MAKING DETECTOR - CORRECTED MEASUREMENTS USING THE LHC DATA

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WHAT DID WE REALLY DO?

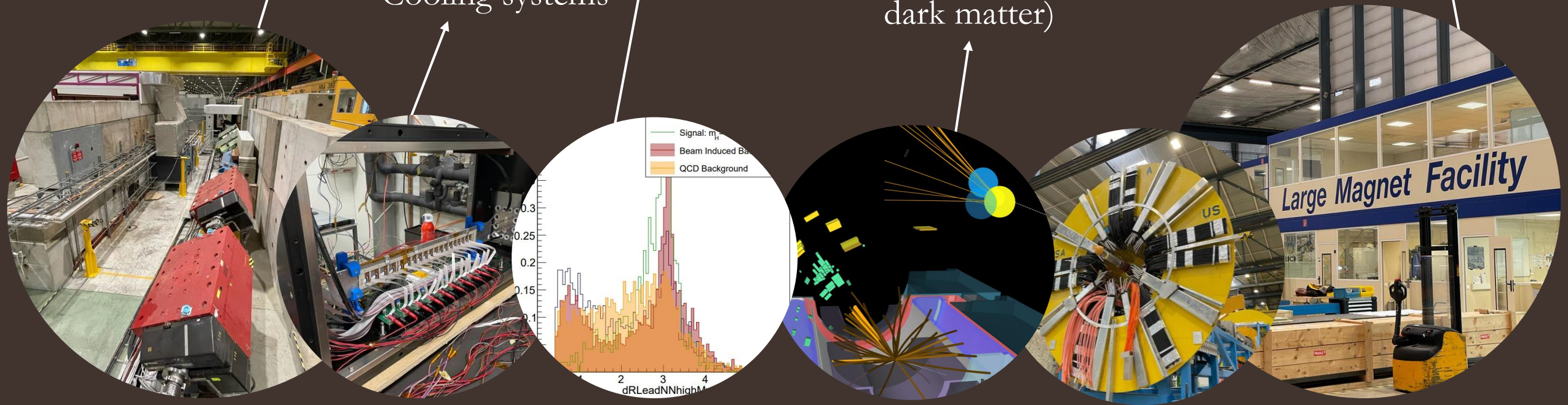
How do we design new detectors? (the North Area)

Cooling systems

Designing searches (separating signal from background)

Measurements (studying neutrinos & dark matter)

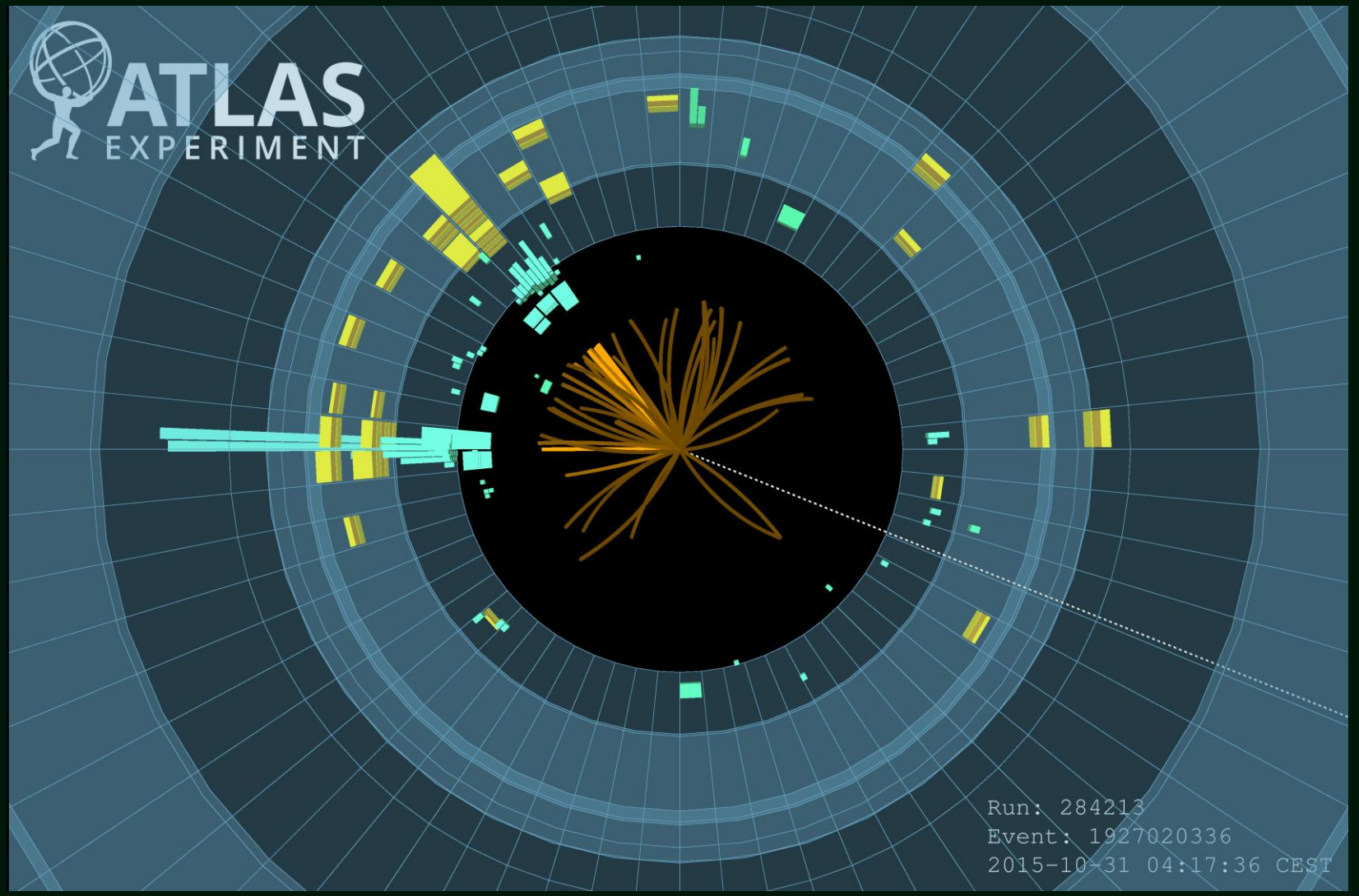
Visiting ATLAS, Large Magnet Facility, the North Area



