

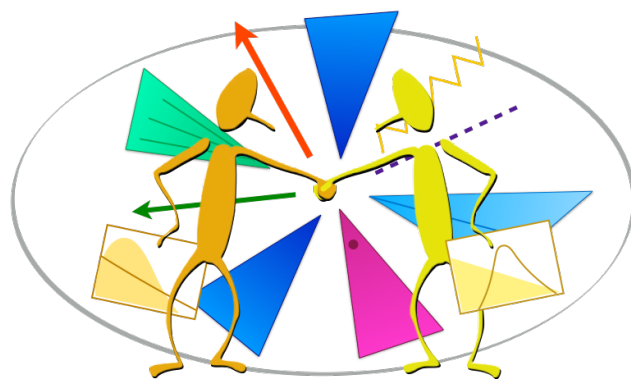


# Analysis Description Language Tutorial & Hackathon

21-22 Nov 2022, Kyungpook National University, Center for HEP

## Welcome and Motivation

Sezen Sekmen (KNU)



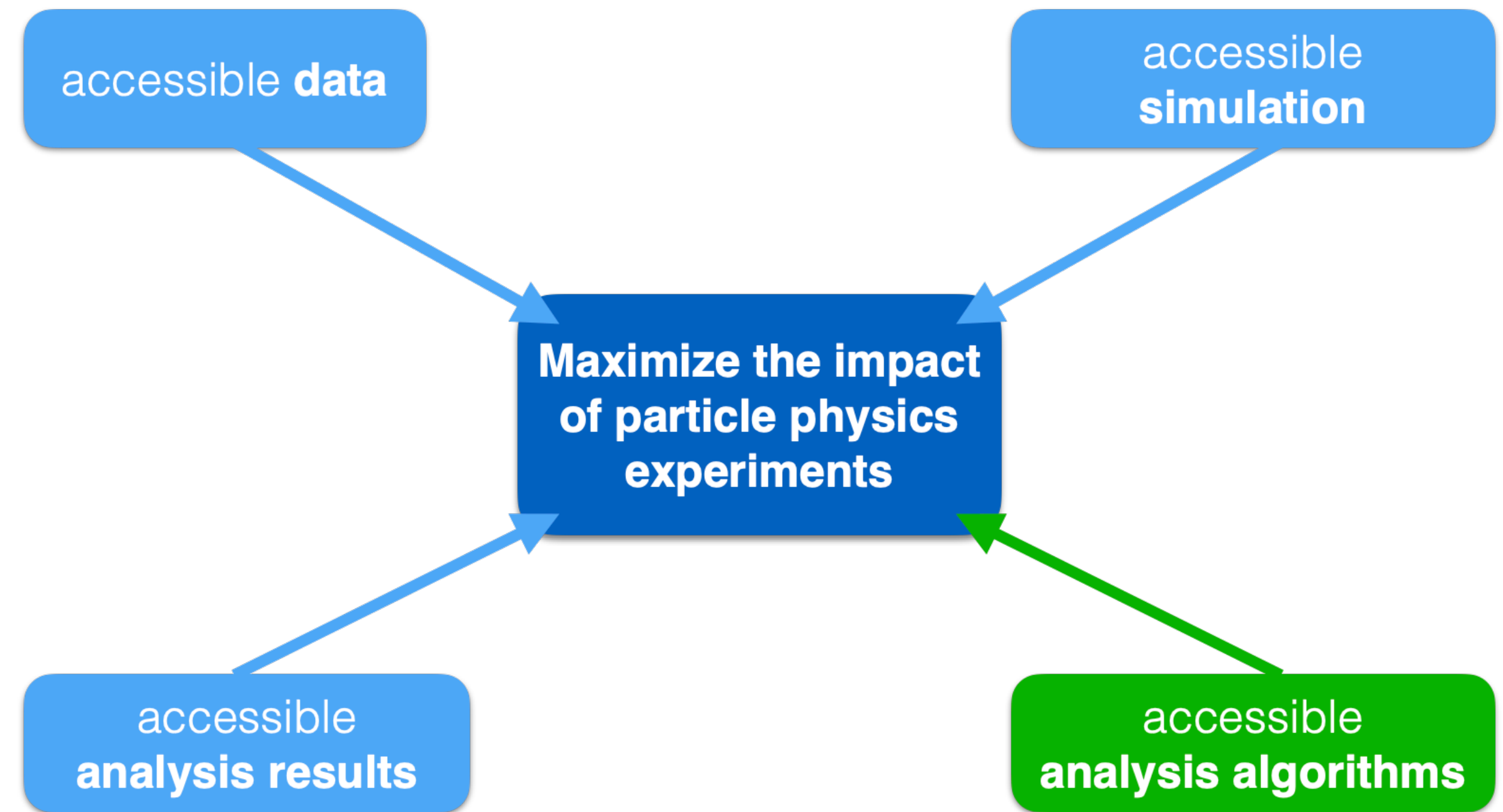
# Why this event?



