



International Masterclasses

Videoconference

Manual

for **Local Organizers**

17.01.2020

Introductory Remarks

This manual is the result of a working group set up at the 1st IPPOG Meeting in Košice, in April 2011, consisting of two experienced videoconference moderators (Kate Shaw, Michael Hauschild), Uta Bilow, responsible for coordination of the International Masterclasses, and Laurenz Widhalm[†] as head of the group.

Based on feedback collected over the years from students, teachers, moderators, and (local and global) organizers, we defined the aims and structure of the videoconference, and compiled a list of dos and don'ts to achieve the best possible videoconference experience for the students.

Current group members are: Uta Bilow, Ina Carli, and Katharine Leney.

Please read this manual carefully to be optimally prepared for your Masterclass videoconference!

Abbreviations used in this manual:

VC refers to the masterclass videoconference

Symbols used in this manual:



Mandatory or strongly advised!



Avoid this!

[†] This manual is dedicated to the memory of Laurenz Widhalm, who initiated the Masterclasses Videoconference WG, and died after long illness on December 24, 2012.

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About International Masterclasses

International Masterclasses provide a unique opportunity for High school students to be "scientists for a day". 16- to 19-year-old students in 60 countries around the whole world are invited to one of about 220 nearby universities or research centers for one day in order to take part in an authentic research process. They hear lectures from active scientists and gain insight into topics and methods of basic research into the fundamentals of matter and the forces. Thus prepared, students perform measurements themselves on real data from particle physics experiments at the LHC (ALICE, ATLAS, CMS, LHCb). At the end of each day, up to five student groups join in a videoconference with CERN for discussion and combination of their results.

The International Masterclasses are a core activity of IPPOG, the International Particle Physics Outreach Group. The program is organized and run by Michael Kobel of the Technical University Dresden, Germany, and coordinated by Uta Bilow from TU Dresden and Ken Cecire, QuarkNet. A working group is preparing the videoconferences.

Particle Physics Masterclasses began in 1997 in the United Kingdom. The European program started in 2005, the World Year of Physics, and has grown constantly since then. In 2006 American students participated for the first time in a parallel program organized by QuarkNet, and since then more and more countries have joined in.

With its unique approach the International Masterclasses cover various aims:

- link school and research institutions
- bridge the gap between science education at school and modern scientific research
- stimulate interest in science
- improve understanding in science and scientific research
- demonstrate the scientific research process
- provide an attractive opportunity to get a first glimpse of modern physics research

More info:

Int. Masterclasses: www.physicsmasterclasses.org

IPPOG: <http://ippog.org/>

QuarkNet: <https://quarknet.org/>

The Aim of the Videoconference

At the end of each day of International Masterclasses students will participate in an international videoconference - together with up to four other institutes, according to the schedule, and moderators from CERN. The videoconference will be held from 4 pm to 5 pm CET. Moderators combine students' results and discuss them with the participants. In addition, the videoconference includes a Q & A session and a quiz.



The Videoconference (VC) has to:

- convey the internationality of the event
- demonstrate how physicists work together internationally
- demonstrate improvement in accuracy by combination of different data sets
- most importantly: BE FUN FOR THE STUDENTS!

it is NOT supposed to:

- deepen the understanding of the physics
(better done locally in the native language)
- teach English vocabulary of particle physicists
(vocabulary should not distract from physics)
- contain a basic discussion of the measurement
(has to be done locally before)
- create a competition regarding the measurements
(“who is the best?”)



The most important rules

Please pay attention in order to reduce the risk of disturbing the whole videoconference!



The VC has to start at 4:00 pm CET sharp.



Stay muted unless you are supposed to talk.



Select students beforehand (for answering moderators' questions on results).



Prepare students in order to have some questions ready for the moderators (Q&A session).



Distribute answer sheets for the quiz beforehand. (Download from <http://ippog.org/resources/2017/quiz-international-masterclasses-imc>)

Elements of the Videoconference

1. Overview & Timing

Welcome & Icebreaker _____ 10' (16:00 – 16:10)

Combination & Discussion of Measurement _____ 20' (16:10 – 16:30)

Open Discussion _____ 19' (16:30 – 16:49)

Quiz _____ 10' (16:49 – 16:59)

Good Bye _____ 01' (16:59 – 17:00)

2. Welcome & Icebreaker (10')

The welcome has to be on schedule, common and interactive!

It has to immediately establish the fact that there is a two-way connection between students and the moderators, and that students can and should actively take part in the VC, and not just listen to the moderators.