MEASUREMENTS
NEUTRINOS & DARK MATTER

During the proton-proton collisions, many processes can occur. We are looking to find out if the Standard Model explains well those that happen in nature. ATLAS is specifically designed to detect particles, but some of the outcome, such as invisible particles, may escape it unnoticed.

HOW DO WE KNOW THEY'RE HERE?

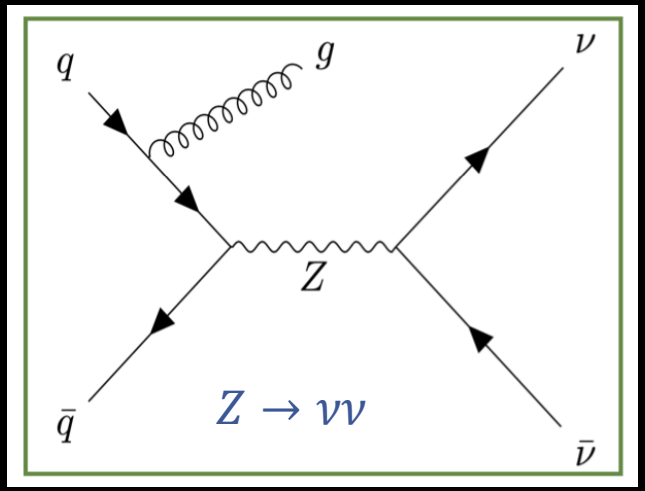


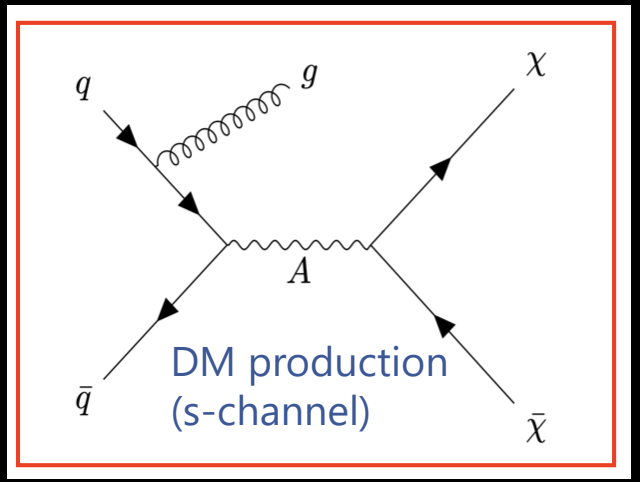
We obviously cannot see them.

But we can indirectly notice them by measuring their missing energy (or mass) when proton-proton collisions occur.

