 1 cores and configuring with shared memory 7500000000, rate limit 209715200, readers 1

Generating O2 command. Adding the following options:

```
Input files: --aod-file @input_data.txt
Reader/Spawner configuration: --readers 1
Memory options: --aod-memory-rate-limit 209715200 --shm-segment-size 7500000000
Time limit: --time-limit 180
Session: --session 131190
Monitoring: --resources-monitoring 2 --resources-monitoring-dump-interval 600
Benchmarking prefix: perf record -F 99 -g --call-graph dwarf --user-callchains
```

Global options (given once): --aod-file @input_data.txt --readers 1 --aod-memory-rate-limit 209715200 --shm-segment-size 7500000000 --time-limit 180 --resources-monitoring 2 --resources-monitoring-dump-interval 600

Workflow options (given for each workflow): -b --configuration json://configuration.json --session 131190

Adding o2-analysis-dq-table-reader

The following O2 command will be executed:

```
perf record -F 99 -g --call-graph dwarf --user-callchains o2-analysis-dq-table-reader -b --configuration json://configuration.json --session 131190 --aod-file @input_data.txt --readers 1 --aod-memory-rate-limit 209715200 --shm-segment-size 7500000000 --time-limit 180 --resources-monitoring 2 --resources-monitoring-dump-interval 600
```

However, if for local debugging you want to run the same workflow, you can achieve this with the following reduced command line:
o2-analysis-dq-table-reader -b --configuration json://configuration.json --aod-file @input_data.txt

On LXPLUS:

1. Copy the **list of files** in input_data.txt
2. Download configuration.json
3. Load **O2Physics** and create a grid token
4. Run the **command** reported in the log

- github repository: `git clone https://github.com/lucamicheletti93/dq\_fitter.git`
 - PYTHON-based code to perform fits with ROOFIT

➤ Main advantages:

- the fit configuration is defined into a **.json** file $\Rightarrow$ easy to cross check with other analyzers
- the user can add extra pdfs directly into the directory **/fit_library** (automatically compiled at run time)
- the implementation of extra pdfs is **templetized**
- all the fit outputs are saved into a **.root** file so that they can be easily used

☐ Tutorial:

1. on Lxplus: `/cvmfs/alice.cern.ch/bin/alienv enter VO_ALICE@O2Physics::daily-20231027-0200-1`
2. go in **tutorial/**
3. generate toy sample: `python tutorial.py config_tutorial_fit--gen_tutorial`
4. run the fit on the toy sample: `python tutorial.py config_tutorial_fit.json--do_fit`

```

1 {
2   "input": {
3     "input_file_name": "tutorial.root",
4     "input_name": ["histMass"],
5     "pdf_dictionary": {
6       "pdf": ["Gaus", "Gaus", "Exp", "SUM"],
7       "pdfName": ["Jpsi", "Psi2s", "Bkg", "SUM"],
8       "pdfNameForLegend": ["J/#psi", "#psi(2S)", "Background", "Fit"],
9       "pdfColor": [861, 417, 1],
10      "pdfStyle": [1, 1, 2],
11      "parVal": [
12        [3.096, 0.6e-01],
13        [3.096, 0.6e-01],
14        [1, 1],
15        [1000, 100, 100000]
16      ],
17      "parLimMin": [
18        [2.9, 7.0e-02],
19        [2.9, 7.0e-02],
20        [-10, 0],
21        [0, 0, 0]
22      ],
23      "parLimMax": [
24        [3.5, 1.9e-01],
25        [3.9, 1.9e-01],
26        [10, 100],
27        [5000000, 5000000, 50000000]
28      ],
29      "parName": [
30        ["mean_Jpsi", "width_Jpsi"],
31        ["sum::mean_Psi2s(mean_Jpsi,0.584)", "prod::width_Psi2s(width_Jpsi,1.05)"],
32        ["aa", "bb"],
33        ["sig_Jpsi", "sig_Psi2s", "bkg"]
34      ],