- Select speakers (students) for your Masterclass already before the VC
- Connect in time (at least 15 min before the VC starts)! Sound check must be done before VC starts!
- Define extra person responsible for setting up VC
- Stay **muted** unless addressed by the moderators

Moderators will ask each Masterclass one short question and let them speak (If you have an idea for a localized question, please submit it to the moderators beforehand, e.g. the Masterclass in Vienna could be asked whether they have seen the VERA accelerator)

Moderators will display a map showing all connecting sites. Example:



3. Combination & Discussion of Measurements (20')

Moderators show and combine the results. They will ask one question to each group, on the measurements and the results.

- select students to answer the question already before the VC starts!
- To prepare your students you can use the information given in *Scenarios for Discussion of Measurements*, p. 14 ff.

4. Open Discussion (19')

After the specific discussion of the measurement, the discussion can expand to more open and general questions.

The students should be prepared by you, in order to have some questions ready.

5. Quiz (10')

Style of 'Who wants to be a millionaire'!

Boundary conditions:

- multiple choice questions (4 answers)
- everybody involved (plays on his/her own)
- correct answer will be revealed immediately after each question
- scoring done by each student him/herself
- answer sheets should have been distributed **before** the VC starts
- no public comparison of scoring
- no prizes, just for fun

Moderators will present the English version via video stream. Local language versions are available for download at <http://ippog.org/resources/2017/quiz-international-masterclasses-ime> and can be shown locally in parallel (prepare second set of PC and beamer).

Detailed instructions for the quiz can be found in the [Annex](#), p. 8.

6. Common Good Bye (01')

There has to be a clear, common end of the VC after 60 minutes!

Also in the case of very lively discussions, the moderators still have to officially end the VC in time. They can, however, offer to stay online after the official end. But this is completely on a voluntary basis. Alternatively, students can be offered to continue the discussion locally with the local experts.

ANNEX

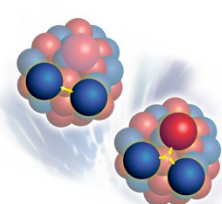
1. Instructions for the Quiz


The purpose of the quiz is to have a highlight at the end of the videoconference, and to get everybody involved. It also helps to have a clear, common end of the videoconference after the open discussion.

Concept of the quiz:

- the presentation is based on the TV-show “Who wants to be a millionaire?”
- there are 7 multiple choice questions (4 answers) of increasing difficulty

Which particle is the mediator of the strong force?





1

A. Neutralino	B. Z boson
C. Gluon	D. Quark

- everybody plays on his/her own and marks the correct answer on the answer sheet
- the correct answer is revealed immediately after each question
- scoring is done by each student him/herself on the answer sheet
- the measure for the score is eV (electron volts); for each correct answer the student increases his/her energy level, the top level is 7 TeV
- as in the TV-show, reaching top score will be very hard
- there is no public comparison of the scoring
- there are no prizes to win, the quiz is just for fun

2. Material for the Quiz

The following material can be downloaded from:

<http://ippog.org/resources/2017/quiz-international-masterclasses-ime>

1.) answer sheet (pdf) COMPULSORY!

- has to be printed and distributed before the VC starts
- to be filled out by each students

Quiz Answersheet

1. ☐ A ☐ B ☐ C ☐ D

2. ☐ A ☐ B ☐ C ☐ D

3. ☐ A ☐ B ☐ C ☐ D

4. ☐ A ☐ B ☐ C ☐ D

5. ☐ A ☐ B ☐ C ☐ D

6. ☐ A ☐ B ☐ C ☐ D

7. ☐ A ☐ B ☐ C ☐ D

Your score
Tick off one energy step for each correctly answered question starting at the bottom.

7 TeV
Full beam energy of the LHC

172.9 GeV
Mass of the top quark

91.2 GeV
Mass of the Z boson

938.3 MeV
Mass of the proton

105.7 MeV
Mass of the muon

2.5 MeV
Mass of the up quark

0.511 MeV
Mass of the electron

2.) quiz in local language (ppt or pdf) OPTIONAL!

- all questions translated in the local language
- to be optionally shown locally in parallel with the moderator's English version
- static version is recommended
- Not all languages available!

Ποια είναι η κατανάλωση ενέργειας του LHC; Αντίστοιχη με ...