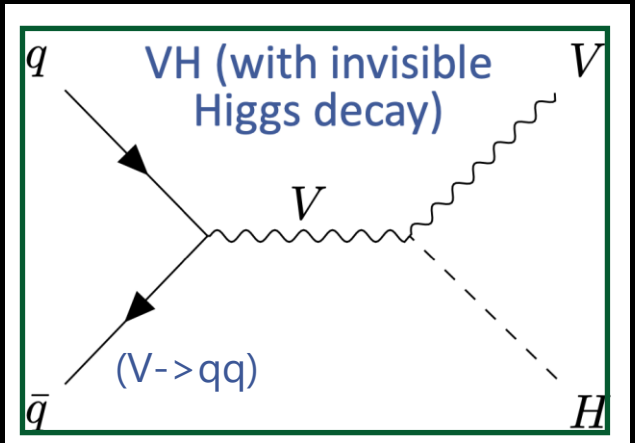
Standard Model

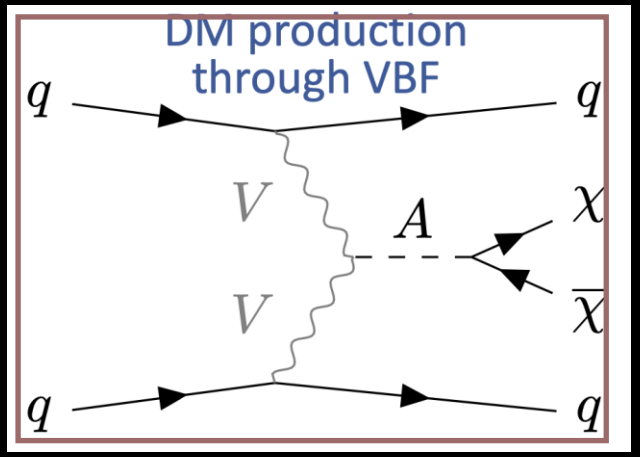
Dark Matter (DM) Production





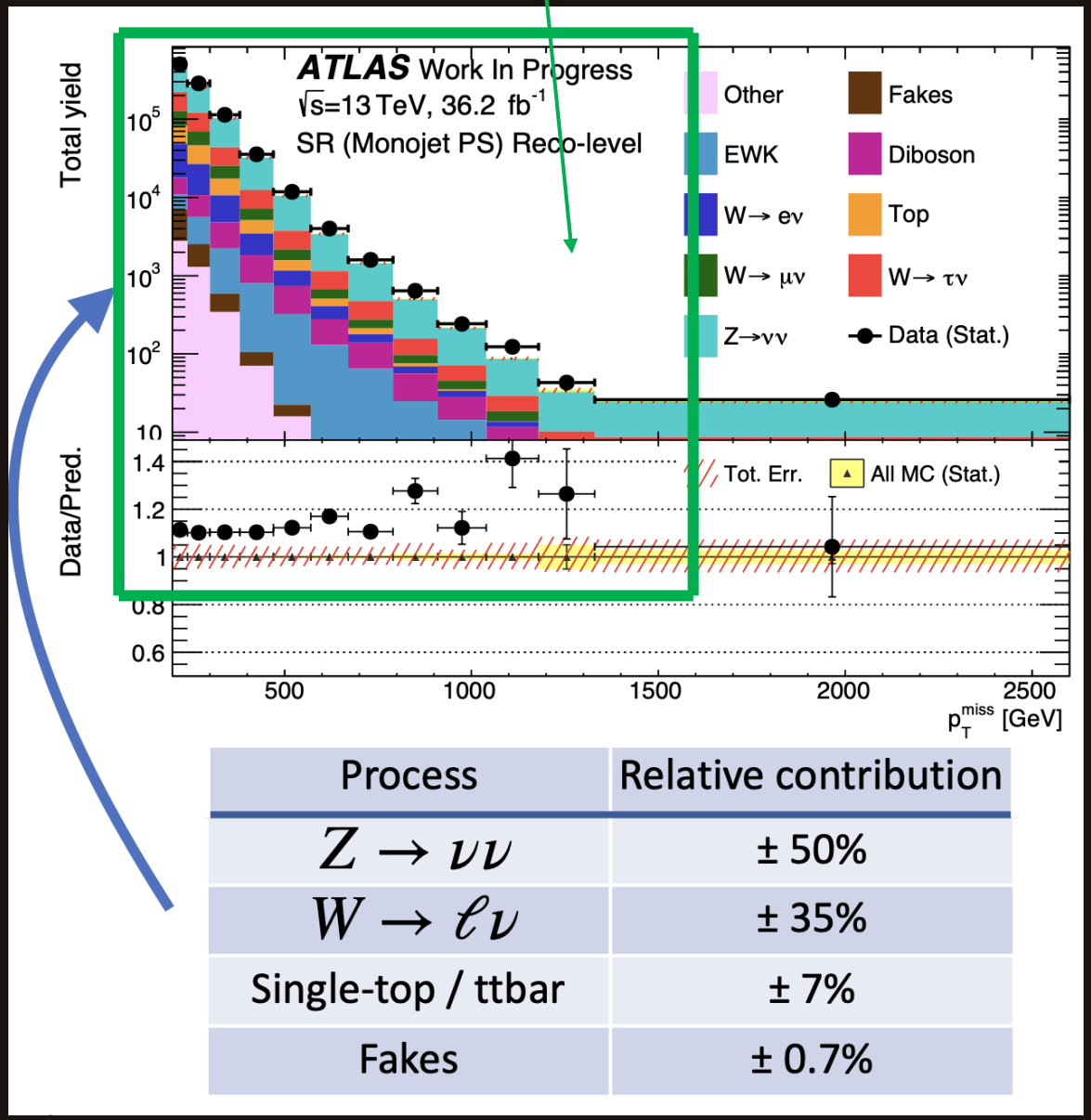
Missing energy + 1 jet





Missing energy + 2 jets

WORK IN PROGRESS



Process	Relative contribution
$Z \rightarrow \nu\nu$	± 50%
$W \rightarrow \ell\nu$	± 35%
Single-top / ttbar	± 7%
Fakes	± 0.7%

Here you can see how we're looking for abnormalities in the data we collect, using statistical models & predictions.

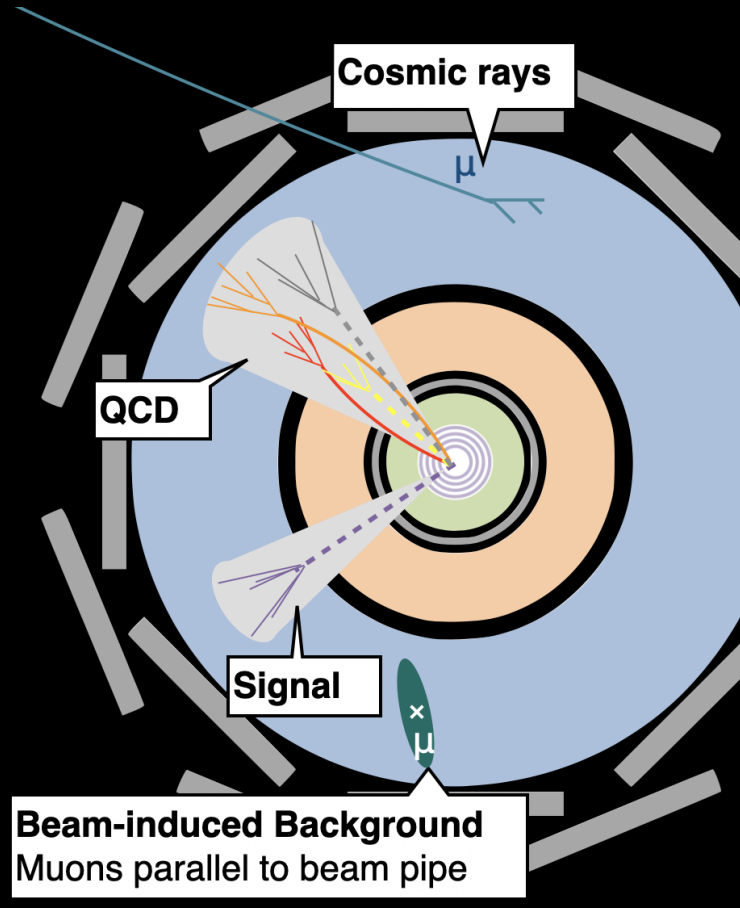
DARK MATTER OR MISMODELLING?

```
    counter+=1
    varValue = getattr(signalEvent, var)
    histogram_signal1.Fill(varValue)
    print(var , varValue)
    if counter > maxEvent : break


  counter=0
  for backgroundEvent in background1Tree:
    counter+=1
    varValue = getattr(backgroundEvent, var)
    histogram_background1.Fill(varValue)
    print(var , varValue)
    if counter > maxEvent : break


  counter=0
  for signalEvent in signal2Tree:
    counter+=1
    varValue = getattr(signalEvent, var)
    histogram_signal2.Fill(varValue)
    print(var , varValue)
    if counter > maxEvent : break


  counter=0
  for backgroundEvent in background2Tree:
    counter+=1
    varValue = getattr(backgroundEvent, var)
    histogram_background2.Fill(varValue)
    print(var , varValue)
    if counter > maxEvent : break


  histograms_background1[var] = histogram_background1
  histograms_signal1[var] = histogram_signal1
  histograms_background2[var] = histogram_background2
  histograms_signal2[var] = histogram_signal2


  c = r.TCanvas("c","c", 500, 500)

for var, ranges in listOfVariables.items():
  histograms_signal1[var].Draw()
  histograms_background1[var].Draw("same")
  histograms_signal2[var].Draw("same")
  histograms_background2[var].Draw("same")

  c.Print(var+".pdf")
```

