



# REPORT

from

## STEERING GROUP on MASTERCLASSES 2015

9<sup>th</sup> IPPOG meeting, 16-18 March 2015, Paris

(by Barbora Gulejova)

Conveners: *Uta Bilow, Ken Cecire*

Participants: *Uta Bilow (Uni Dresden), Ken Cecire (Uni Notre Dame), Farid Ould-Saada (Norway), Peter Watkins (UK), Nicolas Arnaud (France), Michael Kobel (Germany), Despina Hatzifoudiadou (ALICE), Konrad Jende (CERN), Beatrice Bressan (TOTEM), Benoit Lott (CENBG), Barbora Gulejova (CERN)*

Videoconference participants: *Ralf Averbeck (GSI), Bolek Pietrzyk (CNRS), Giuseppe Latino (INFN), Carolyne Hamilton (CoEPP)*

### GENERAL OVERVIEW

- good year for MC with record participation again (~8% grow in # of MC, 14 new institutes)
- LHCb organisation fully integrated for the first time!
- TOTEM ready to participate
- ALICE and LHCb discussed and agreed on common dates beforehand
- media coverage for MC ok (press releases in english and german, help of EPPCN)
- internal communication: circulars 1 per month until January, afterwards 1 per week
- efficient and useful collaboration of Uta and Ken in Dresden (Sept 2014 – Feb 2015)

### STATISTICS

- CERN data (ALICE, ATLAS W, ATLAS Z, CMS, LHCb)
- 26.2-2.4.2015 (32 days)
- 42 countries (new Morocco)
- 193 institutes (154+42 Fermilab)
- 255 MC (213+45 Fermilab)
- 10500 high-school students (1040 Fermilab VC)
- 51 VC with CERN, 154 institutes registered, 80 slots offered by CERN - fully booked, not enough!
- VC moderators 47 (CERN) + 18 (FNAL), 40% new! - multiple recruiting channels, new: feedback from CERN moderators to help further improving

### ISSUES

#### 1.) Registrations to MC via doodle

- some institutes from a bit exotic countries didn't give a contact details => problem

**TO DO:** Next year registration system could be changed so that when somebody register, they must give the contact details if they want to book (use google docs) (MC SG)

#### 2.) VIDYO

- despite of a lot of Vidyo TV testing with colleagues, still a lot of technical problems!!!
- Twiki and updated manual are good resources, but some issues can be improved...

**TO DO:** Next year write on first page of manual for moderators: „MUTE when you don't speak!!! Tell them in advance!“ The moderator can mute them one by one! (MC SG)

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- Many technical issues on institutes' side -connecting very late, bad audio, noisy, not muted
  - Poorly prepared institutes students not selected, questions not collected
  - improved setup in rooms at CERN requested, camera angle, screens,...

### 3.) **Funding and support**

- Coordinator of MC at Dresden (Uta) paid by CERN, contract till the end of 2015! To be continued? Negotiations ongoing!

### 4.) **Varia**

- We lost Jamaica this year – they couldn't make it
- ATLAS W vs. ATLAS Z, again decrease in popularity
- Several sessions (~12) cancelled on short notice = ~5%, but still worrying – sometimes resulting in non-international VC, which upsets other participants

## DISCUSSION ITEMS

### Virtual Masterclasses

- CMS: **first text** done (Marzena, Ken and others)
- WG on MC in other countries: **continue developing!**
- Serbia wants to replace online visits of CMS by virtual international MC
- ATLAS virtual visit could be used as a complement of MC (in addition to VC)

### International Masterclass Day

- new proposal inspired by International Muon Day
- 1 day event on International Masterclasses
- different places: "MC going around the world"
- 24 hours shift (depending on zones – in US late afternoon/evening, Europe during the day)
- good media, press coverage (it is easy to promote one day event!)
- October, November (as in southern hemisphere – spring is October, November, good for students for M.C.)
- the mentors would have to prepare students, so that they are able to explain it to other students
  - they could receive the spreadsheet with details (prepared slides exist already?)

