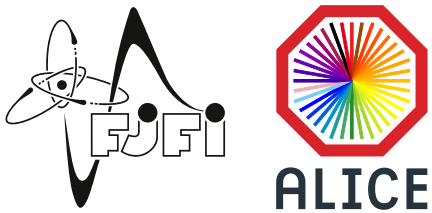
Measurement of charm mesons on ALICE

DUCD23

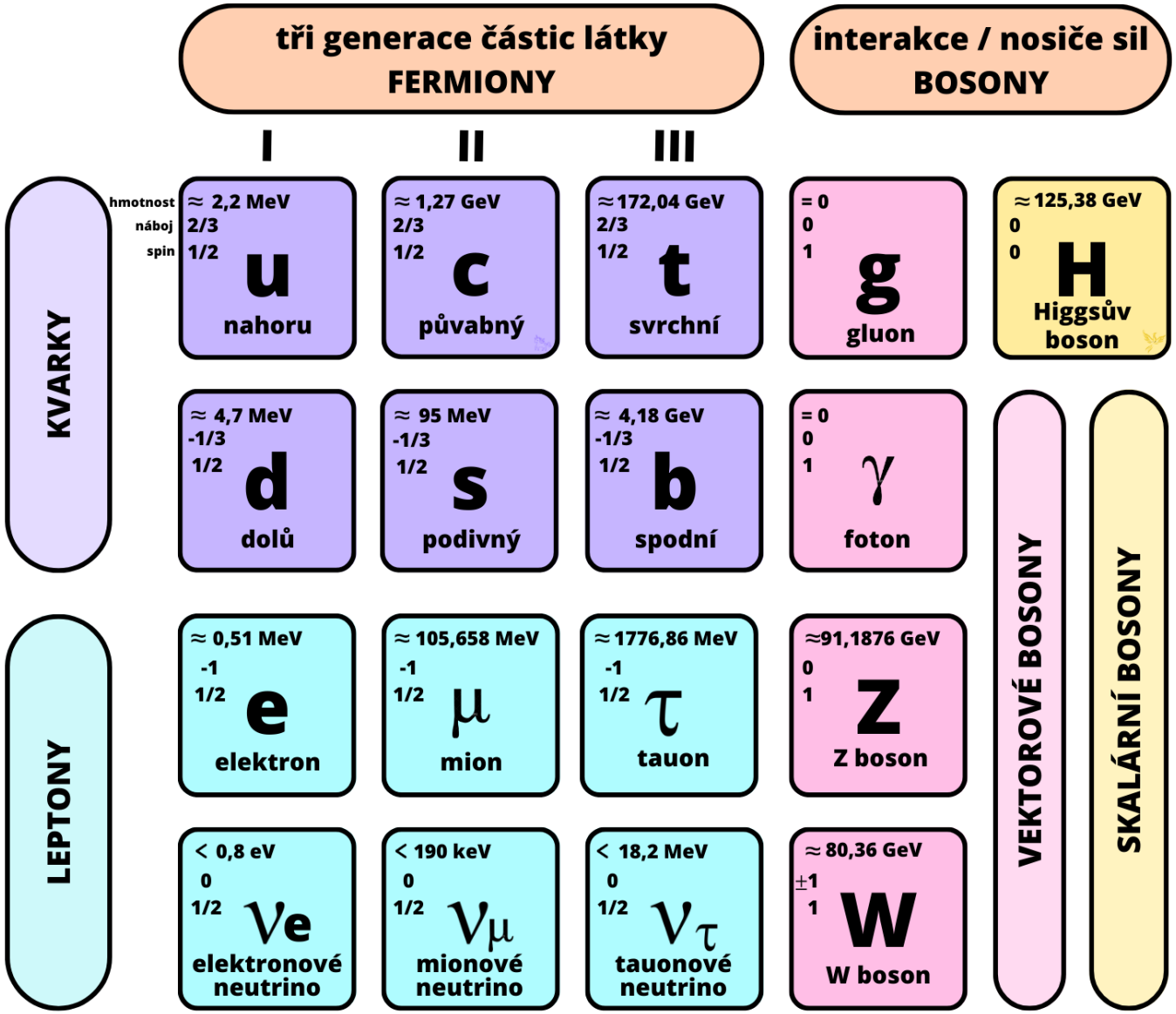
Karla Žertová

14. 9. 2023



Outline

Standard model of elementary particles



Ultra relativistic heavy ion collisions

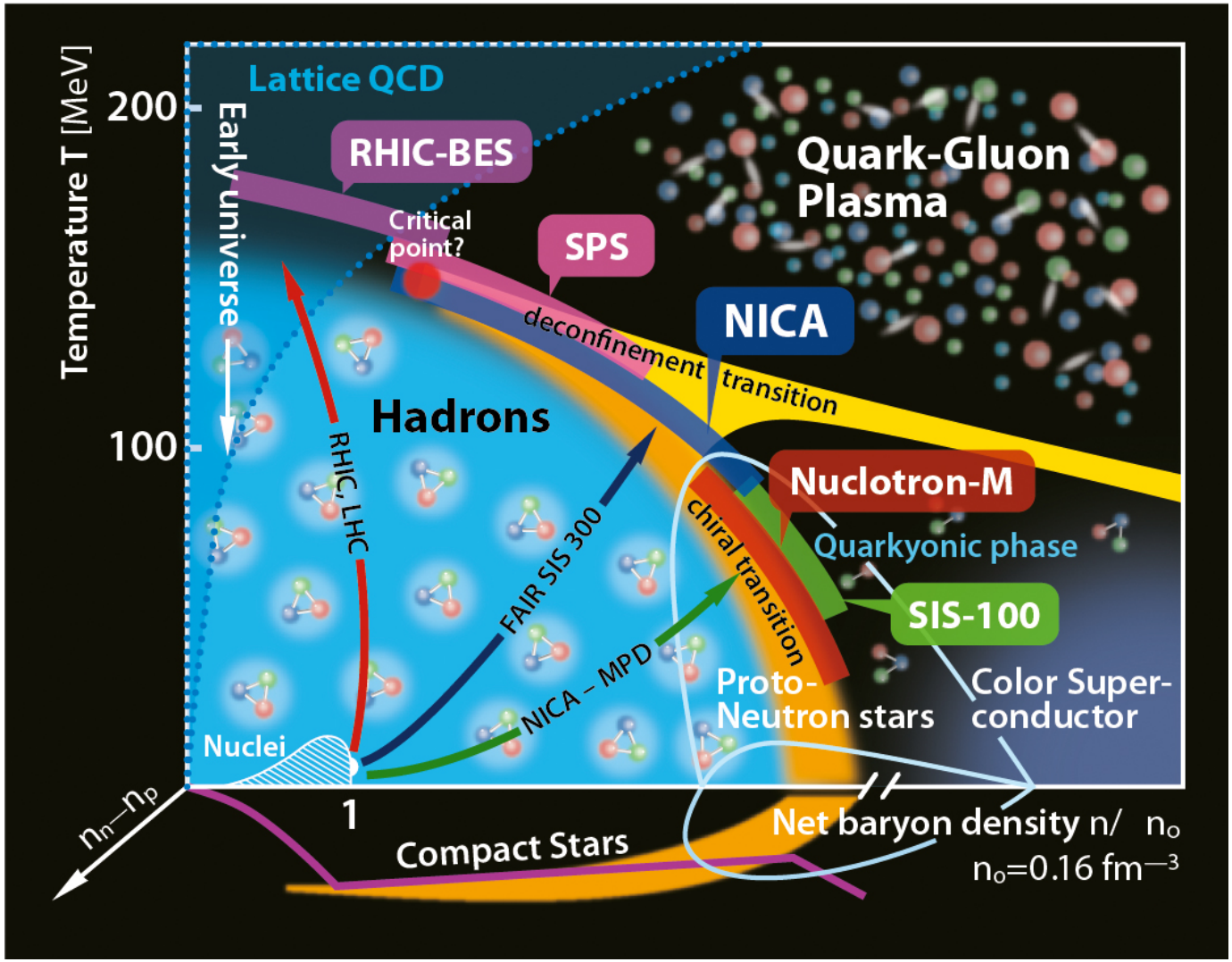
Quark-gluon plasma (QGP)

- matter of quasi-free quarks and gluons at extreme densities and temperatures
- $T_c = 150$ MeV
- Big Bang
- produced in central ultra relativistic ion collisions
- study of strong interaction properties

Particle collisions

- LHC $\rightarrow$ pp, pA, AA

Phase diagram of QGP



Charm mesons

D meson

- c quark/antiquark
- $D^+\,(c\bar{d}), D^0\,(c\bar{u}), D_s^+\,(c\bar{s})$
  - $M(D^0) = 1864,75\ \pm\ 0,15\ \pm\ 0,11\ \mathrm{MeV/c^2}$
  - $M(D^+) = 1869,51\ \pm\ 0,12\ \pm\ 0,07\ \mathrm{MeV/c^2}$
  - $M(D_s^+)\ =\ 1968,19\ \pm\ 0,20\ \pm\ 0,14\ \pm\ 0,08\ \mathrm{MeV/c^2}$
- prompt: primary vertex
- unprompted: $B^+ \to D^-\pi^+\pi^+$
- hard probes