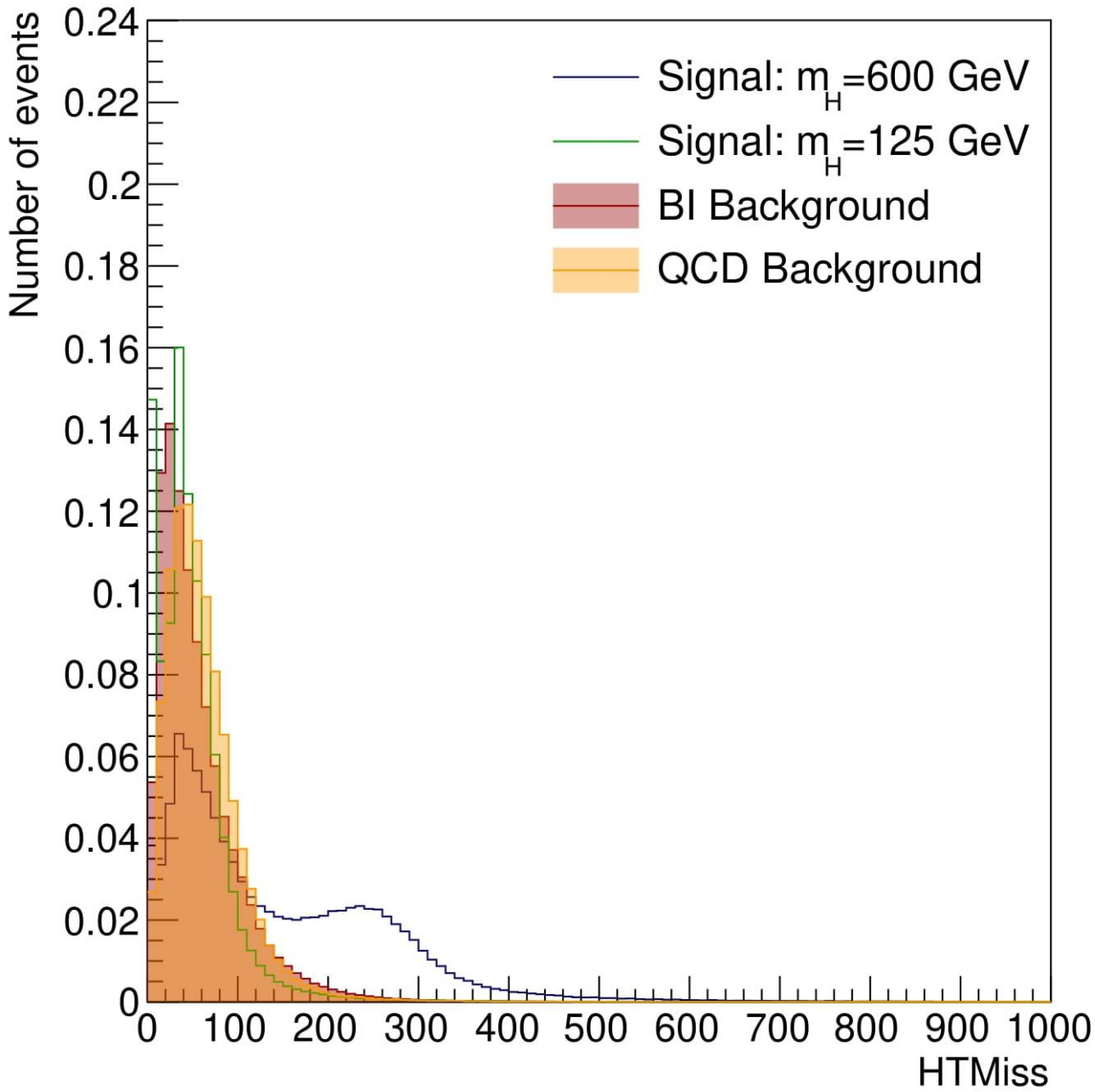
DESIGNING SEARCHES SEPARATING SIGNAL FROM BACKGROUND

SOFTWARE

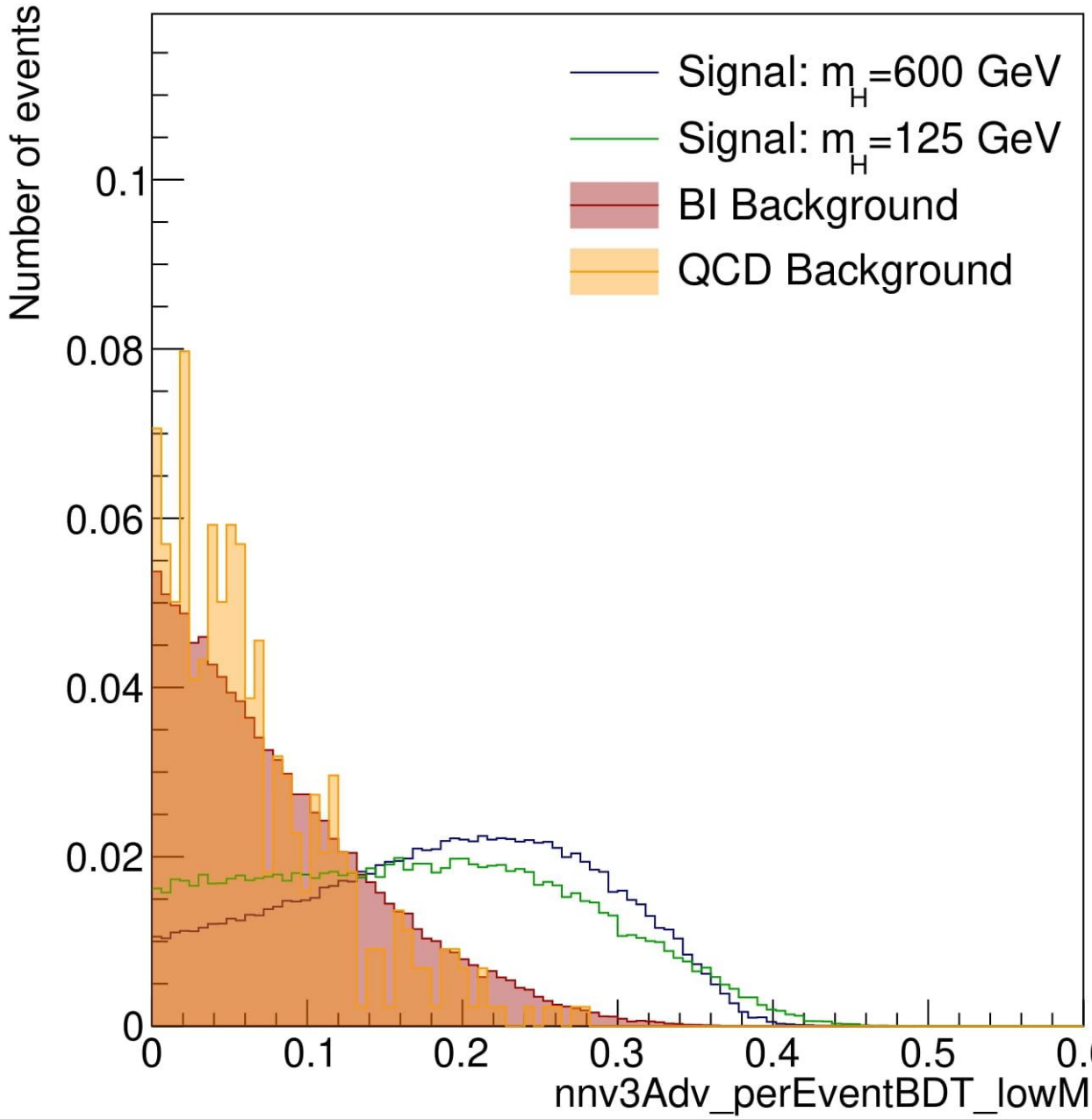
We used simulated LHC data in order to create selections which could be used to ease the search for long-lived particles from proton-proton collisions in ATLAS.