### ISSUES (not yet decided):

- How much interest?
- coverage of moderators (get enough people for shifts at CERN, Fermilab, etc...)
- open it up to all Masterclass types, or just introduce some most famous and others later?
- concentrating more at CERN and international collaborations or more general on PP? (for example Q&A on PP, CERN, experiences on M.C., how they liked it...)
- Needs a better name?

**TO DO:** Discuss the Issues (**Ken, Uta**)

### Can we grow infinitely? What are the bottlenecks?

- see report from WG on MC in other countries + Masterclass with Fermi Data

## DISCUSSION ON ALL MEASUREMENTS

### ALICE MASTERCLASSES 2015: Nuclear Modification Factor

Ralf Averbeck (GSI, Germany)

- One session on 13 March 2015
- 80 participants at 4 institutes: Darmstadt, Frankfurt, Munster, Prague
- all groups discovered quark-gluon plasma
- institutes get homework before MC: they produce the plots which are compared with the real published results, it was really very close to published results – motivation for students
- very good feedback

**GOOD PRACTICE:** they have **DVD** - good solution which works almost everywhere (even if problem with connection, etc...)

## **CMS MASTERCLASSES 2015**

Ken Cecire (University of Notre Dame, US)

- very stable with continuous improvement
- 23 Countries, 78 institutes
- 21 VC, 12 languages
- July-February 2015 at Uni Aachen, support Quarknet and Notre Dame
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**GOOD PRACTICE:** connection problems because student used to connect, disconnect and reconnect. Now they **connect just one time** and do all work with data without reconnecting – works well.

## **ATLAS W-PATH in INTERNATIONAL MASTERCLASSES 2015**

Konrad Jende (CERN)

- 35 MC analysed 38 000 events, ~1540 students (if they work in pairs)
- W charge ratio: > 70% of institutes' measurements fall within  $R_{tot} \pm 0.02 = 1.48 \pm 0.02$  (before it was 1,22) - very close to what ATLAS expects to see!
- success rate of identifying W events ~98,6% and WW events 80,8%
- WW events measurement very ambiguous for students, as it can be confused with Z event, easier to explain W than Z measurement
- already complicated enough – only for fraction of very interested students do something more complicated

**GOOD PRACTICE:** Too much background, increased signal intensity and selected events, so that students can find their exactly those cuts, which were used for ATLAS publications.

## **ATLAS Z-PATH in INTERNATIONAL MASTERCLASSES 2015**

Farid Ould-Saada (University of Oslo)

- 86 different institutes, 100 Z path events, 24 countries on 5 continents, 19 days (feb-april 2015)
- VC with both CERN and Fermilab, it will continue based on ATLAS data and results

**GOOD PRACTICE:** there is a **zip file to be downloaded with data and programs**, producing tables, etc.  
- no additional work for students if they want to run it themselves

### **SUGGESTIONS:**

- prepare for possible new discoveries (graviton, SUSY) using similar final states, introduce more advanced looping over events, take part in open access and preservation of data for education!
- students develop their tools to analyse the data, do something more, build the full thing, using code

**TO DO:** meet & discuss on how shift things further after MC - inspire PP courses, which are often very theoretical, but MC are practical and make things very nicely understandable (**Pete, Farid, Ken**)

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## LHCb MASTERCLASSES

Bolek Pietrzyk (Centre National de la Recherche Scientifique, FR)

- 8 VC in 6 days in March (2 in the evening with US)
- Bad news: Moritz Karbach, leader of MC on LHCb, passed away recently in climbing accident ☹

**ISSUE:** Outside the CERN (european) working hours no more Vidyo support available <-> connection with US not possible during the normal CERN working hours!

**TO DO:** convince US groups to do it early in the morning during normal CERN working hours (**Ken**)

## ALICE MASTERCLASSES 2015: Looking for strange particles

Despina Hatzifoutiadou (ALICE)

- 14 international physics MC, 500 participants, newcomers: Maynooth (Ireland), Trieste

**ISSUE:** Visual analysis takes too long (get results from different computers to one).

Skip it in future? NO, it's important part where students engage!

