

INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS

Masterclass Report
22nd IPPOG meeting
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IMC 22: What do we expect?

Three settings:

- (1) Masterclasses at universities or labs (high school students allowed on campus)
- (2) Remote Masterclasses with students in classrooms
- (3) Remote Masterclasses with individual students, connecting from home (or elsewhere)

→ We have experience and are prepared for all 3 cases!

Expected videocon situation:

- (1) + (2): Sessions with student groups connecting
- (3): Sessions with individual students connecting → one dedicated week March 7-12
- Moderators might not sit together

IMC 22: Registration

- Doodle registrations started on Nov 8
- More slots will be added (announcement in next circular on Nov 19)
- International Day of Women and Girls in Science on Feb 11

	ATLAS Z	ATLAS W	CMS	LCHb	ALICE S.P.	ALICE R_AA	ATLAS Z	CMS WZH	MINERVA
	CERN						Fermilab		
VC slots offered	120	35	60	45	25	5	many	many	many
registrations	79	16	53	20	19	4	5	5	2

- Registration for Belle II and PTMC also ongoing

New developments in ALICE Masterclasses



- Updates with ALICE Strangeness MC
 - New and more advanced online version, modes for [students](#) and [tutors](#)
 - Back-end data base, results pushed automatically to database, create and store events
 - No need for external tools, e.g. Google Docs
- New MC on femtoscopy
 - measurement of QGP source size by summer student/WUT
 - obtain the source size of the QGP droplet created during Pb-Pb collisions
 - based on the analysis of two-particle (two-pion) correlations in momentum space (based on momentum differences of two particles)
 - [Prototype](#) presented to summer students on July 30

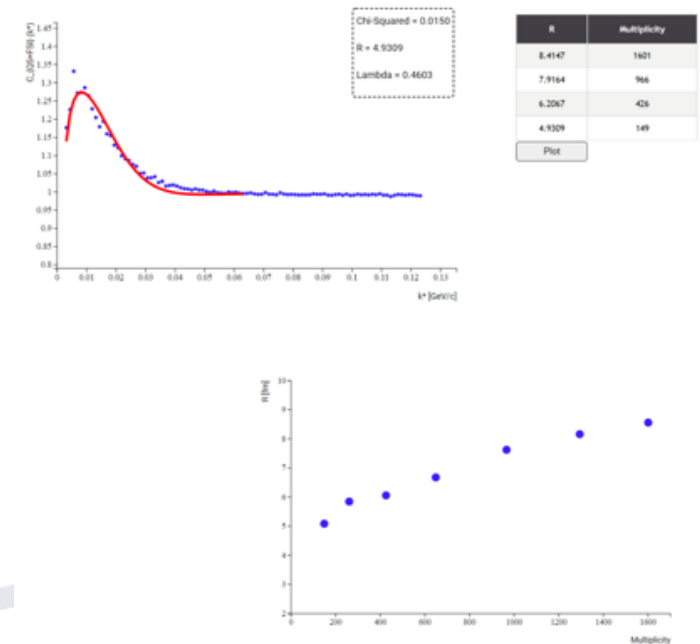


Figure 7.10: An example of the Radii vs Multiplicity plot.