The search for long-lived particles

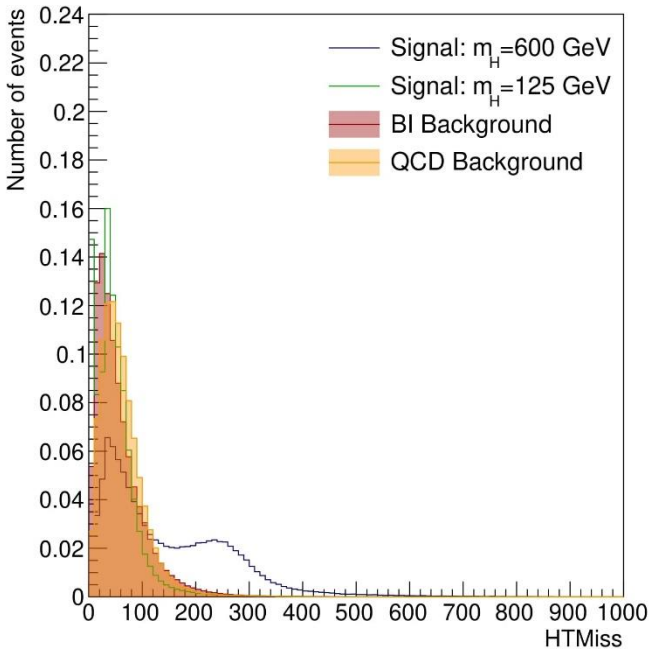


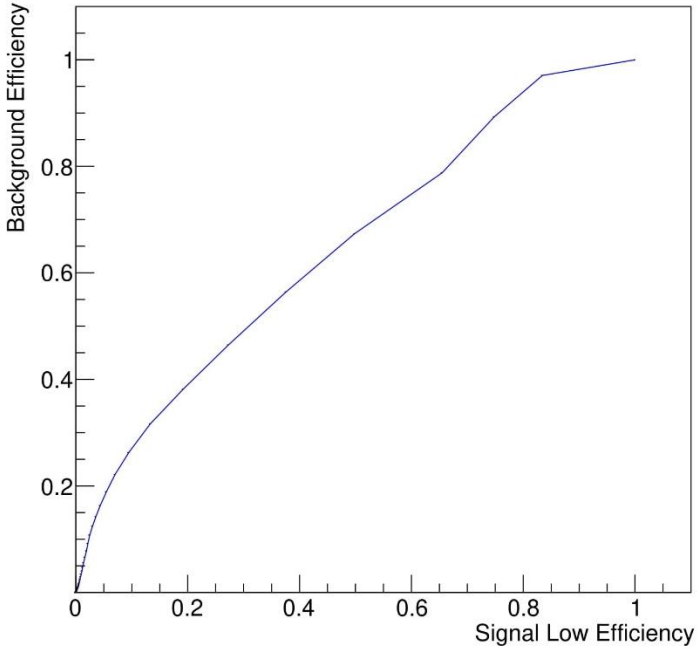
The search for long-lived particles



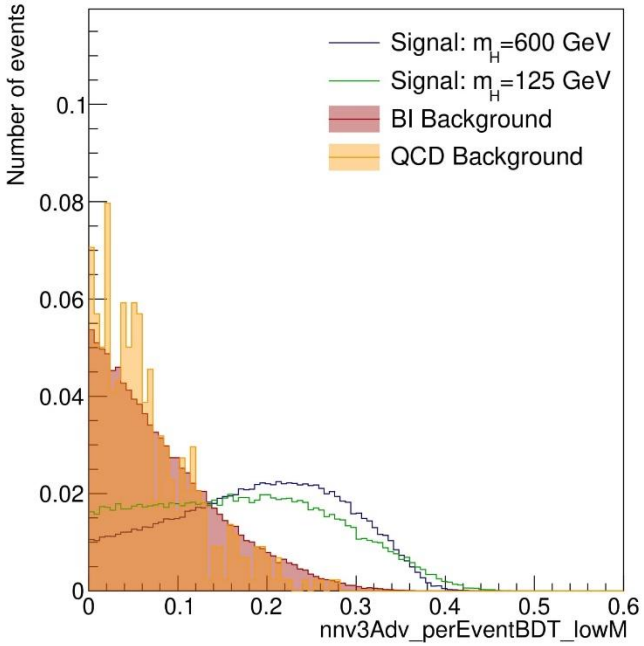
AI-assisted selection targeting low mass signal particles