3

A. Ένα μικρό χωριό (5000 κάτοικοι)

B. Τα νοικοκυριά του καντονιού της Γενεύης (500 χιλ. κάτ.)

C. Ελβετία (8 εκ. κάτοικοι)

D. Γαλλία (66 εκ. κάτοικοι)

The English animated version will be shown by the *moderators* at CERN and shared via Vidyo. If you want to show (in addition) a version in your local language, the latter should be static (questions and multiple choice answers only, no timer, no solutions). It is not recommended to show an animated version in local language in parallel, as it is too hard to synchronize with moderators.

a) Procedure of the quiz

- 10' before the end of the VC moderators announce the end of the discussion and start of the quiz
- moderators start the animated .ppt and explain the rules

- each question and the 4 answers are read aloud by the moderators; optionally, local organizers show the translated question in parallel
- moderators start the timer, students have to tick off their answer on their answer sheet within this time
- moderators reveal the correct answer, and briefly explain why this is correct
- all students that got the answer right may now tick off their next energy level on the answer sheet
- after the last question and explanation of the correct answer, moderators say something like: “I hope you all had fun with the quiz – and the whole videoconference. Now time is up...”

3. Vidyo – technical details

The video linkup is via Vidyo.

Vidyo documentation: <http://www.cern.ch/vidyo>

a) Meeting rooms

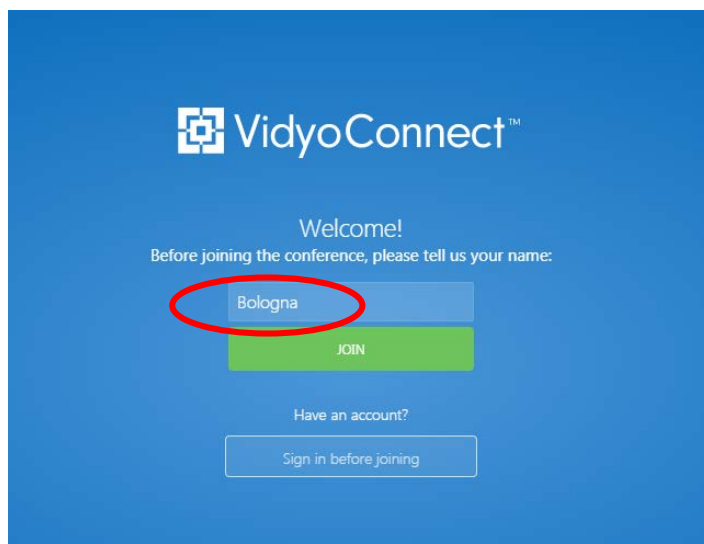
The VC's will be held in the following venues (accessible directly via the web link).

Masterclasses_2020_VC1 / <https://vidyoportal.cern.ch/join/Wnq3V6cnnO>

Masterclasses_2020_VC2 / <https://vidyoportal.cern.ch/join/ye8a5NXdyHJM>

The correct Vidyo room (VC 1 or VC 2) for your Masterclass can be seen from the schedule:
www.physicsmasterclasses.org/index.php?cat=schedule

Login and type the name of your city. Do not login with your personal account!



If you connect via H323:

Dial the IP address of the Vidyo gateway:

vidyogw06.cern.ch **188.184.66.56** or

cern-vidyo-gateway3.internet2.edu **207.75.165.84**

Once the connection is established with the gateway, dial in the meeting room extension:

1052093 (VC1) or 1010004 (VC2), followed by the "#" key

If you connect via GNU/Linux computers:

These are supposed to access Vidyo via WEBRTC. Please use the following URL:

VC1:

<https://vidyowebRTC.cern.ch/web/index.html?portal=https://vidyoportal.cern.ch&roomKey=Wnq3V6cnnO>

VC2:

<https://vidyowebRTC.cern.ch/web/index.html?portal=https://vidyoportal.cern.ch&roomKey=ye8a5NXdyHJM>

More instructions:

<http://information-technology.web.cern.ch/services/fe/howto/users-use-h323sip-client-connect-vidyo-meeting>

Vidyo frequently asked questions:

<https://cern.service-now.com/service-portal/faq.do?name=vidyo>

Vidyo support

vidyo-support@cern.ch

4. Vidyo Tests

A Vidyo test session period (~ 4 weeks before Masterclasses begin) will be conducted. The tests have to be performed by all new participants and by those with new equipment or rooms. All tests should be performed with exactly the same equipment and in exactly the same room as the real event.

The test room is:

Masterclasses_2020_VC1:

<https://vidyoportal.cern.ch/join/Wnq3V6cnnO>

or use access code 1052093, followed by the "#" key.