**TO DO:** We must find the way, how to do it more efficient (using text file...?). The others do it differently, they already have good solutions so this should be shared! (**Ken, Nicolas, Despina**)

**ISSUE:** Lab statistics analysis: google doc, spreadsheets ok, but some difficulties with password, safe?

## TOTEM MASTERCLASSES DEVELOPMENT

Giuseppe Latino (INFN), Beatrice Bressans (TOTEM)

- improvements in the CMS analysis tool- more data, data merge, plot histogram in t and theta, runs on windows and linux... data from TOTEM could be used and merged and pictured (scattering angle, background...)
- TOTEM is the only possibility where students can get data which show scattering
- results from students from different groups/countries can be merged (possible up to 20 groups)
- new tutorial is available for moderators, tutors leading the class

**TO DO:** Needs further developments: more stable windows version, mac version (**Giuseppe, Beatrice**)

**TO DO:** Plan to do similar webpage as ATLAS? Missing are: introduction (one should repeat conservation of momentum); explanatory presentation to be downloaded for teachers (including a message that proton is not a wave, etc... ) (**Beatrice**)

## GENERAL SUGGESTION: Summarise where we see the Higgs? (on the webpage?)

- ATLAS: D + photon, Lepton event – students analyse individual events, mass plot, there is no real peak, but they can get a probability of Higgs being there
- CMS: choose few events, Higgs candidates ~125 GeV

## MASTERCLASSES in AUSTRALIA

Carolyne Hamilton (CoEPP, Communication & Outreach coordinator for Australia)

- CoEPP - ARC Centre of Excellence for Particle Physics at the Terascale, Australia
- Int. MC in Australia (mostly focus on ATLAS) has been a flagship for high school students, they became a very important part of educational program
- 2012 – inaugural masterclass in Melbourne, 46 students
- 2013-first international MC, 97 participants (Adelaide, Melbourne, Sydney)
- 2014-second int. MC, first trial of virtual MC - 'virtual high school' ([www.aurora.nsw.edu.au](http://www.aurora.nsw.edu.au)) - used also HYPATHIA, standard model lecture, also students with high academic abilities from rural

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and remote areas! – organised in conjunction with New South Wales Department of Education and Communities (DEC)

**NEXT STEPS:** Province of South New Wales in Australia DEC wants to have PP MC in curriculum of all high schools. – INSPIRATION FOR OTHERS!!!

**TO DO:** DEC plans to develop online resources, multimedia; CoEPP will provide assistance to DEC, provide tutors and liaise with CERN and IPPOG for resource development (Carolyne, CT)

## **MASTERCLASSES with FERMI DATA**

Benoit Lott (Centre d'Etudes Nucléaires de Bordeaux Gradignan (CENBG))

- 'Where do cosmic rays come from?' - short-lived and scattered easily, we can see only neutral gamma rays
- based on the Fermi-LAT data - large area telescope (LAT) on board of the Fermi Satellite
- data are public on website of NASA, you can look at the sky online (1873 sources like pulsars, gamma rays bursts, etc...which accelerate high energy particles to produce gamma rays)
- HEP detector, calorimeter measuring neutral gamma rays (produced by high energy particles)
- '**Exploring the violent universe**' - focus on variable sources: Active galactic nuclei (AGNs), gamma-ray bursts (GRBs), both related to black holes
- MC exercise: Determine luminosity (photon -> flux-> luminosity!) of bright events (e.g. announced in press releases) and compare to that of sun, find highest energy photons in GRB, AGN flares
- COSMIX - Cosmic Accelerator project, for general public, amateur astronomers to observe 'violent universe' with same gamma ray data, which are public, and similar tools as scientific community
- only with 4 parameters (energy, time, 2 positions in the sky you can play with data and create sky maps, animations of sky regions...)
- Small scale trial run in the fall of 2015 (3-4 classes in Montpellier, Bordeaux, Paris) - well received!
- Data and software can be downloaded by teachers easily + tutorial: good feedback!

**TO DO:** Benoit asked IPPOG to circulate information and help to find schools who would be interested (Uta to follow up with Benoit).