

# Status of the Z-Path project

Even S. Håland

On behalf of the Z-Path group

(Farid Ould-Saada, Eirik Gramstad, Magnar K. Bugge, Vanja Morisbak and myself)

IPPOG meeting (Pisa 2018)

- ① Status of the Z-Path: In Norway and internationally
- ② Student performance statistics
- ③ IMC quiz as Kahoot quiz
- ④ My work: using Jupyter notebook for ATLAS Open Data analysis

- 30 video conferences: 23 (CERN) + 7 (Fermilab)
  - 104 institutes (CERN)
  - 7 institutes (Fermilab)

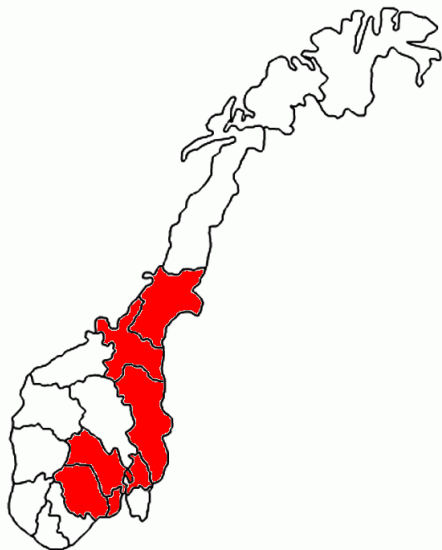
# Z-Path in Norway

## Oslo:

- Two days (February 27th and March 21st)
- Total number of participants:
  - ~ 500 high-school students
  - ~ 30 teachers
  - Coming from 7 out of 18 Norwegian counties (the red part of the map)
- 14 local tutors (to help students on practical exercises)

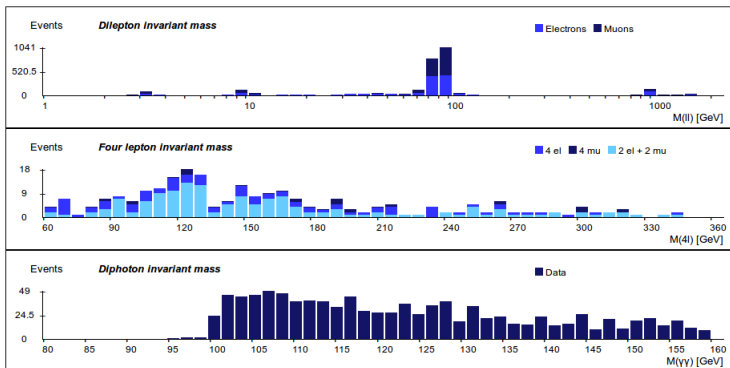
## Bergen:

- One day (February 15th)
- 44 students and 2 teachers

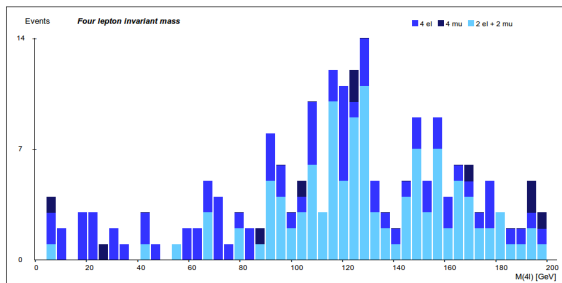


# Statistics - summary (Oslo, March 21st)

Final state	Student distribution	Expected
$ll$	3294	3575
$4l$	322	40
$\gamma\gamma$	1071	1650
Sum	4687	5265