Current measurements of D mesons on ALICE

Fragmentation of c quark

- ALICE in pp collisions mesured production of D^0, D^+,D_s^+, Λ_c^+, Ξ_c^0, D^{*+}
- possible to determine the fragmentation ratio $f(c \to H_c)$
- difference between ee, ep and pp systems

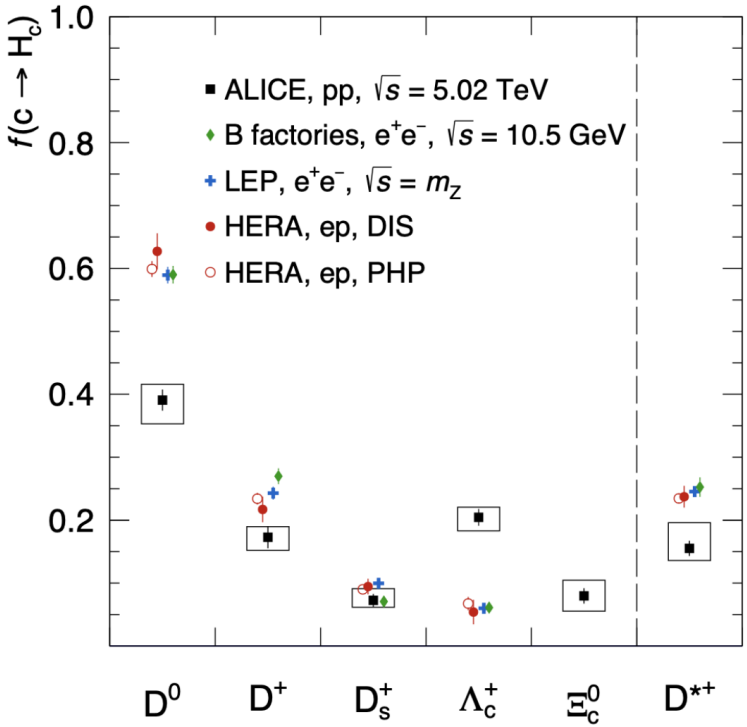


Figure: [1].