```

- Input file and input histogram / tree

- Array of pdfs to be used in the fit
- The last element (**SUM**) indicates the operation among the pdfs

- The parameters of the pdfs have to be set providing the range
- The order is the same as the pdf list
- To set a parameter as constant it is sufficient to use the same value for **parVal**, **parLimMin**, **parLimMax**

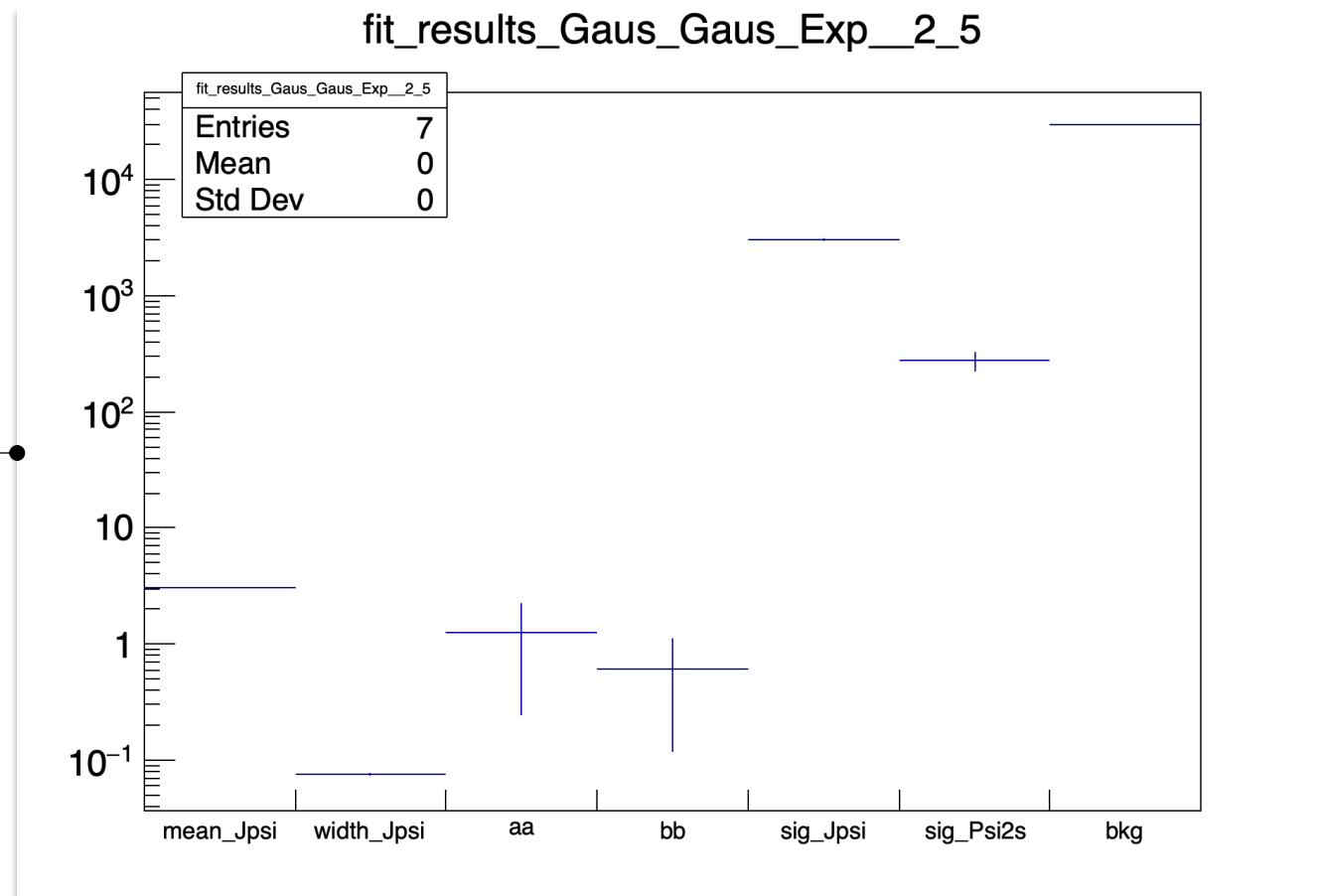
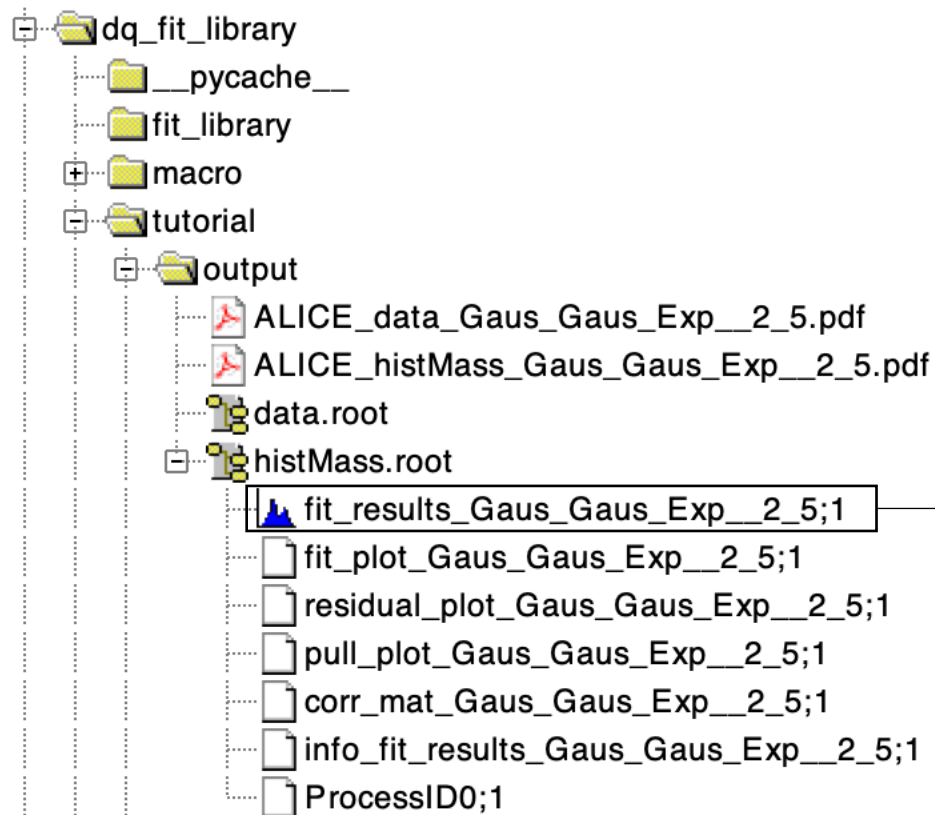
- **parName** embed the constraints:

$$\mu_{\psi(2S)}^{FIT} = \mu_{J/\psi}^{FIT} + \Delta m_{PDG}$$

$$\sigma_{\psi(2S)}^{FIT} = \sigma_{J/\psi}^{FIT} \cdot \left(\frac{\sigma_{\psi(2S)}}{\sigma_{J/\psi}} \right)_{MC}$$

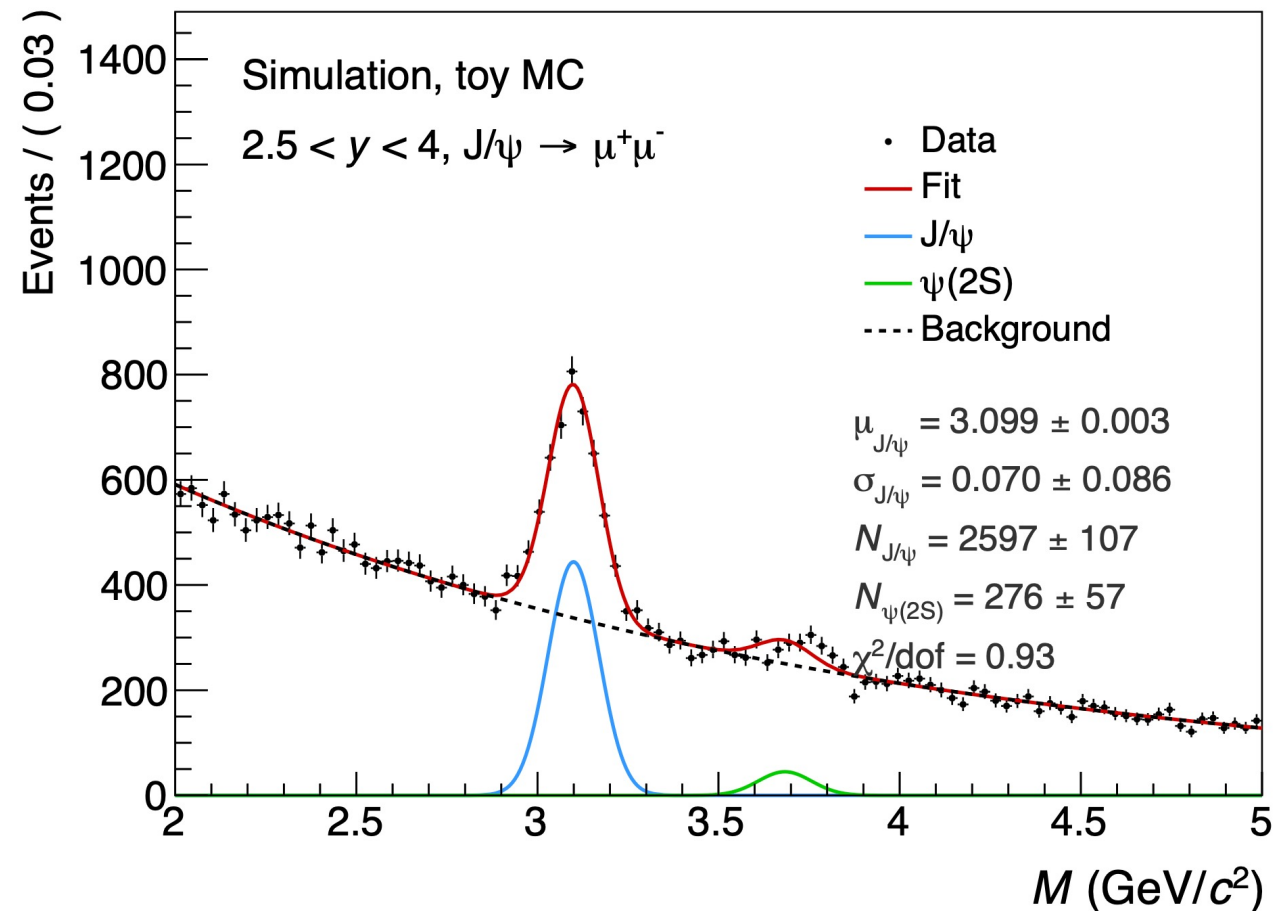
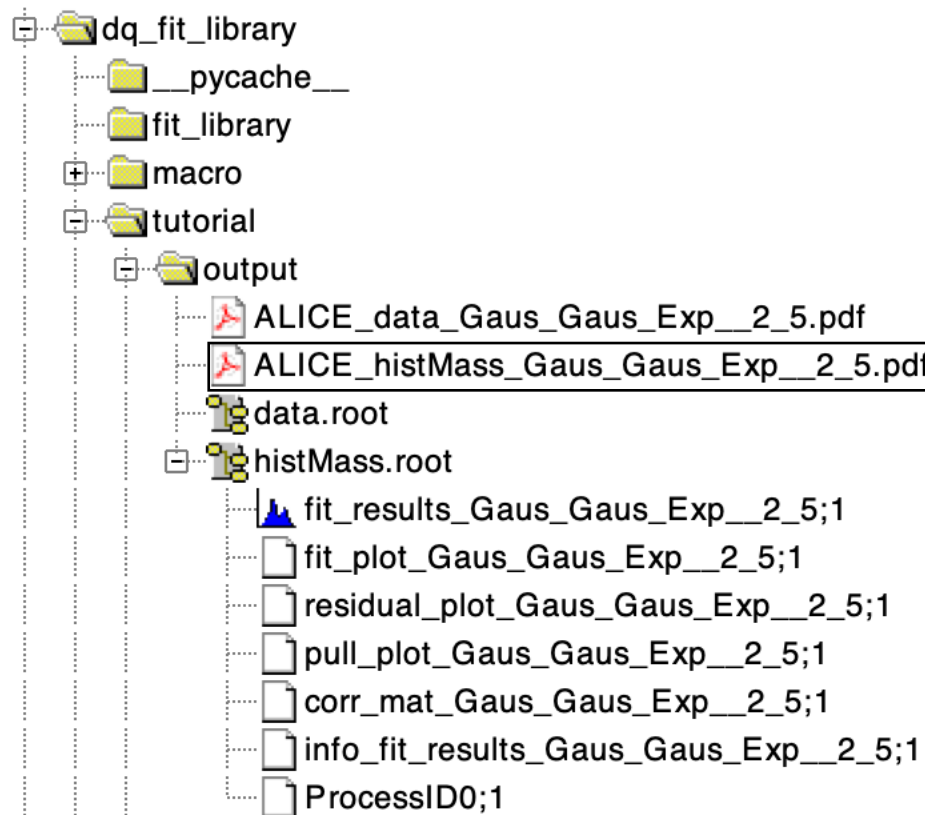
DQ Fitter: output