Institutes that want to test outside the official tests can use the Vidyo TV at:

<http://information-technology.web.cern.ch/services/fe/vidyo/howto/users-test-your-setup>

5. Hardware Recommendations

a) PC

- Intel Dual Core or Dual 2 Core, 2Gb RAM with Windows XP/Vista/7 (recommended) or selected Linuxes (SLC 5.5 or Ubuntu 10.01),
- Recent graphic card
- Macintosh (recommended) with Intel processor with 1Gb RAM with Mac OSX 10.5 or later

b) Video

- Logitech C920 HD Pro (~ 100 €) or other USB camera

c) Audio



Echo cancelling device is strictly required

- You can get echo cancelling device from Phoenix company:
<http://www.phnxaudio.com>
- Or from CERN stores: Jabra Speaker 510 UC at
<https://edh.cern.ch/edhcat/Browser?command=searchItems&argument=&top=&objid=%24%24EDH7ajmnnh6e&showAdvanced=&scem=&keywords=jabra>
- You can also get a Jabra device: <http://www.jabra.co.uk/headsets-and-speakerphones/all-products/speakerphones>

6. Room setup

a) Office (1 - 2 person)

1 PC + camera + Headphones or Speakerphone (~ 200 €)

b) Small conference room (10 people)

1 PC + camera + Phoenix Solo (~ 150 €), external speakers needed,
or Phoenix Quattro (~ 500 €), external speakers optional

1 PC + H.323 device like Tandberg or Polycom (starting at 8.000 €)

c) Large conference room (10 - 30 people)

1 PC + camera + Phoenix Quattro (~ 500 €)

1 PC + H.323 device like Tandberg or Polycom (starting at 8.000 €)

d) Auditorium

1 PC + H.323 device like Tandberg or Polycom (starting at 8.000 €)

1 PC + Phoenix Solo (~ 150 €) or Phoenix Quattro (~ 500 €)

1 PC + Phoenix SOHO card (PCI card to Desktop PC)

We advise to use the first option. If it's not possible (too expensive) you will have to get the echo canceller device Solo or Quattro. Connect this device with USB to PC, and the speakers of the room connect to the echo canceller.

We strongly recommend to test and tune the setup before the Masterclass. All tests should be performed with exactly the same equipment and in exactly the same room as the real event.

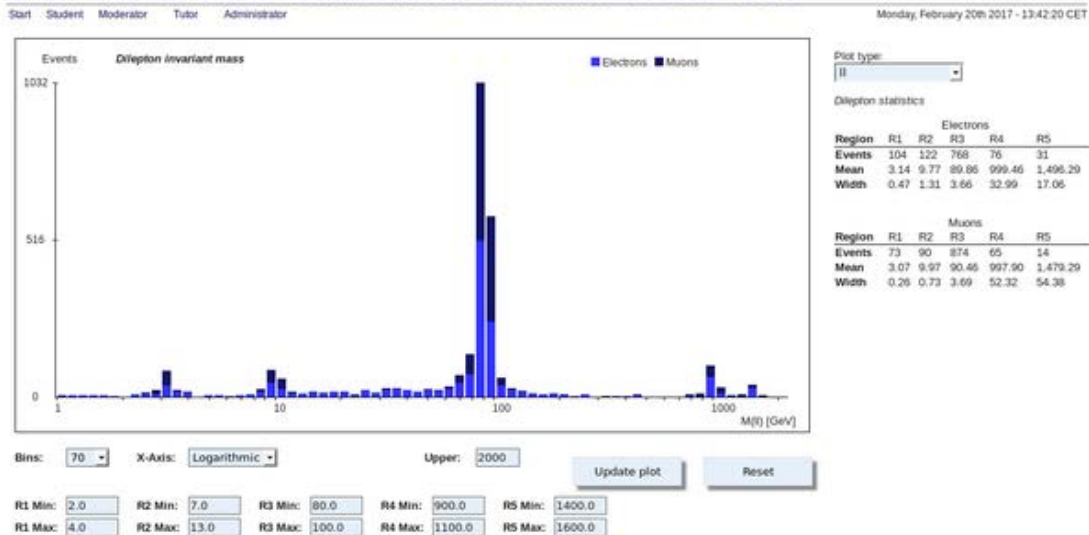
Furthermore, we recommend using a second set of PC and beamer, without transmission of audio, to display the results of the combination or questions during the quiz.

7. Scenarios for Discussion of Measurements

To streamline the discussion of measurements sets of questions have been developed which will be used by the moderators. There are 5 scenarios for ATLAS and CMS measurements. Each scenario consists of a plot/histogram/table/etc. and 1-2 relevant question(s) that students are supposed to answer. These scenarios will help moderators and institutes to go through the results and the physics discussion in an efficient way.