Experiment ALICE

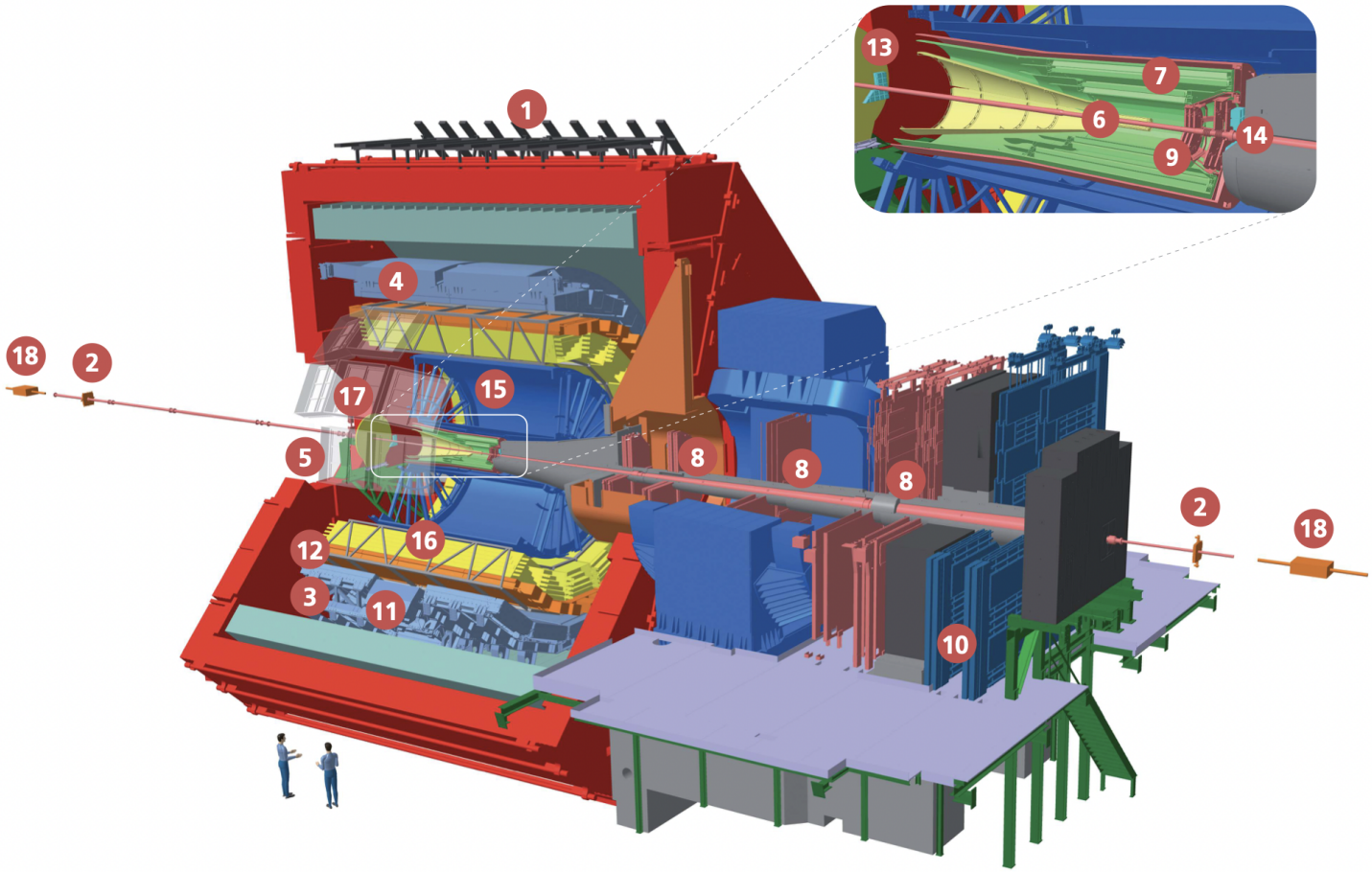


Figure: ITS - 6,7, MFT - 9, TOF - 12, TPC - 15

Run 3

Run 3 (2022-2025)

- new detector MFT
- upgrade of detectors
- continuous read out
- 100times more data compared to Run 1
- new analysis framework: O2Physics

Framework O^2

Principle

- Online-Offline
- installation on a local computer
- CERN server

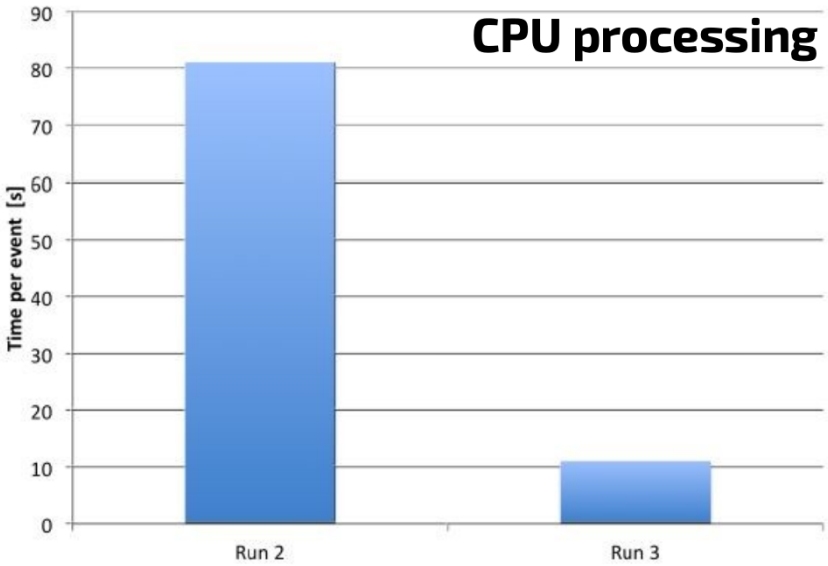
O2Physics

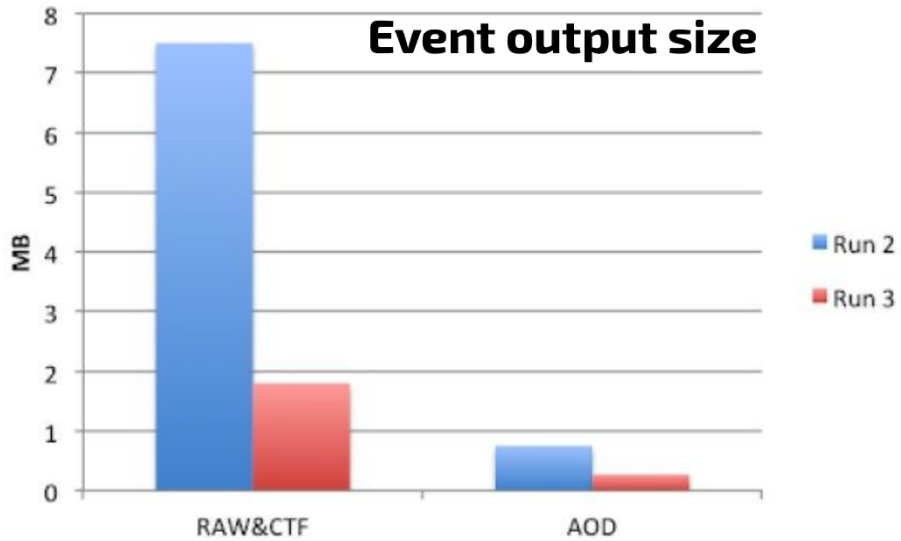
- replace AliPhysics
- collisions and tracks as separate arrays of analysis objects
- flat tables
  - only basic tables saved
  - on-the-fly