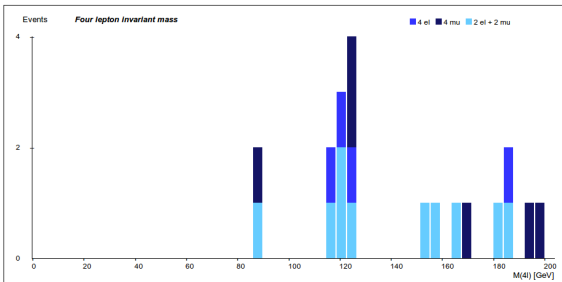


# Statistics - the $4\ell$ channel (Oslo, March 21st)



**Upper plot:** student distribution

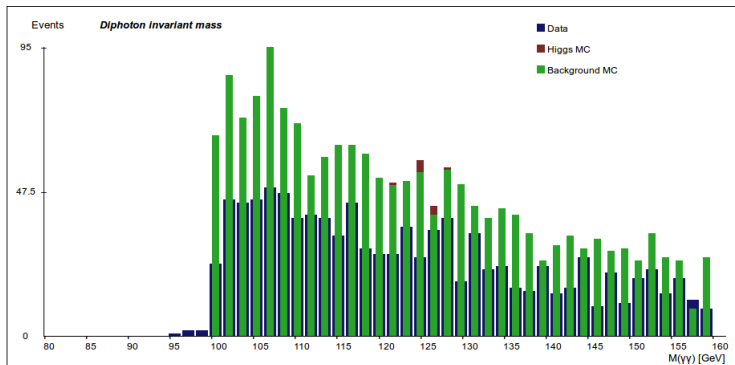
**Lower plot:** expected distribution



Main difficulty: knowing which electrons (not) to select

# Statistics - the $\gamma\gamma$ channel (Oslo, March 21st)

- **Plot:** data and expected signal/background in the  $\gamma\gamma$  channel.
- Data undershooting expectations.
  - Converted photons interpreted as electrons?
- But: (maybe?) less undershoot around 125 GeV. Biased selection?



# Quiz as Kahoot quiz

Made a Kahoot version of the IMC quiz which we ran in parallel with the video conference:

- <https://play.kahoot.it/#/k/8bcdacf9-8909-4580-b77b-d0943e53ef85>
- Students could use their smart phones to answer questions and get points according to if they pick the right answer and how quick they are.
- Don't have to print the answer sheet.
- Relatively easy to run centrally by the moderators at CERN.



# Quiz as Kahoot quiz

Tested in Oslo on March 21st:

- 153 players
- 51.59% correct answers
- Score of 3.52 out of 5 on "how fun was it?"
- 71.43% said they learnt something
- 66.67% recommended the quiz
- Best player had 6/7 correct answers (did answer Z-boson as the mediator of the strong force (!))
- Most difficult question: Which of the following inventions was driven by particle physics research at CERN? (29% correct)
- Easiest question: How much of our universe is matter or energy of which we know nothing about? (81% correct)

All statistics: <https://cernbox.cern.ch/index.php/s/B5Yjmuhf69vUUYv>

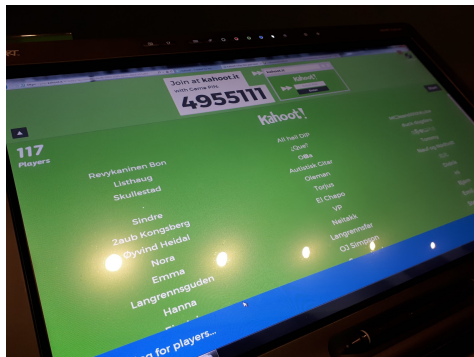
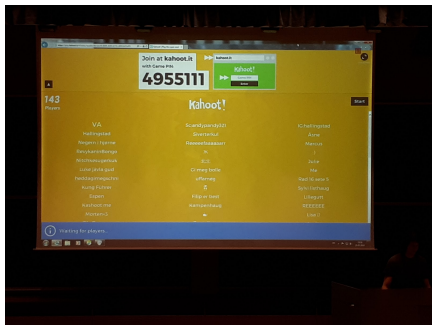


Photo: E. Gramstad

- Working 25% at the Z-Path project (since February) through funding from the Olav Thon foundation.
- Goals:
  - Help developing teaching resources for particle physics courses at university level.
  - Contribute to making the particle physics teaching at University of Oslo more research based.
- How is this achieved?
  - Using the ATLAS Open Data dataset.
  - Making analysis examples using Jupyter notebook with C++ and ROOT.
  - Example: [http://nbviewer.jupyter.org/github/evensha/ZPath/blob/master/Dilepton\\_analysis.ipynb](http://nbviewer.jupyter.org/github/evensha/ZPath/blob/master/Dilepton_analysis.ipynb) (work in progress!)
  - Will be tested/used by students during the next few weeks.

# Outlook and future plans

- Improving the typical analysis problems (too many  $4\ell$  and too few  $\gamma\gamma$ ):
  - More time for practical work?
  - Further explanations on how to tackle of these kinds of events?
  - Less events to process?
- Introducing dark matter:
  - Introduce the concept of MET.
  - Only DM (Z+MET) or with SUSY (direct slepton production).
  - Possible to extend OPlot to deal with MET and scatter plot MET- $m_{\ell\ell}$ ?
- Student projects (at university level) using ATLAS Open Data and Jupyter notebook:
  - Will be tested by students in the coming weeks.
  - More signal models? (DM, SUSY, graviton, heavy  $\nu$ 's, etc.)