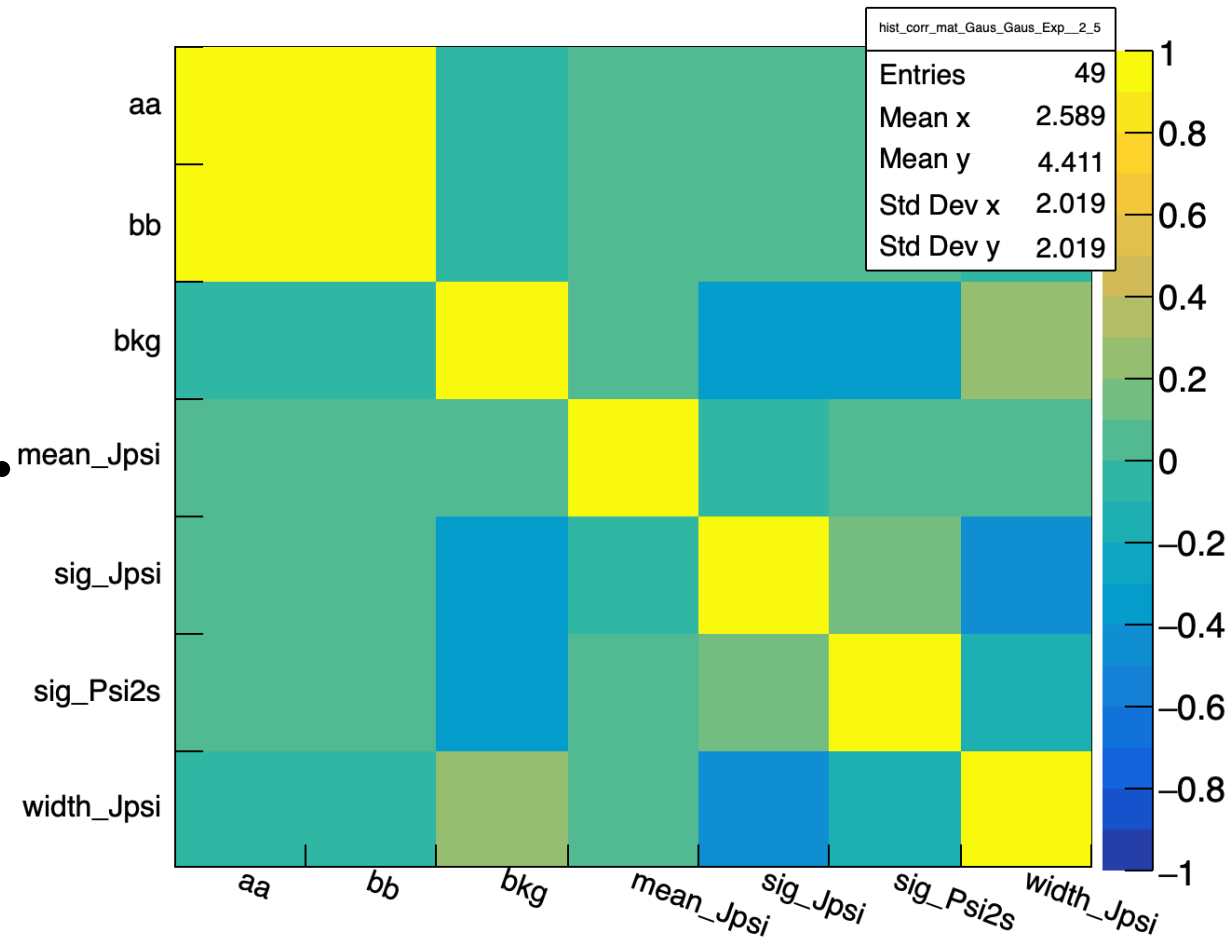
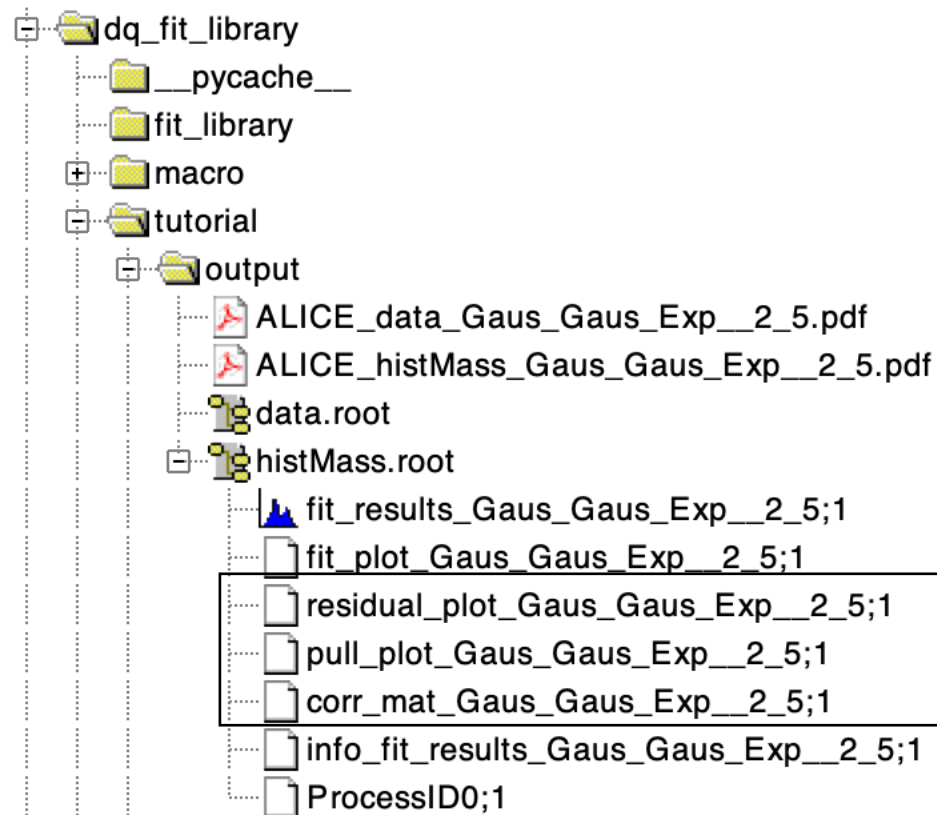
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O2 tutorial



DQ Fitter: output

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28/04/2023
O2 tutorial





- The user can decide to save also the residual plot, the pull plot and the correlation matrix