O^2 framework

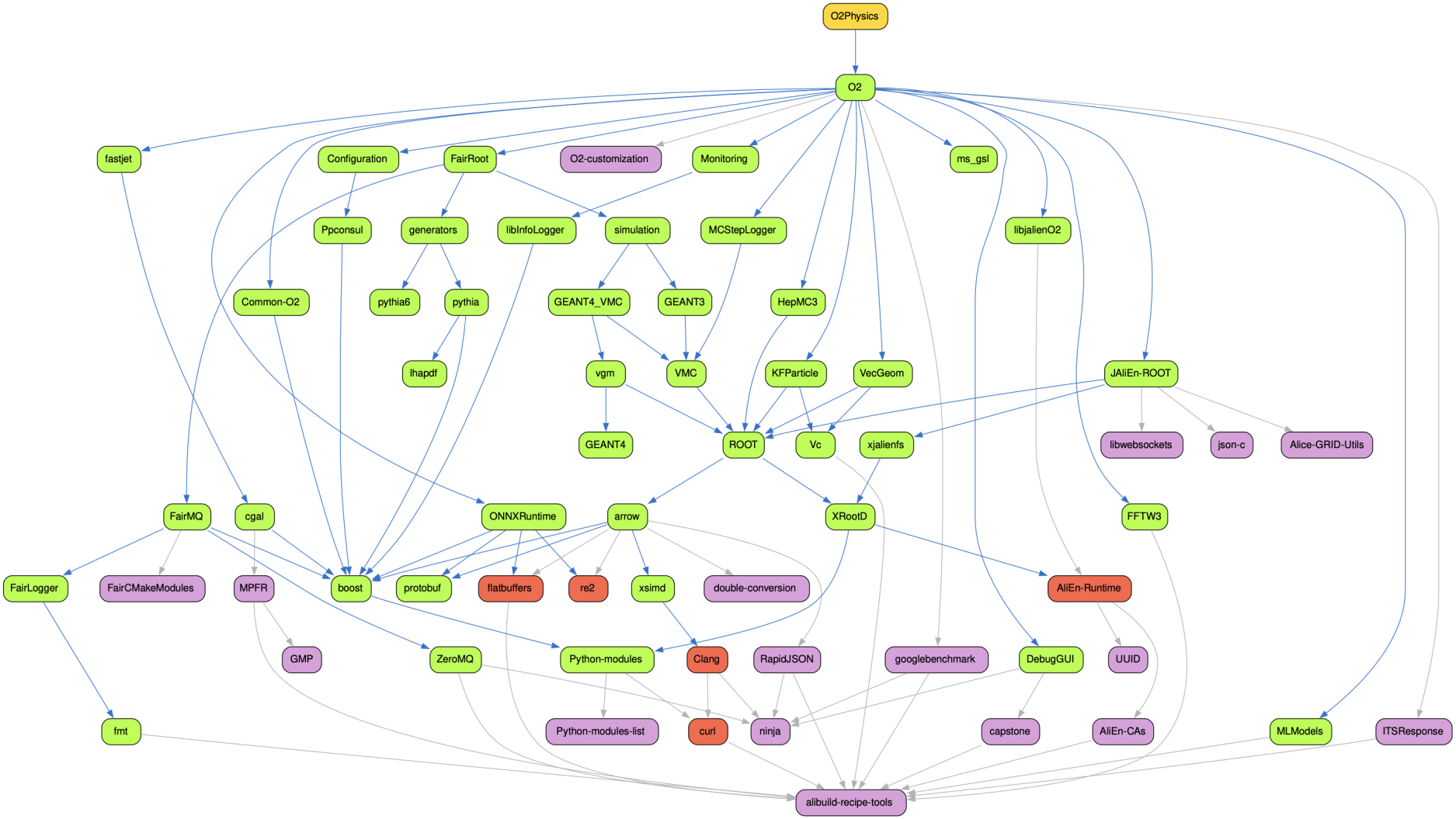
Advantages

- Speeding up processing (5x)
- Rapid reduction of data (3x)





O2Physics dependence



Analysis task

Workflow

- tasks created by end users
- helper tasks
- shared memory

Running an analysis

- `o2-analysis-my-analysis --aod-file AO2D.root`
- `o2-analysis-my-analysis --configuration=json://file.json`

Heavy Flavour analysis - D^0 meson

Decay channel

$$D^0 \rightarrow K^- + \pi^+$$

1. phase

- Rough selection of tracks of charged particle - K, π (η, p_T, ...)