Particle physics data are created by different experiments and analyzed in thousands of different ways.

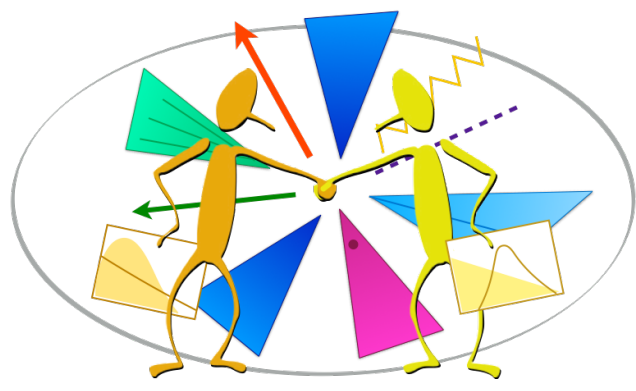
- > Tremendous physics heritage.
- > Inspires new ideas.
- > the more we explore, the more we add to scientific knowledge.

We must fulfil practical requirements to **maximize the scientific impact of particle physics analyses.**



**This event**

*This event focuses on a method to make analysis algorithms accessible.*



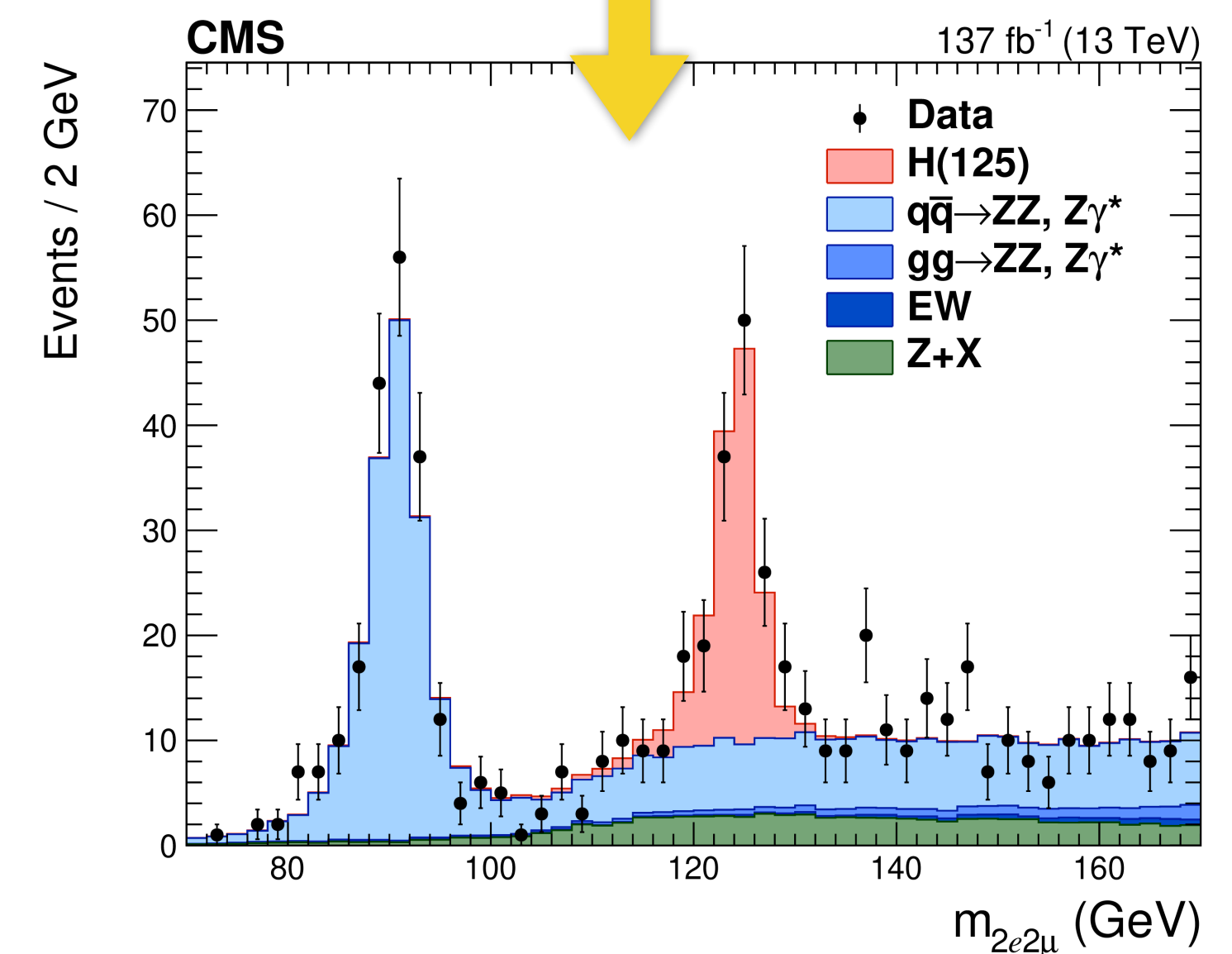
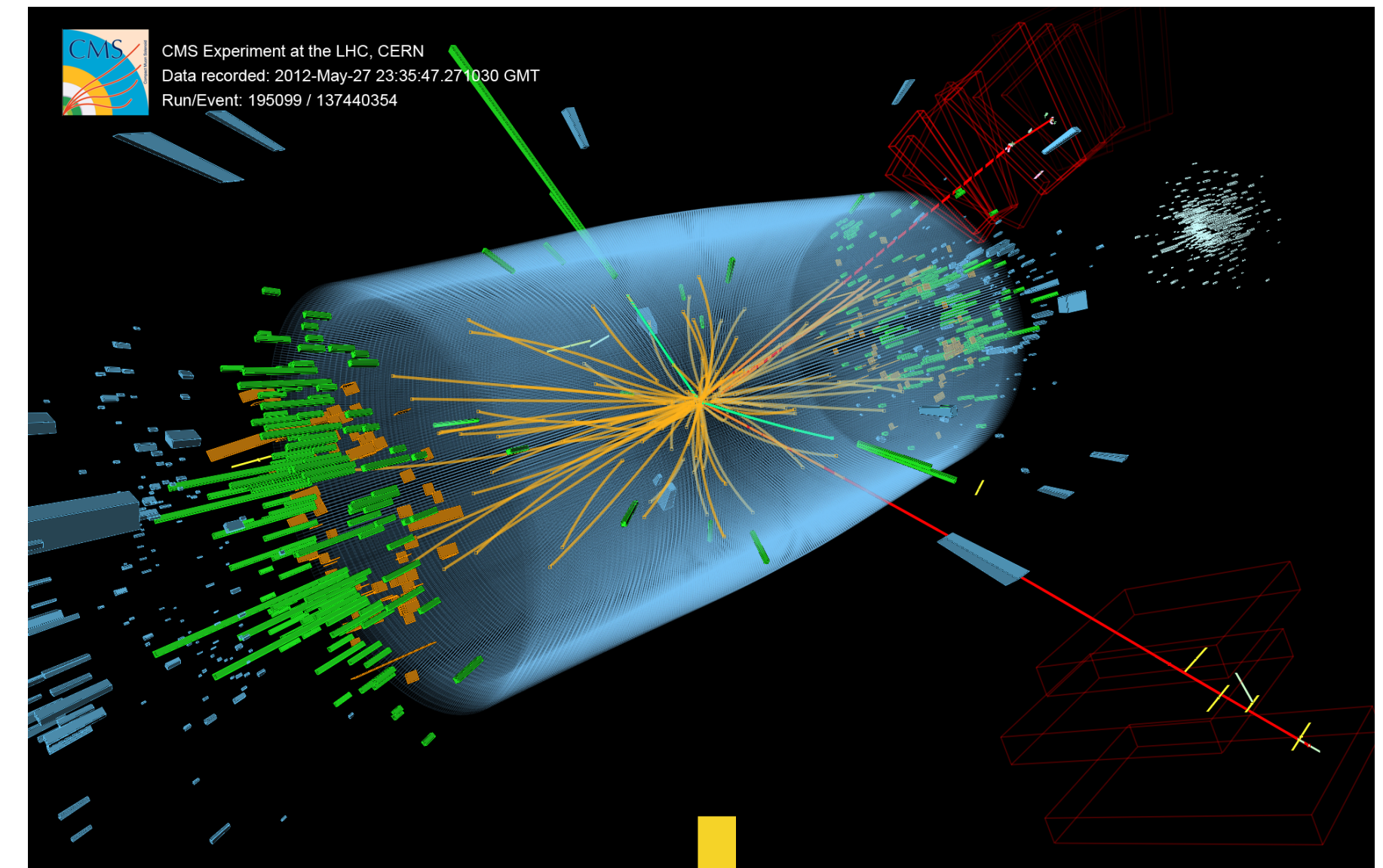
# Analysis physics algorithms