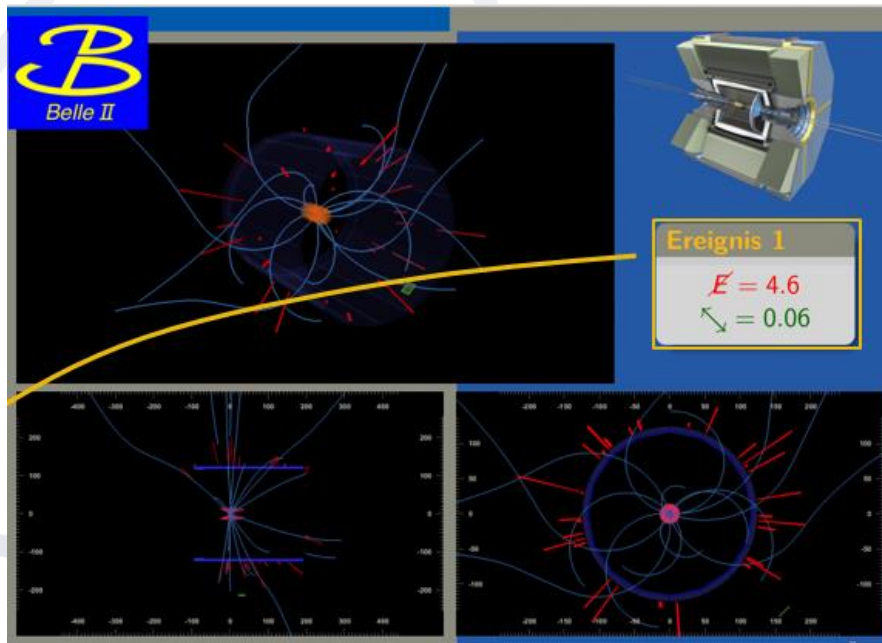
New Belle II Masterclass



- Concept: Based on event displays, classify event as $e^+e^- / \mu^+\mu^- / \tau^+\tau^- / \bar{q}q / \bar{b}b$
- Derive R -value: $R = \frac{N(\bar{q}q)}{0.5 \cdot [N(\mu^+\mu^-) + N(\tau^+\tau^-)]} = N_c \cdot \sum_{\text{Quarks}} q_{\bar{q}q}^2 = N_c \cdot \frac{10}{9}$
- Deduce **number of quark colors**

EXAMPLE EVENT DISPLAY

$e^+e^- \rightarrow \Upsilon(4S) \rightarrow \bar{b}b$

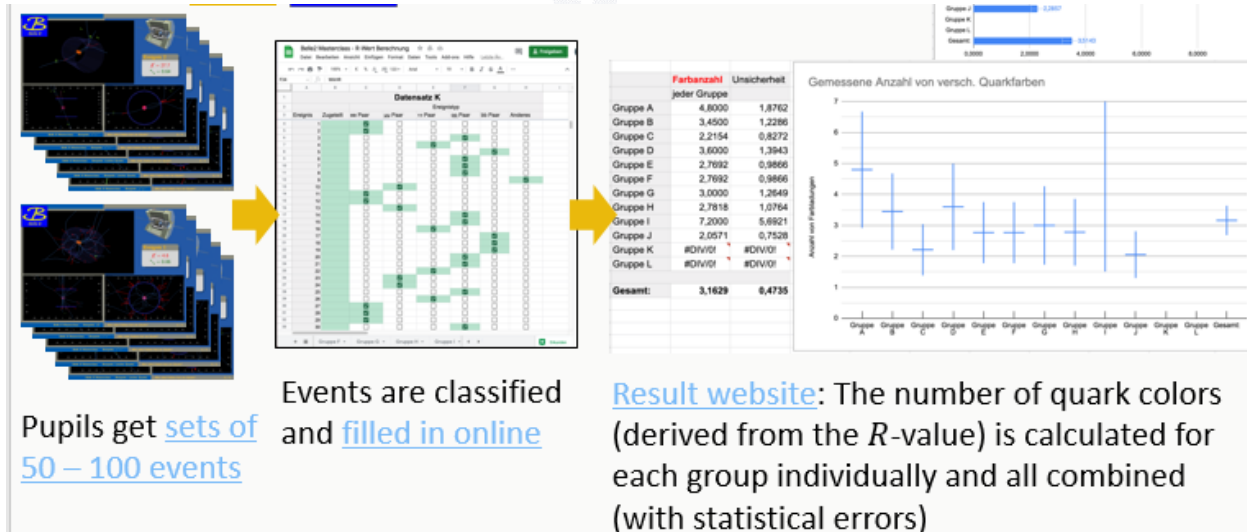


m_{miss}^2 as “missing energy” or \cancel{E}

foxWolframR2 as “straightness” or $\overleftrightarrow{}$



New Belle II Masterclass



MC data!

- Successful pilot Masterclass in July
- In German, currently translated to English, more languages will follow
- Will be offered in IMC22
- Developed by physicists and teacher students
- Accompanying material: videos, interactive worksheet, quizzes
- <https://www.pi.uni-bonn.de/outreach/netzwerk-teilchenwelt/belle2-masterclass>

Developments from QuarkNet



- CMS Masterclass updates
 - iSpy WebGL event display: improved view, settings controls, picking and table views
 - Upgrade of underlying WebGL library
 - Upgrade histograms in CIMA
- OPAL Masterclass
 - Upgraded and adapted to modern design, responsive layout etc.
 - Purpose: couple with LHCb recent results to investigate lepton universality
- New NOvA Masterclass
 - NOvA: long baseline neutrino oscillation study
 - Combine Far Detector event display analysis (small number) with python notebook (many events from Near Detector)
 - Under development, concept tested with teachers
 - Limited trial Masterclasses in IMC22



World Wide Data Day 2021 (W2D2)

- Wed, December 1st
- for high school students, guided by physics teachers
- simplified measurement with data from ATLAS and CMS
- measurement Φ and $\Delta\Phi$ as last year; future tbd
- As of this morning, 64 registrations
- 24-hour-span videoconference with 30 min calls to share and discuss results