2. phase

- reconstruction of the secondary vertex and selection of daughter particle candidates D mesons

3. phase

- fine selection of D meson candidates (topological selection, PID)

D^0 meson data

MonteCarlo simulated data

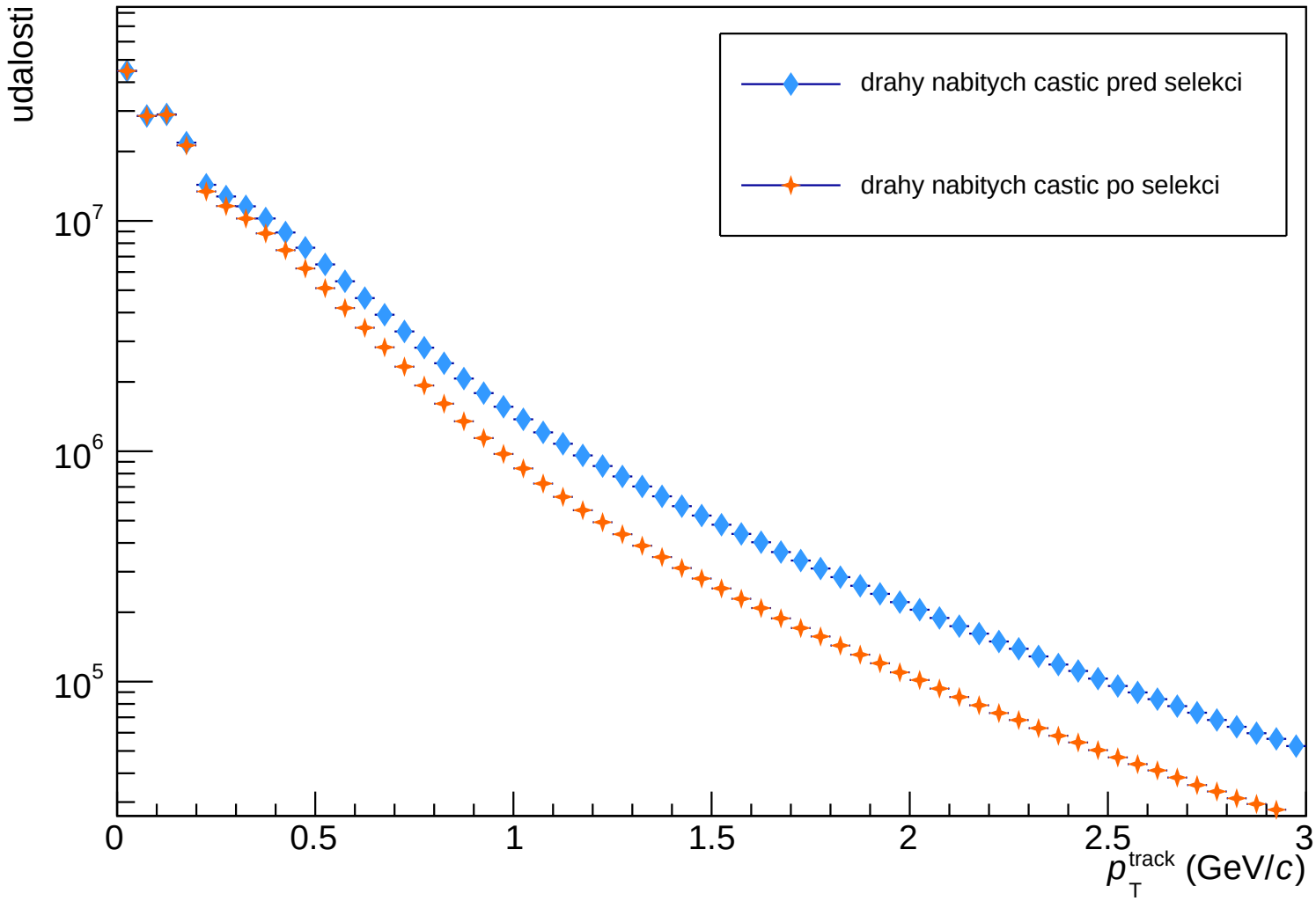
- # collisions = 4 300 436
- path: /alice/sim/2022/LHC22b1b/302008/AOD/001-051
- pp, 13.6 TeV - HF triggers