Particle physics analyses require processing independent ensembles of data products called **events** from real and simulated particle interactions.

The **analysis physics algorithm** includes

- **defining analysis objects**
- **defining quantities** based on event properties
- **selecting events**
- **re-weighting simulated events** to improve their agreement with real collision events,
- **estimating backgrounds**
- **statistical analysis** to interpret experimental results by comparing them to predictions.



# Welcome to the analysis jungle

Inclusive analyses  
with hundreds of  
selection regions

Overlaps between  
different analyses?

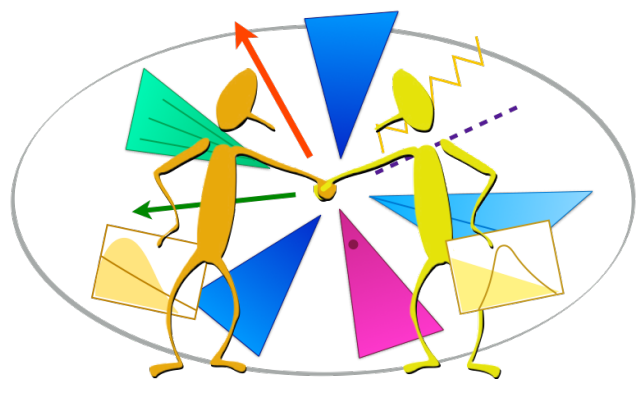
Multiple analyses  
exploring similar  
final states

Is my control region  
your signal  
region???

Many alternative  
definitions for  
analysis objects

Many variables,  
ambiguous  
definitions

...we can get better organized to work more efficiently!

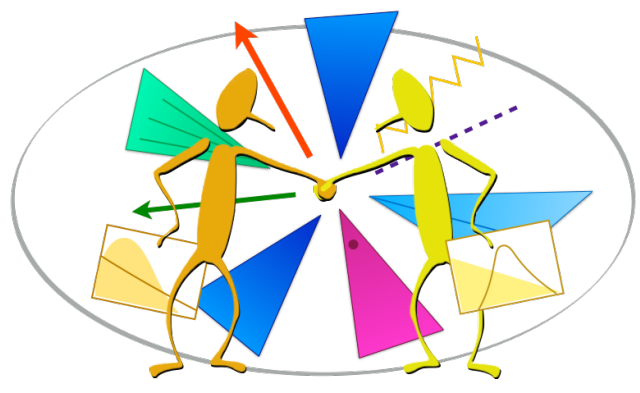


# Analysis physics algorithms are useful



Having analysis physics algorithms available in a clear and easily accessible way is very useful. We can

- Easily communicate design details within our own analysis team. Spot errors quickly!
- Easily communicate our analysis with other colleagues, reviewers.
- Learn many other analyses easily.
- Understand how our analysis is similar or different from the others.
- Perform (re)interpretation studies.
- Perform creative studies using multiple analyses simultaneously.
- Remember how the analysis was done after 20 years!