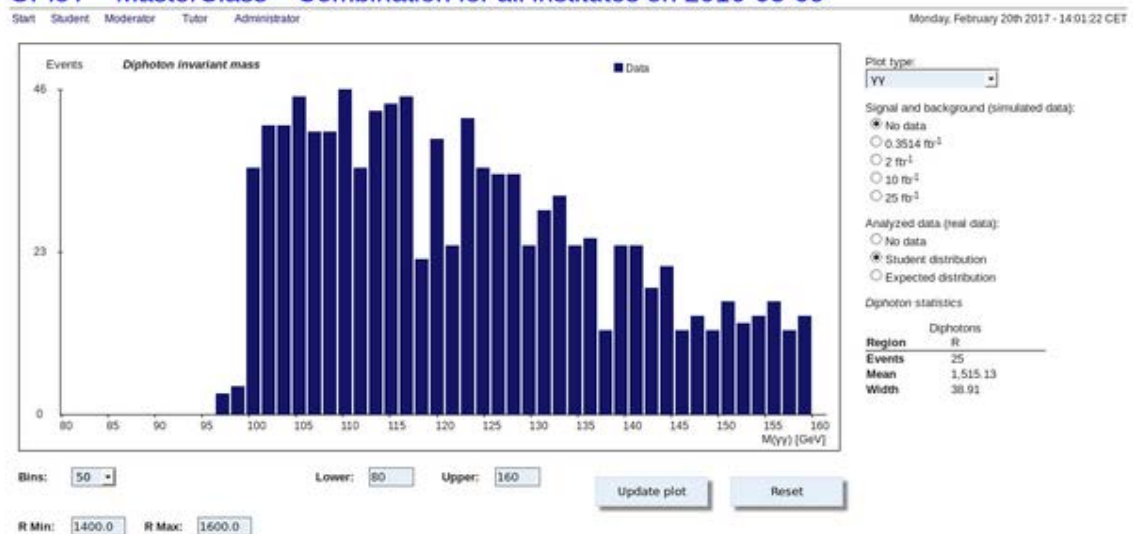
a) ATLAS Z path

OPlot – MasterClass – Combination for all institutes on 2016-03-09



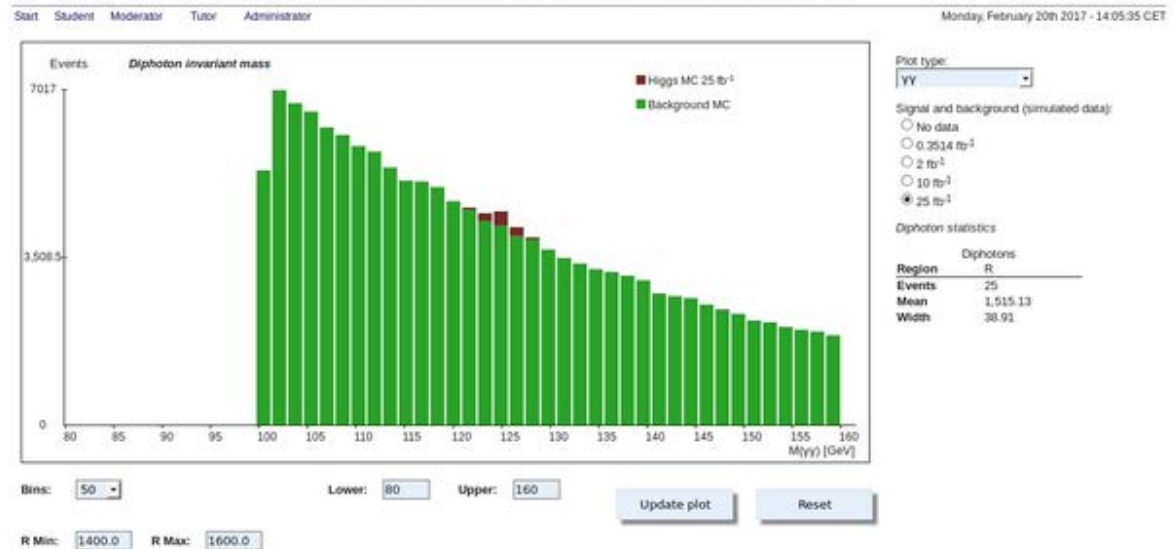
- Question 1: What does it mean when we see a peak in the distribution? Do you see any peaks that you did not expect?

