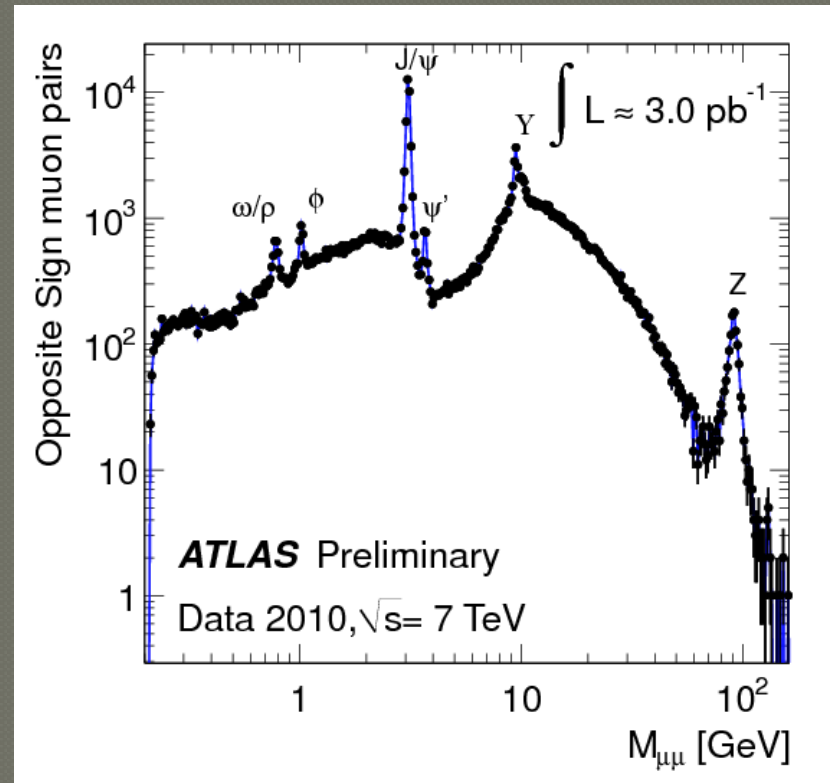


Invariant mass technique applied to Z, Z' and $J/\psi, Y$

*Maiken Pedersen, Farid Ould-Saada
University of Oslo*

Invariant mass technique (1)

- accounts for short-lived particles (Z boson and J/ψ and Y meson) in the detector
 - decay products $e^+e^- / \mu^+\mu^-$ measured
 - identify electrons and muons in collision events recorded by ATLAS at LHC
 - add energies and momenta of decay products to form E/p of hypothetical decaying particle's invariant mass with usual $E-p$ equation)



$$m_0 c^2 = \sqrt{E^2 - \vec{p}^2 c^2}$$

Z – Path

- Each group of 2 students analyses 50 events using HYPATIA
 - Selects Z candidate events decaying e^+e^- or $\mu^+\mu^-$
 - Inserts tracks into invariant mass table of HYPATIA
 - Enters invariant mass together with lepton type into a web-plotting tool
- <http://cernmasterclass.uio.no>
 - **username: ippog**
 - **password: mc12**
- As moderator you pick up results from this url
- You do not need do anything, except chose correct values from menus
- All combination is already done for you
- You will select plots
 - 1. Institute by institute
 - 2. All institutes on that day

Access point

MasterClass

MasterClass

cernmasterclass.uio.no/index.php

MasterClass – Index Page

[Start](#) [Student](#) [Moderator](#) [Administrator](#)

Tuesday, February 21st 2012 - 00:28:21 CET

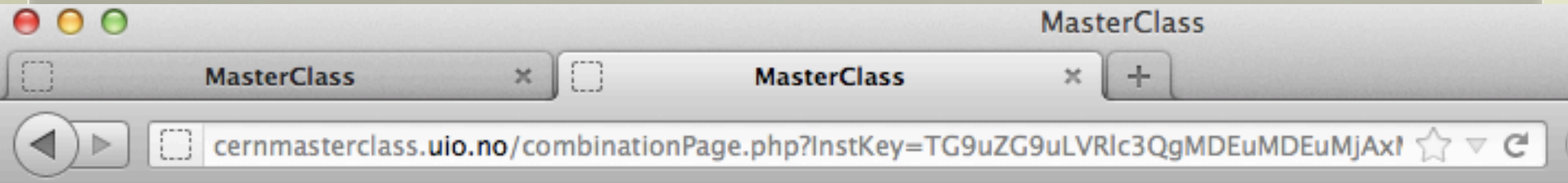
Welcome to the plotting-tool for Hands-on-CERN Masterclasses!

If you are a student, choose "Student" from the top menu.

If you are a moderator at the videoconference or a teacher choose "Moderator".