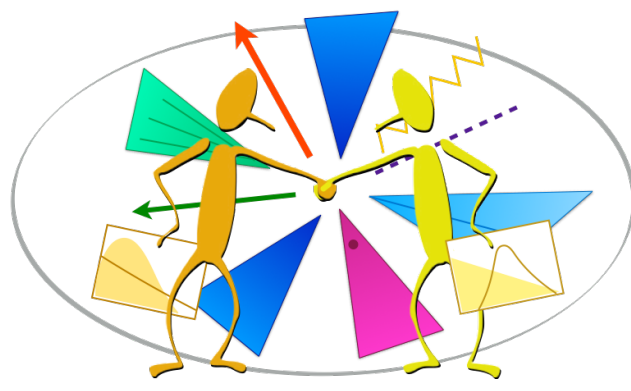
# Are our analysis algorithms accessible?



We write / document analysis physics algorithms in following media:

- Analysis code:
  - Not always easy to decipher and maintain. Usually **private**.
  - **Physics content and technical operations are intertwined** and handled together.
  - Everyone's code is different.
- Publications / papers:
  - Only conceptual descriptions. **Not enough exact technical detail**.
- Internal documents in experiments (e.g. analysis note):
  - More detail compared to papers, but does not always provide the exact technical description. Usually in **draft mode**, and not accessible outside the experiments.

Could there be **an alternative approach**?



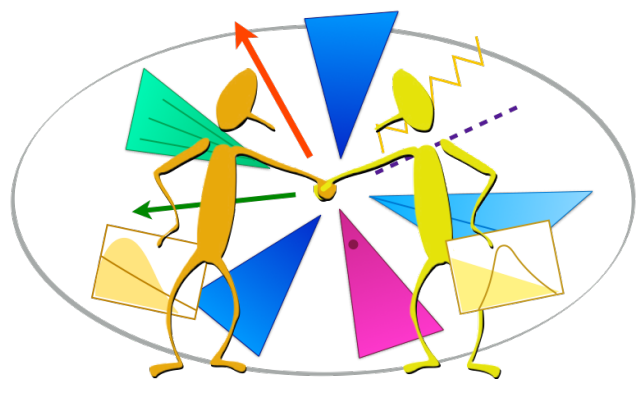
# Analysis Description Language



Our suggestion for a clear and accessible analysis physics algorithm description:

## Analysis Description Language

a **dedicated language** with a **human readable syntax** designed to describe the physics algorithm of a particle physics analysis in a **standard and unambiguous** way.



## Event program: 1st day



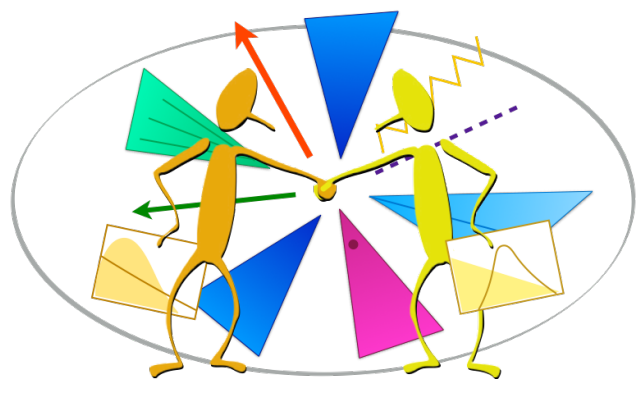
This tutorial & hackathon includes **tutorials, hands-on exercises and discussions on ADL.**

Participants will also **implement selected analyses in ADL.**

1st day:

- **Tutorial:** Understand what ADL is, what it looks like, where and how it can be used.
- **Tutorial:** Learn about CutLang, the tool that can run ADL analyses on events.
- **Hands-on:** Study simple ADL file examples to learn ADL syntax.  
Run these on events using CutLang.
- **Hands-on:** Run a complete CMS analysis using ADL/CutLang on CMS Open Data events.
- **Discussion:** Select an analysis for for implementation.