OPlot – MasterClass – Combination for all institutes on 2016-03-09



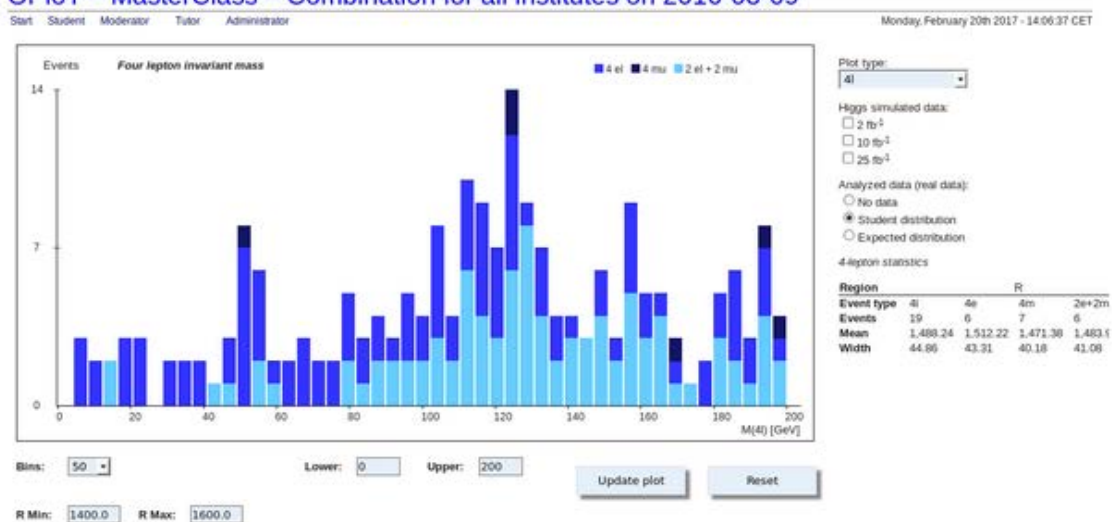
- Question 2: Do you see a peak corresponding to the Higgs boson? Why not? (Hopefully students are aware of statistics limitations from local institute discussions.)

OPlot – MasterClass – Combination for all institutes on 2016-03-09



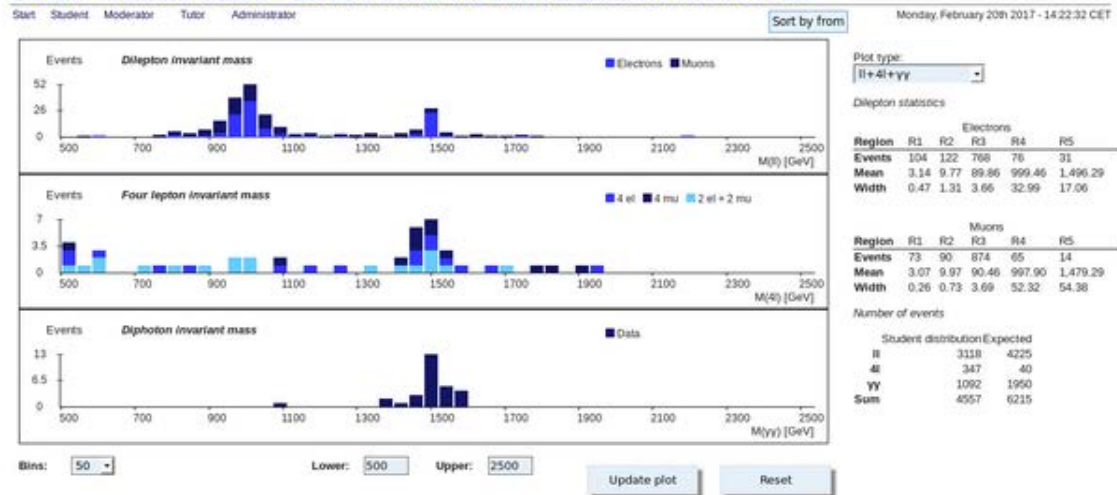
- Question 3: Do you think we could see the peak here even if it had the same color as the background? Why does it help to collect more data?

OPlot – MasterClass – Combination for all institutes on 2016-03-09



- Question 4: Why are there many more 4-lepton events than expected? (Here you can compare to the table in the summary screen or to the expected distribution.) What can you say about the composition in terms of 4e, 2e2μ, and 4μ?