[vanja.morisbak \(AT\) fys.uio.no](mailto:vanja.morisbak@fys.uio.no)

Select each institute by turn



MasterClass – Combination Page

[Start](#) [Student](#) [Moderator](#) [Administrator](#)

Institute Moderator Tasks

Chosen institute and date is: London-Test 01.01.2012

[Choose a new institute](#)

To select another institute on a given date

- [Combination Plot - all groups in London-Test 01.01.2012 on](#)
- [Combination Plot - all institutes on a given date](#)

To plot one institute histogram

MasterClass – Combination for London-Test 01.01.2012 on

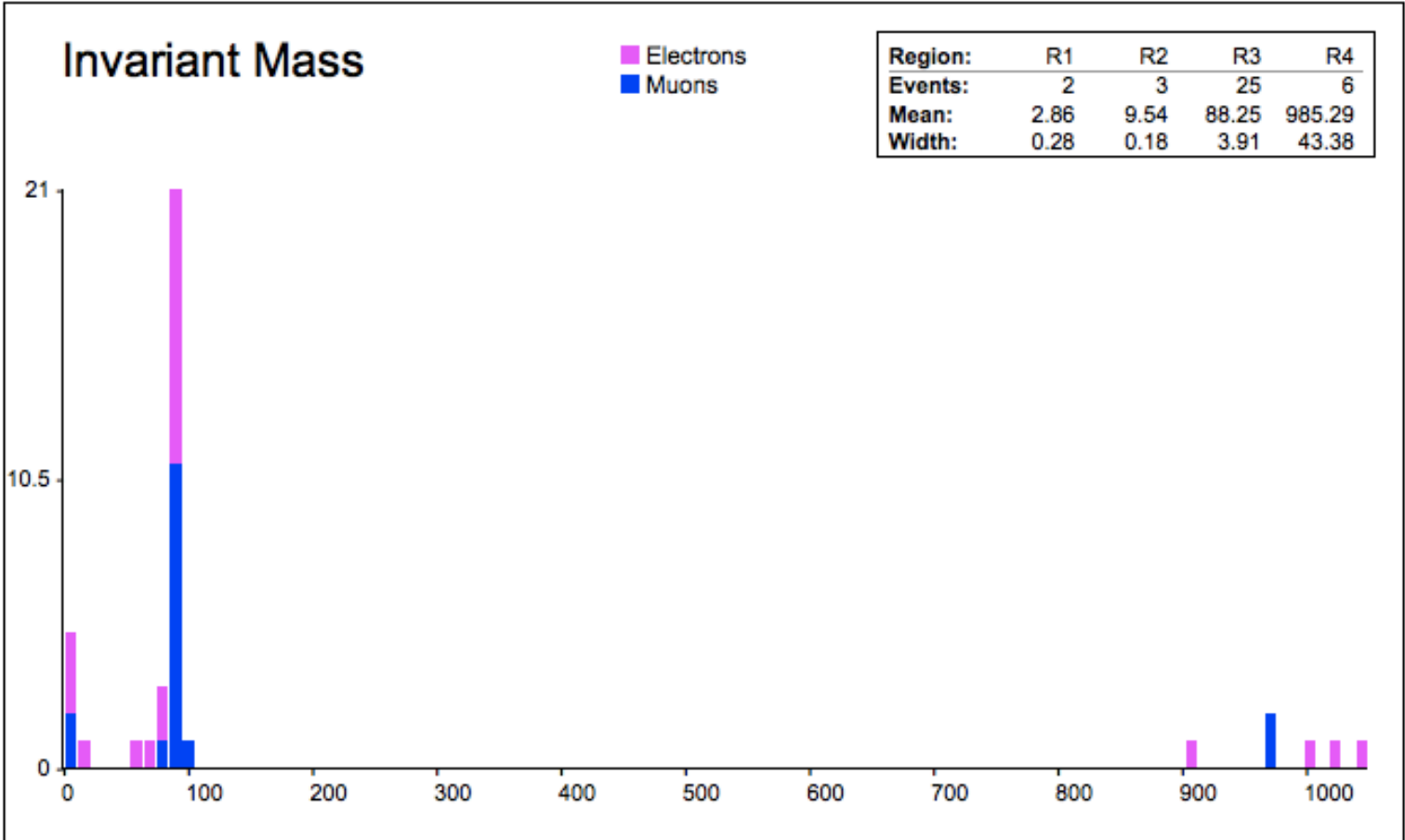
Data:

One entry per line

```

2.58 el
9.29 el
9.67 el
16.61 el
60.8 el
69.98 el
78.14 el
83.68 el
86.35 el
86.44 el
86.84 el
87.98 el
88.09 el
89.55 el
90.23 el
90.31 el
91.38 el
91.44 el
905.03 el
1004.57 el
1020.64 el
1038.61 el
3.14 mu
9.67 mu
79.61 mu
85.1 mu
85.4 mu
86.98 mu
87.65 mu
87.79 mu
89.47 mu

```



Bins: X-Axis:

R1 Min: R2 Min: R3 Min: R4 Min:
 R1 Max: R2 Max: R3 Max: R4 Max:

Finally show all institutes today plotted together

MasterClass – Combination Page

[Start](#) [Student](#) [Moderator](#) [Administrator](#)

Institute Moderator Tasks

Chosen institute and date is: London-Test 01.01.2012

Choose a new institute

- [Combination Plot - all groups in London-Test 01.01.2012 on](#)
- [Combination Plot - all institutes on a given date](#)

To plot all institutes on that date together

[vanja.morisbak \(AT\) fys.uio.no](mailto:vanja.morisbak@fys.uio.no)

MasterClass – Combination for all institutes on 01012012

Start Student Moderator Administrator

Choose new date

Chosen date is 01012012

Data:

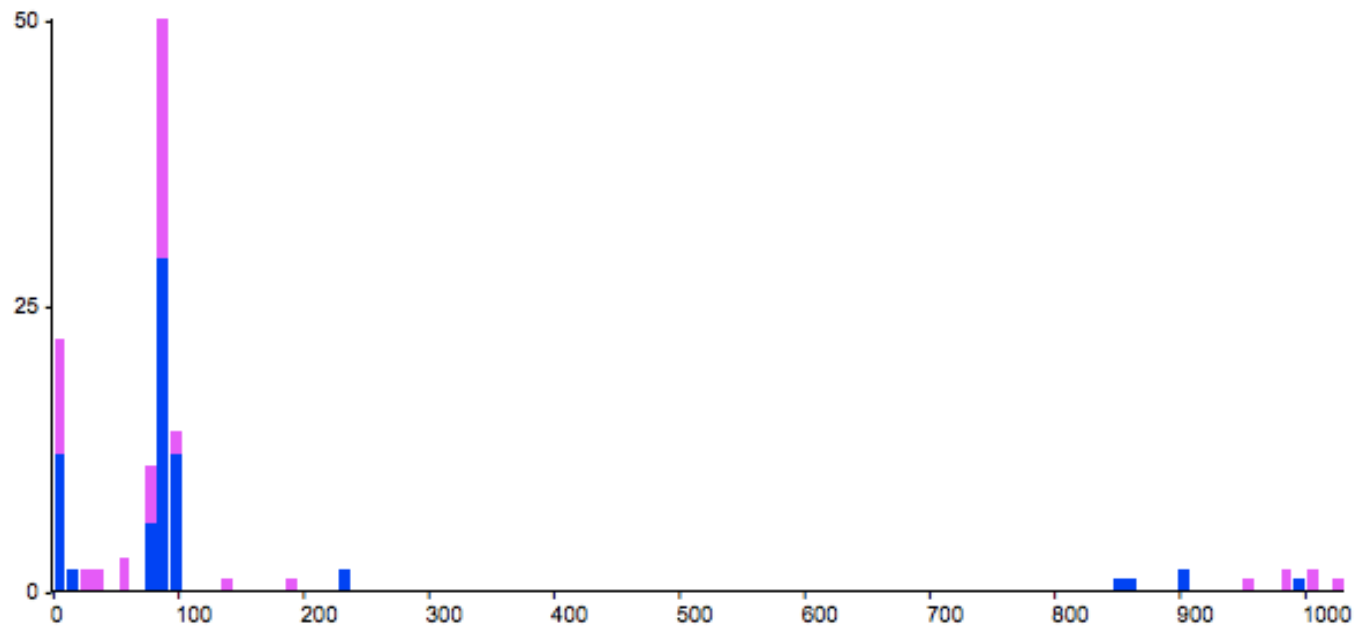
One entry per line

```
1.06 el
1.06 el
3.18 el
3.18 el
3.53 el
8.12 el
8.12 el
9.42 el
10.13 el
10.13 el
28.87 el
28.87 el
31.83 el
31.83 el
58.17 el
58.17 el
60.74 el
79.39 el
79.39 el
81.59 el
82.21 el
82.21 el
83.87 el
84.16 el
84.79 el
84.89 el
84.94 el
86.87 el
87.77 el
87.84 el
```

Invariant Mass

Electrons
Muons

Region:	R1	R2	R3	R4
Events:	9	10	73	11
Mean:	2.62	9.35	88.08	952.58
Width:	0.86	0.64	4.94	57.18



Bins: 100

X-Axis: Linear

Refresh

R1 Min: 0.0 R2 Min: 5.0 R3 Min: 70.0 R4 Min: 500.0
R1 Max: 5.0 R2 Max: 10.0 R3 Max: 100.0 R4 Max: 1500.0

In the end you can show official ATLAS
Results - a pdf w/3 slides (also attached to agenda)

MasterClass – Combination Page

[Start](#) [Student](#) [Moderator](#) [Administrator](#)

Tuesday, February 21st 2012 - 01:14:12 CET

Institute Moderator Tasks

Chosen institute and date is: London-Test 01.01.2012

[Choose a new institute](#)

- [Combination Plot - all groups in London-Test 01.01.2012 on](#)
- [Combination Plot - all institutes on a given date](#)
- [Official ATLAS Results](#)