ALICE R_{AA} Masterclass

A brief overview and introduction

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What do we want to measure





- Charged particle spectra in pp and Pb-Pb collisions
- Building the $R_{\rm AA}$
- Suppression of charged particles in Pb–Pb collisions
- Larger suppression with increasing centrality \rightarrow effect of the QGP!

What do we want to teach (physics wise)

- Basic understanding of elementary particles
- ightarrow Quarks and gluons
- The strong interaction, confinement
- ightarrow Color charge (and how it compares to the electric charge)
- The quark-gluon plasma and asymptotic freedom
- Connection to the early universe
- And of course all upcoming questions







What do we want to teach (experiment)











- The LHC and how a particle accelerator works
- \rightarrow lons accelerated by EM-fields (why use a circular collider)
- How do we measure particles?
- \rightarrow Old bubble chambers and modern TPCs (from ALICE)
- ightarrow Charged particles ionizing gas

What do we want to teach (programming)





Übung:

Führe den Code aus der folgenden Zelle aus und varliere anschließend die Variablen a und b, um alle Möglichkeiten durchzuprobieren:

In [4]: if ab: print('a ist größer als b') elif a=b: print('a und b sind gleichgroß') else: print('b ist größer als a') b ist größer als a')

b ist größer als a



- Due to many events and many tracks per event, counting "by hand" not feasible
- \rightarrow Let the computer do the work
- Specialized programs are needed
- Programming is not as hard as you think! (You don't have to understand how a computer works to start coding)
- Short introduction to Python (numbers, strings, lists and simple commands)

How to use it





Übung:

Führe den Code aus der folgenden Zelle aus und varliere anschließend die Varlablen a und b, um alle Möglichkeiten durchzuprobleren:

In [4]:

```
if a>b:
    print('a ist größer als b')
elif a==b:
    print('a und b sind gleichgroß')
else:
    print('b ist größer als a')
```

b ist größer als a



- Python tutorial and R_{AA} program available on github/Jupyter Notebook: https://github.com/dmuhlhei/ALICE_MC_RAA (only downside: if you are inactive for longer than 10min, your code will be reset)
- Platform independent and can be used for online and offline masterclasses!

Final Results





- R_{AA} as function of centrality for two p_T intervals
- Results from different groups compared to ALICE results
- Discussion of statistical and systematic uncertainties
- Physical interpretation of results (QGP and energy loss)

Offline Masterclasses with ROOT





- Programming not necessary! (However most if the students enjoyed it)
- ROOT needed, therefore computers with **ROOT** are **necessary** (virtual machine also possible but not done yet)
- Counting tracks "per hand" in pp collisions
- Use automated process in Pb-Pb