Rough selection of daughter tracks

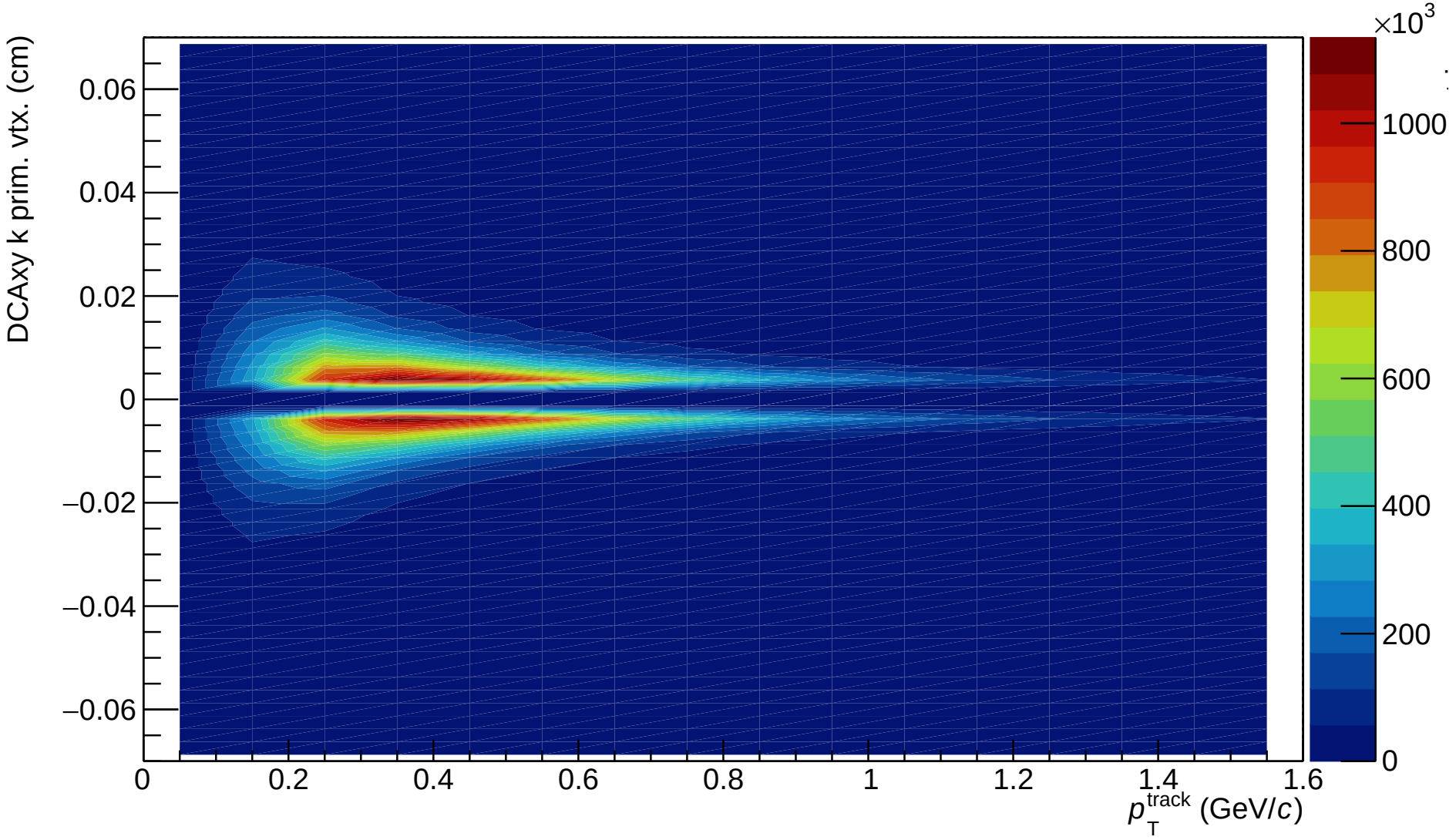
Candidates of daughter tracks

- $p_T > 0$ GeV/c
- $|\eta| < 4$
- $\mathrm{DCA}_{x,y} > 0{,}0025$ cm

pp, 13,6 TeV - MC data



pp, 13,6 TeV - MC data



Fine selection of candidates

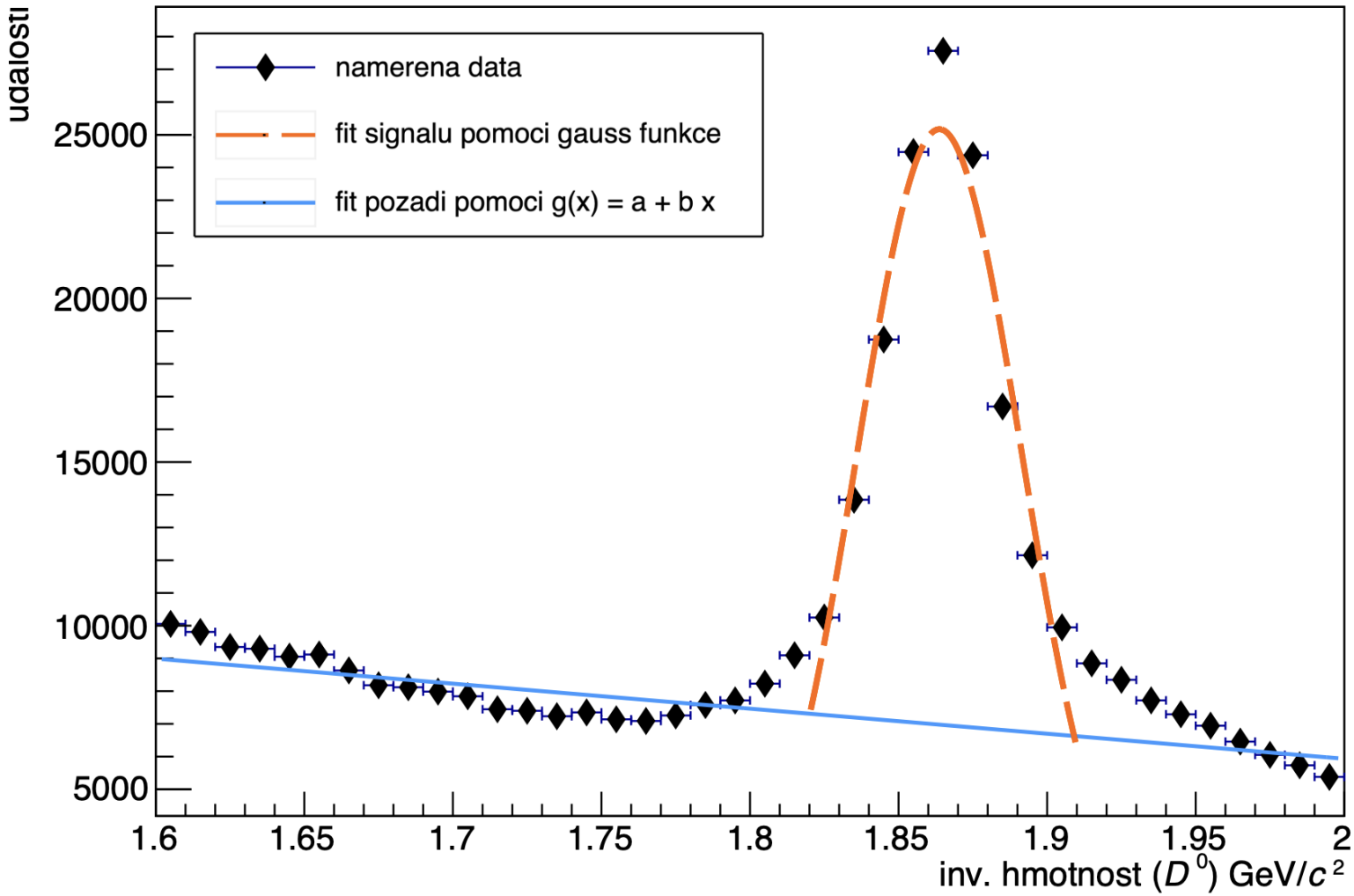
Before

- reconstruction of secondary vertex
- selection of daughter tracks candidates

Candidates of D^0

- $0 < p_T < 50$ GeV/c
- $0,15 < p_{T_{\text{TPC-PID}}}$ GeV/c
- topological selection
- PID of candidates

D^0 mesons Run 3 - MC



Conclusion

Outcome

- fitted mass from MC data: $M(D^0)_{\text{exp}} = 1860 \pm 30$ MeV/c^2
- table value: $M(D^0)_{\text{tab}} = 1864,75 \pm 0,15 \pm 0,11$ MeV/c^2

Creation od analysis task to identify D^0 mesons in the $D^0 \to K^- + \pi^+$ channel and analysis of a MC data set.

Outlook

analysis of real data from Run 3

~ THANK YOU ~

References

[1] Collaboration, ALICE. (2021). Measurement of beauty and charm production in pp collisions at $\sqrt{s} = 5.02$ TeV via non-prompt and prompt D mesons. DOI: 10.1007/JHEP05(2021)220, Published in: JHEP 05 (2021), 220