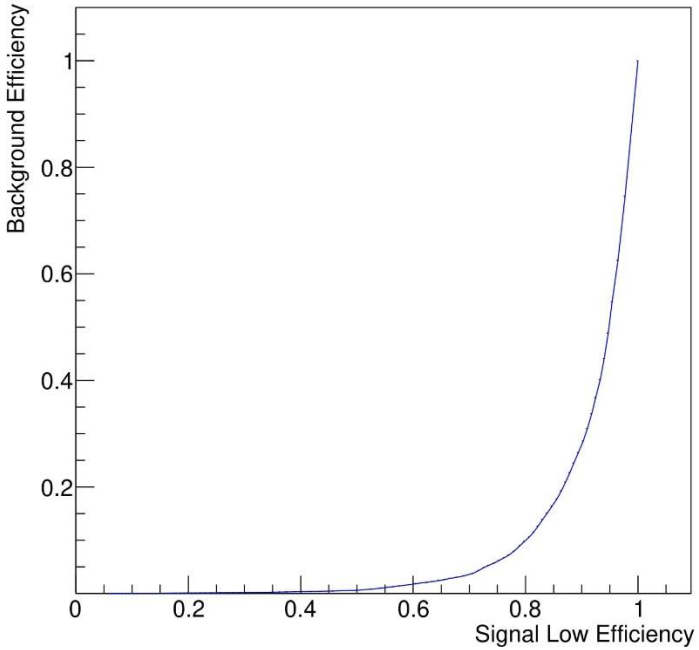
The search for long-lived particles





The search for long-lived particles

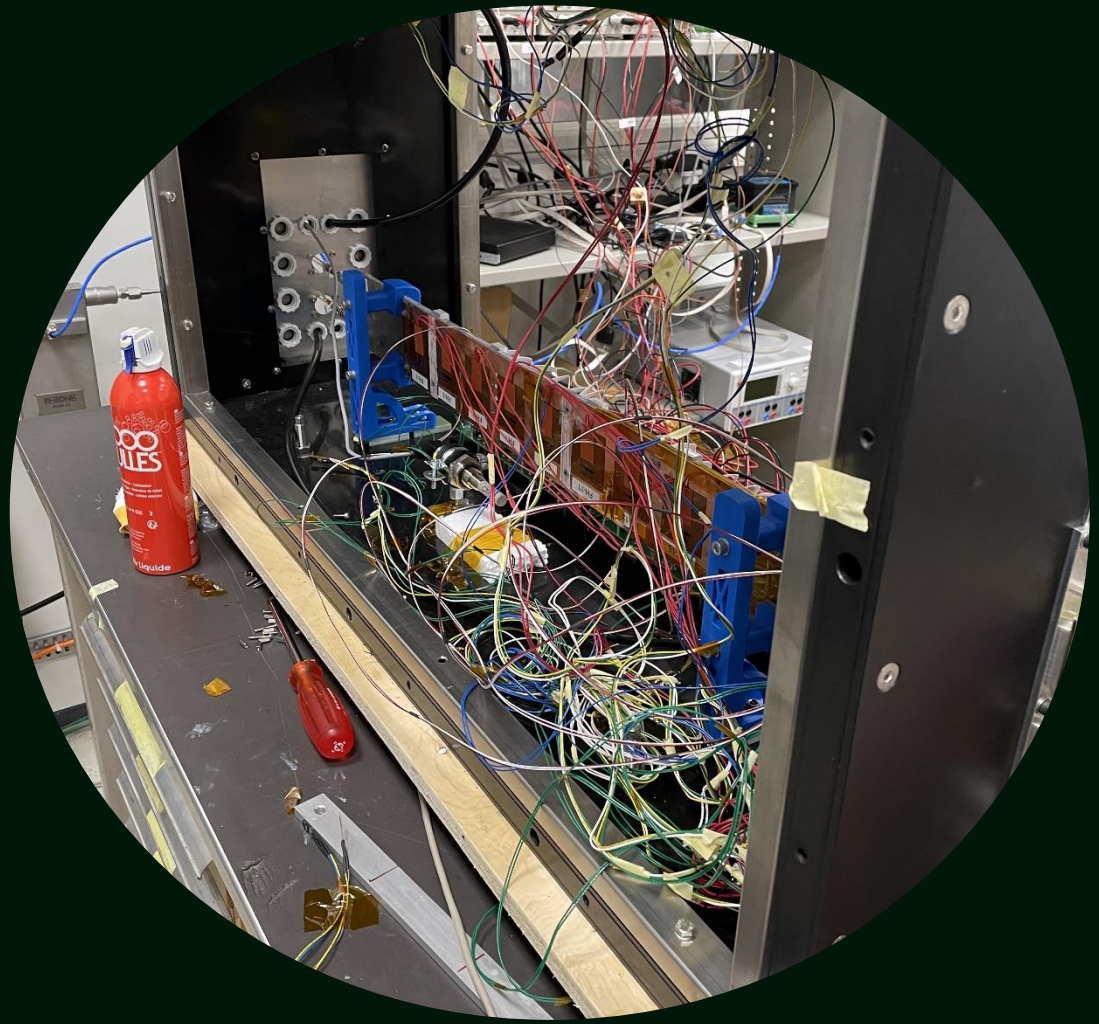




NEW DETECTORS

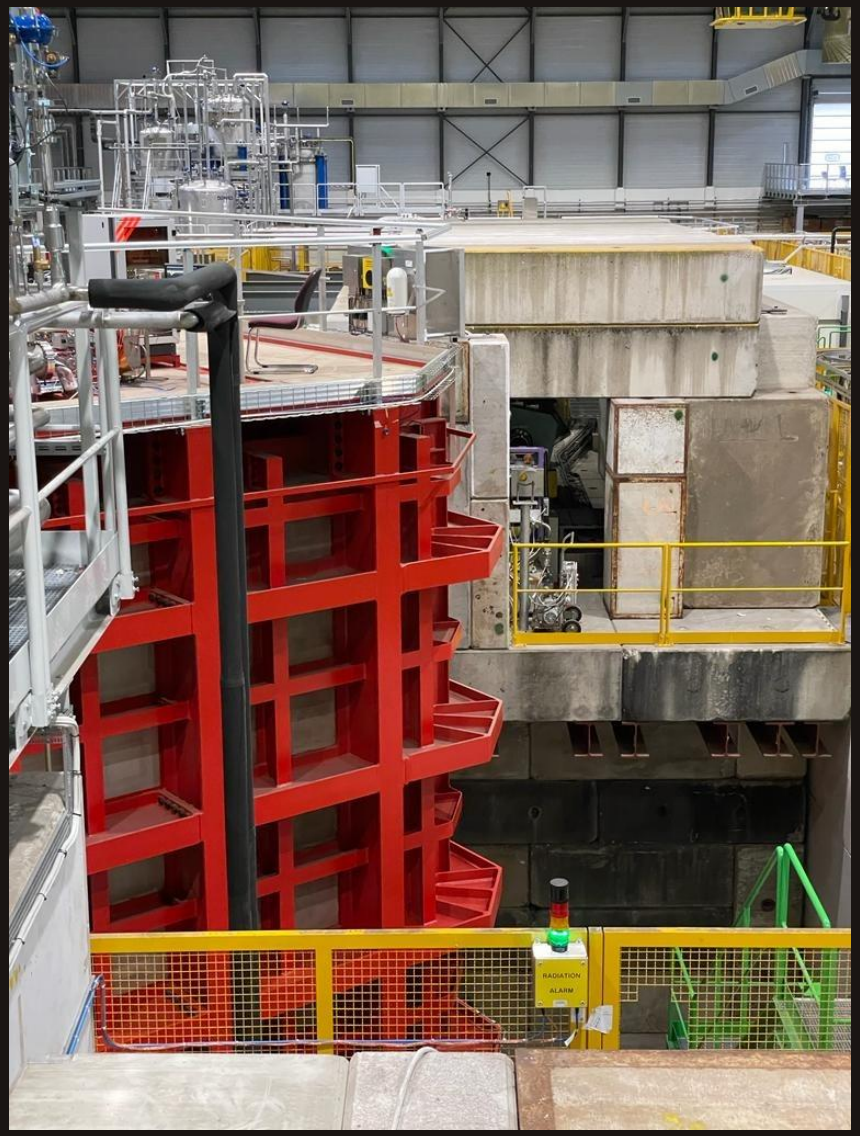
Resolution of 25 ps → Better tracking → Better differentiation between signal and background