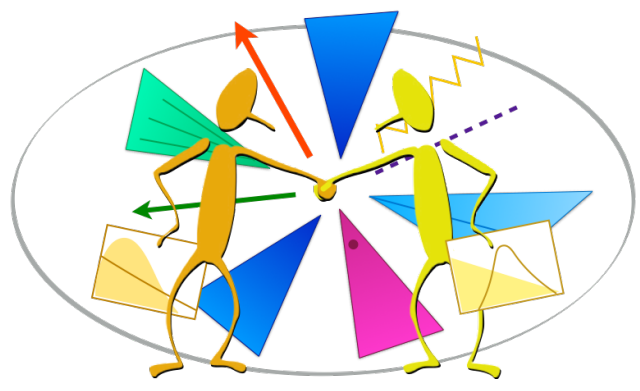


## Event program: 2nd day



### 2nd day:

- **Hands-on:** Free work session on implementing your analysis on ADL/CutLang.
- **Discussion:** Discuss implementation issues, questions, suggestions.
- **Discussion:** Using ADL/CutLang for (re)interpretation of experimental search results.  
Large scale validation of ADL/CutLang analyses using SModelS EM-creator
- **Discussion:** Creative uses of ADL to push boundaries of particle physics analysis.



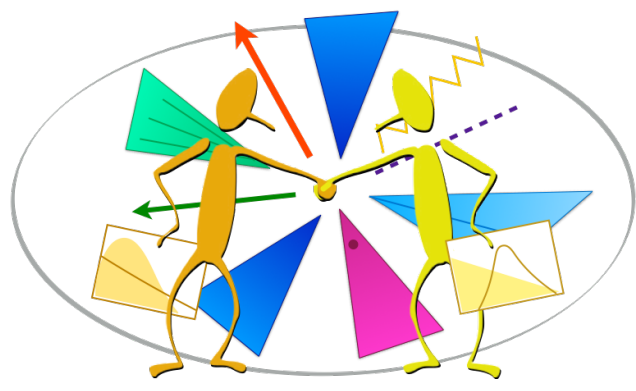
# Practical information: Mattermost



We will have technical discussions using **Mattermost**.

Please join the workshop channel!

- Join the “**ADL/CutLang**” team by clicking the following link:  
[https://mattermost.web.cern.ch/signup\\_user\\_complete/?id=ocuxdq3xabr49p3x5wy1qj9a1y](https://mattermost.web.cern.ch/signup_user_complete/?id=ocuxdq3xabr49p3x5wy1qj9a1y)
- Join the “**ADL/CL @KNU'22**” channel by
  - either browsing the channels via the “+” sign near ADL/CutLang channel name.
  - or clicking  
<https://mattermost.web.cern.ch/adlcutlang/channels/adlcl--knu22>



# Practical information: Docker



We will perform hands-on ADL exercises using **CutLang** and **CMS Open Data** on the environment-independent platform **Docker**.

We will use a **Docker container** that hosts **CutLang**, **ROOT** and **open data access**.

- install Docker desktop from <https://www.docker.com/>
- More information on installing Docker and basic operations can be found in: <https://cms-opendata-workshop.github.io/workshop2022-lesson-docker/02-installing-docker/index.html>
- Follow the instructions below for installing the CutLang / ROOT / Open Data Docker container: <https://cms-opendata-workshop.github.io/workshop2022-lesson-run2-adlcl/02-installing-cutlang/index.html>



# THANKS!



A big THANK YOU to everyone contributing to this event!

- Gökhan Ünel, Changgi Huh, Junghyun Lee, Harrison Prosper  
— for creating and presenting the tutorial & hackathon content.
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- All of you participants  
— for your curiosity on ADL and contributions to discussions.



Let's get started!