OPlot – MasterClass – Combination for all institutes on 2016-03-09



- Question 5: What does it tell us that the particle at 1000 GeV is not seen in the 4-lepton and diphoton distributions, while the particle at 1500 GeV is seen in all distributions?

b) ATLAS W path

Moderators show combined online spreadsheet.

Analysis

Total #	$W \rightarrow \ell + \nu$				Background	WW
1615	e^+	e^-	μ^+	μ^-		
ATP	56	56	56	56	343	133
Bonn-NTW						
BSZ Riesa	18	27	22	16	86	21
Hamburg-NTW-1	25	17	19	14	149	20
R.-Hildebrand-Gym. Ma	0	0	0	0	390	91
Total	99	100	97	86	968	265
$\Sigma W^+ , \Sigma W^- $	$ W^+ $	196	$ W^- $	186	$ W^+ + W^- $	382
Ratio	$ W^+ / W^- $		1.0538		\pm	0

Comparison with results of the ATLAS collaboration (from 2011):

Measurement of the $W \rightarrow \ell\nu$ and $Z/\gamma^* \rightarrow \ell\ell$ production cross sections in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector^{*)} and Search for the Standard Model Higgs boson in the $ll \rightarrow WW(\ell\ell) \rightarrow 4\ell\nu\bar{\nu}$ decay mode using 1.7 fb⁻¹ of data collected with the ATLAS detector at $\sqrt{s} = 7$ TeV^{**)}

*) Authors: The ATLAS Collaboration (Submitted on 5 Dec 2011): <http://arxiv.org/abs/1109.5141.pdf>

**) Authors: The ATLAS Collaboration (24 Aug 2011): ATLAS-CONF-2011-134

	$W \rightarrow \ell + \nu$				Background	WW cand.
	e^+	e^-	μ^+	μ^-		
Total	77885	52856	84514	55234	21930	469
$\Sigma W^+ , \Sigma W^- $	$ W^+ $	162399	$ W^- $	108090	$ W^+ + W^- $	270489
Ratio	$ W^+ / W^- $		1.50		\pm	0.01

Question 1: What was your result for R_{\pm} ? How did the combination with the other institutes change the total result?

Question 2: Is the result compatible with the results measured in ATLAS?

WW-Histogramme

Masterclasses 2013 Search for H→WW→lνlν
For Educational Use Only

Entries

■ WW without Higgs
■ Expectation for mH=125GeV/c²
■ Background, e.g. from tt or Z
 • Measurement: 18.97.13

	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6	bin 7	bin 8	bin 9	bin 10	Sum
N	21	19	20	27	23	18	31	31	25	21	236
B	8.1	11.8	11.9	12.7	17.3	17.4	20.6	25	29.9	32.5	187
S	12.9	7.2	8.1	14.3	6.7	0.6	19.4	6	-4.9	-11.5	48.8
Z	4.5	2.1	2.3	4	1.4	0.1	2.3	1.2	-0.9	-2	3.6

number of bins [1 ... 20] maximum of y axis
 standardization ☐ 1 ☐ 2 ☐ 3 ☒ 4 cut on bin number
 Higgs contribution ☐

[Submit](#)
[Default](#)

Question 4: How would you interpret the blue and green areas? What do they mean?

Masterclasses 2014 Search for $H \rightarrow WW \rightarrow l\nu$
For Educational Use Only

Legend:

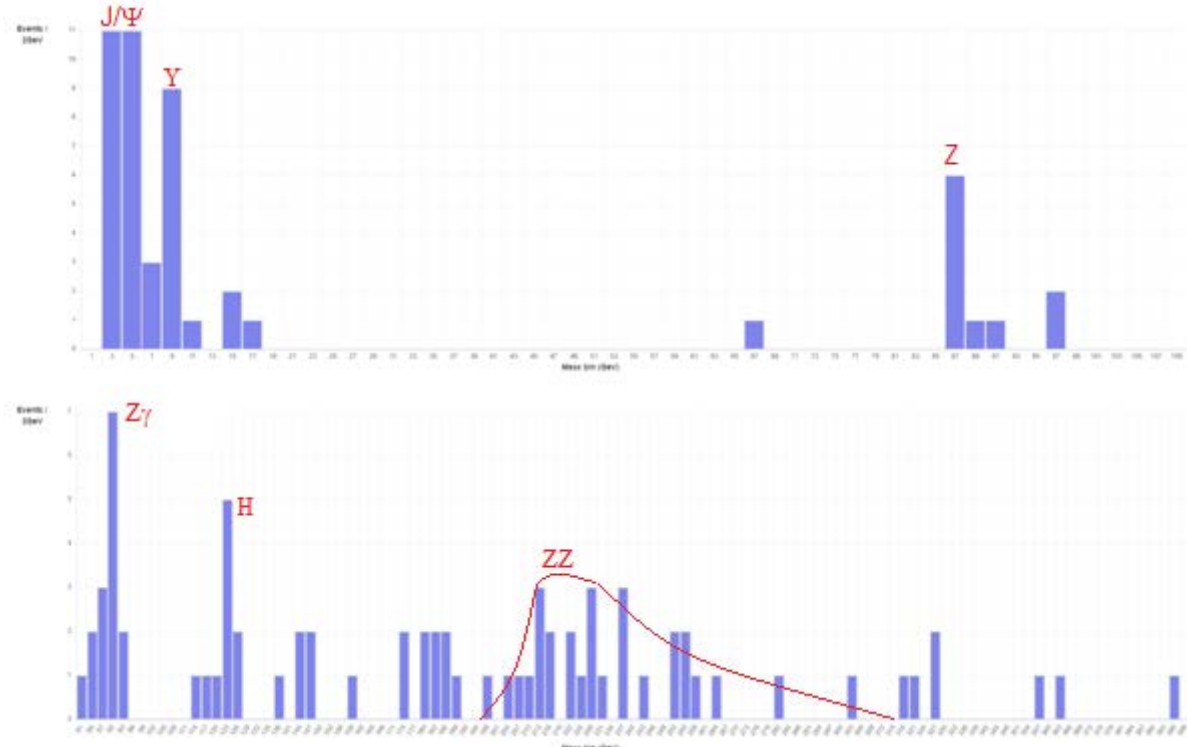
- WW without Higgs
- Expectation for $m_H=125\text{ GeV}/c^2$
- Background, e.g. from $t\bar{t}$ or Z
- Measurement: Bonn 16.02.15

	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6	bin 7	bin 8	bin 9	bin 10	SUM
N	5	3	2	1	2	2	3	7	5	9	39
B	1.5	2.2	2.2	2.4	3.2	3.2	3.8	4.6	5.6	6	34
S	3.5	0.8	-0.2	-1.4	-1.2	-1.2	-0.8	2.4	-0.6	3	4.3
Z	2	0.5	-0.1	-0.9	-0.7	-0.7	-0.4	1.1	-0.2	1.2	0.7

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c) CMS

There is a new version of CIMA as of 2020. Moderators share overall 2- and 4-lepton mass plots as well as key ratios. The mass plots appear together in CIMA in the Mass Histogram tab with the 2-lepton plot at the top and the 4-lepton plot at the bottom. Expected peaks are marked here in red.



The above plots were made with limited data. The full masterclass plots may look different and the relative heights of peaks may appear to be different.

The key ratios, e/μ and W^+/W^- are in the Results tab toward the bottom, isolated here in red.

Group	e	μ	W^+	W^-	W_\pm	Neutral	Zoo	Total
5.1	0	0	0	0	0	0	0	0
5.2	4	7	1	0	0	7	1	9
5.3	11	14	6	2	1	13	1	23
5.4	0	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	0	0
10.1	7	6	1	1	0	5	7	14
10.2	6	5	2	2	0	5	0	9
10.3	13	22	9	5	2	13	1	30
10.4	33	43	17	16	0	33	1	67
10.5	17	18	11	8	0	13	0	32
10.6	46	59	31	17	0	44	8	100
10.7	12	18	6	10	1	6	12	35
10.8	2	6	1	0	1	6	0	6
10.9	21	24	10	5	5	19	4	43
Total:								
Group	e	μ	W^+	W^-	W_\pm	Neutral	Zoo	Total
All	172	222	95	66	10	164	35	370
Ratios:								
e/μ								
0.73								
W^+/W^-								
1.44								

The expected values are $e/\mu = 1.0$ and $W^+/W^- = 1.4$, though results will vary.

Question 1: Where are the peaks in the Mass Histograms? What do they represent?

Question 2: Where is Z boson in the 2-lepton plot? What are the other peaks, then?

Question 3: Do you have possible Higgs events in the 4-lepton plot? Where? Can we claim discovery?

Question 4: Why does there appear to be a Z peak in the 4-lepton plot as well? Since the Z does not directly decay to 4 leptons, how do we explain this?

Question 5: Is there anything else significant in the 4-lepton plot?

Question 6: What do you expect the ratio of electron events to muon events to be? Is your result consistent with this?

Question 7: What is the ratio of W^+ to W^- bosons? What does this ratio tell us about protons?