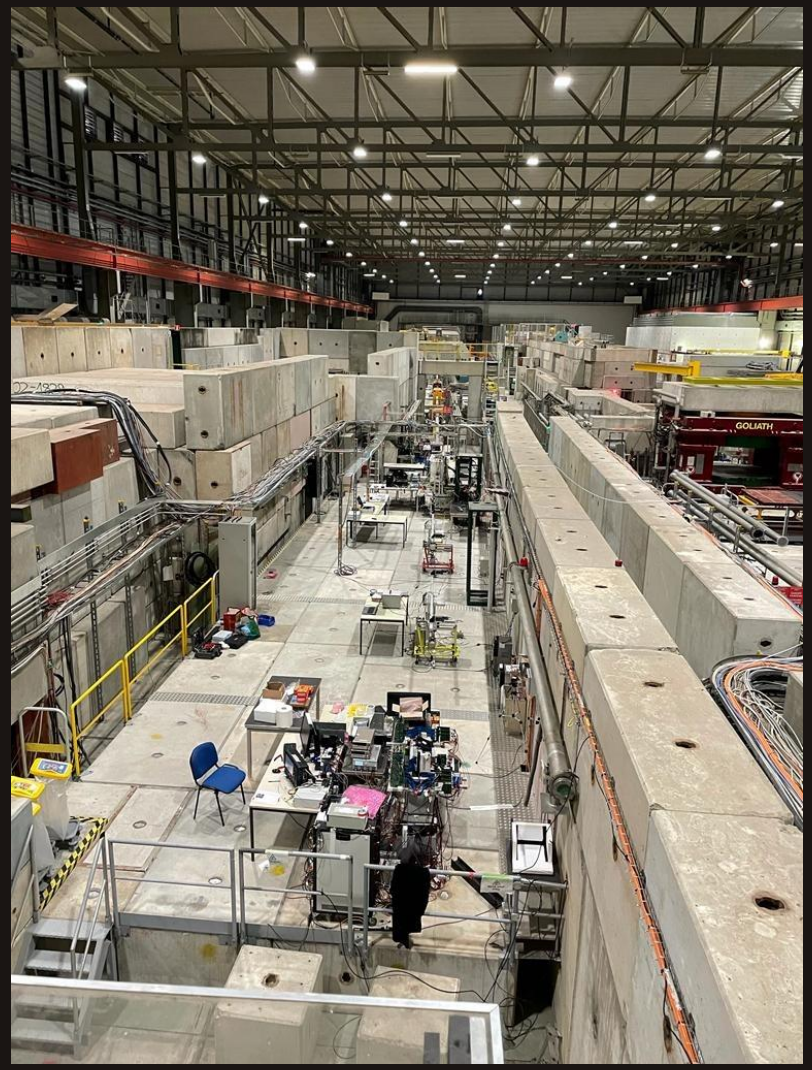
Cooling systems for new detectors

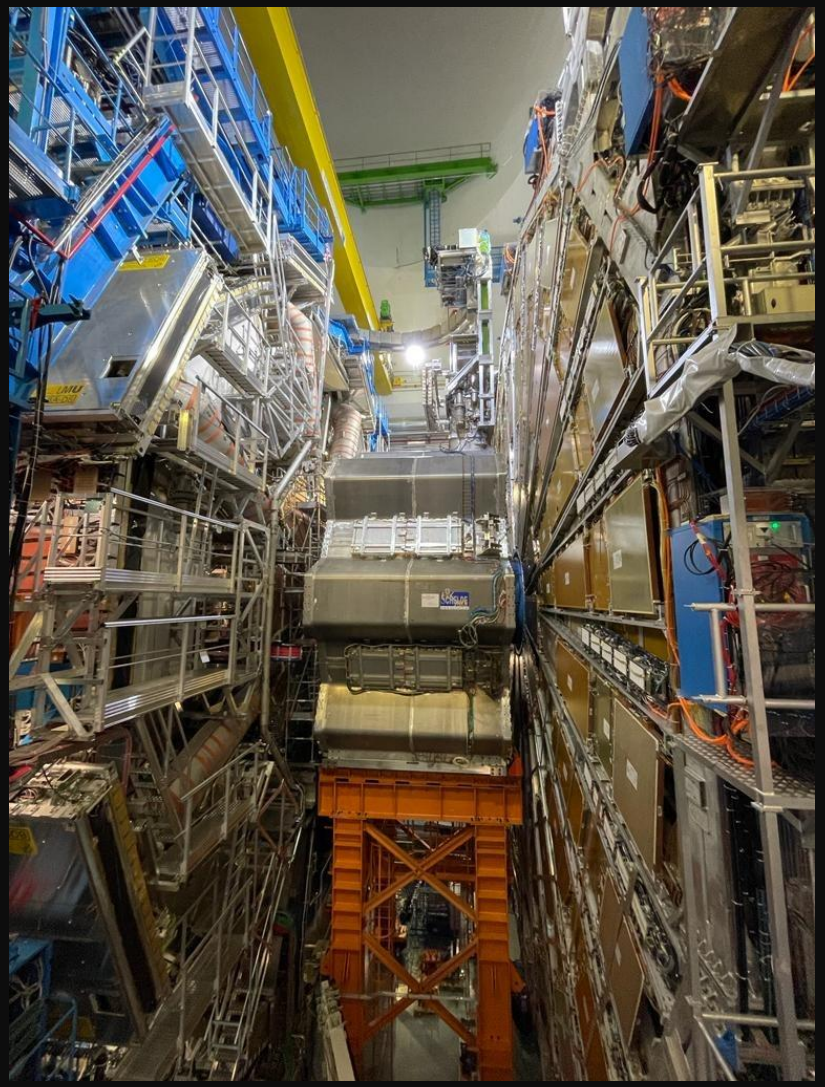


EXPLORING CERN – ATLAS, Large Magnet Facility, The North Area & many more


DUNE


RADIATION
ALARM


GOLIATH




Large Magnet Facility


A
US
USA

Special thanks to Louie and all the organizing team!