

Friday - overview

- **Session 1 (9am – 10.20am)**: Group discussion on questions, split into three sections:
 - Machine learning/data science
 - Symmetries
 - ATLAS data analysis
- **Session 2 (10.40am – 12noon)**: In your groups, choose one topic and prepare a short presentation
- **Session 3 (1.20pm – 3pm)**: Deliver presentations, receive certificates, close!

Session 1 instructions

- Split into groups of ~10 students
- Spend time discussion the list of given questions – you might want to make notes!
 - The questions will be on Indico
 - You can look at any slides etc
 - You can look on the internet
- You don't have to answer every question, but you must discuss at least a few questions from each section (ML, symmetries, ATLAS data).
- Think about which question(s) you would like to make a presentation about

Session 2 instructions

- In the same groups, you will prepare a **5 minute presentation** that you will deliver in the afternoon.
 - You will have pens and large paper and will create a poster by hand
 - You will then talk about it for 5 minutes as a group
 - You need to decide who is going to do what:
 - If everyone talks, that is 30 seconds each.
 - Or, some people might make the poster and some people might give the talk
 - You should practice your presentation - do it a few times out loud!
- 5 minutes is **NOT LONG!** Choose one or two questions to focus on and don't try to do too much

Session 3 instructions

- Each group delivers their presentation!
- Tips:
 - Make the poster clear and nice to look at from a distance
 - When talking, look at people in the room and project your voice
 - Smile and enjoy it 😊
- We will then give everyone a certificate

Topic 1: Data Science and ML

- **What is data science - what does it mean to you?**
- What is machine learning?
- What do the following ML terms mean?
 - Task
 - Model
 - Feature
 - Instance
 - Label
 - Training/test split
 - Supervised vs unsupervised learning
 - Hyperparameters
 - Overfitting
- Can you name some different ML tasks?
- Can you name some different ML models

Topic 1: Data Science and ML

- What kind of academic disciplines use data science for what purposes
- What kind of non academic disciplines use data science and for what purposes
- How can data science and ML support sustainability and the SDG?
- What are the privacy consideration of using data science and ML
- In the different data science domains discuss the potential to draw incorrect conclusions. What would be the result and how can we mitigate this
- Are there other examples where data science and AI can lead to negative implications.
- How can data science and ML be used to improve education? healthcare?

Topic 2: Symmetries

- What is a symmetry generally, what do we mean when we say something has a symmetry?
- What is a discrete symmetry, and what is a continuous symmetry?
- How is symmetry realised in physics?
- What does it mean is something is invariant under
 - Space translation
 - Time translation
 - Rotation translation?
- What is Noether's theorem?
- What conservation laws arise because something is invariant under
 - Space translation
 - Time translation
 - Rotation translation?

Topic 2: Symmetries

- What does mean when a particle is invariant under the following:
 - Parity
 - Charge
 - Time
- Can you explain why parity is not conserved (parity violation) in beta decay?
- What is gauge symmetry? What does it conserve?
- What gauge bosons pop out when we conserve
 - Colour (SU(3))
 - Weak Isospin (SU(2))
 - Hypercharge (U(1))
 - And you should find TWO gauge bosons that mix together to reveal two KNOWN neutral gauge bosons (weak, and em)
- Do you know the role of Higgs boson in this?

Topic 3: ATLAS and Data Analysis

- What is the LHC and what is ATLAS? What is the goal of the experiment?
- What is dark matter?
- How can it be produced in a proton proton collision at LHC and how is it detected?
- What's the structure of the proton?
- Why collider protons at the LHC? Can you think of other particles we could collide with a new accelerator that would produce net resting results?
- What other particles can we create at the LHC?
- How do we detect quarks and gluons?
- What is the goal of cut-based optimisation analysis?
- How do we identify important variables for analyses?
- Can you think of a different analysis you would like to do? To study which particle?

Topic 3: ATLAS and Data Analysis

- If you were an experimental physicist in 10 years what would you like to search for?
- Can you imagine a new machine or experiment to detect some particle, force or phenomena (maybe even string theory)?