Glasgow Masterclass and LEP quiz app

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Masterclass Network Workshop
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University of Glasgow

Glasgow Masterclass update

Post-Covid, we only just started doing Masterclass events again this year…

- **11 June 2024, 17 schools (4 dropouts), 120 students**
  - Schools selection prioritising small size / area SIMD
  - Talk, lab, talk, CERN link, lab, talk, … and breathe
  - Very tight to fit everything in, especially with dept refurbishments
  - Lunch with pizza very popular!
  - And the sun shone! (Luckily, since we had lots of walking to do)

- **Material**
  - Talks: particle/collider physics intro by Aidan Robson; BSM physics / theory by David Miller; neutrinos by Paul Soler
  - Labs: EM lab to measure q_e/m_e ratio, and event-display computer lab… more later
  - Scottish-student level: Higher < A-level < Adv Higher

University of Glasgow | Particle Physics Masterclass 2024

Particle Physics Masterclass

Tuesday 11th June 2024, 1000–1530, Kelvin Building

Welcome to University of Glasgow's School of Physics and Astronomy!

There are currently building works ongoing in much of the campus, including the physics building, and we expect that some talks will have to happen in other buildings. Please arrive in time for a 10 minute walk from the Kelvin Building.

We hope you enjoy today's events, and seeing how a research lab works!

Registration and meeting from 0915, Kelvin Building level-2 laboratories.

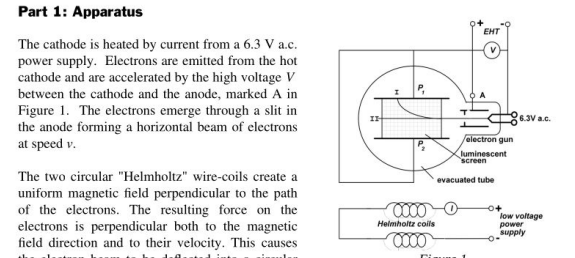
1000	***Collider Physics***	Prof Aidan Robson	East Quad LT
1045	***Lab session***		
	Group A: Fundamental properties of the electron	Prof Paul Soler	Rm 323
	Group B: Collider data: Z boson decays and hunt-the-Higgs	Dr Jonathan Jamieson	Rm 333
1200	***Lunch***		Common Room
1245	***The Search for New Physics***	Dr David Miller	East Quad LT
	CERN live-link	Dr Siyuan Yan	
1345	***Lab session***		
	Group A: Collider data: Z boson decays and hunt-the-Higgs	Dr Brian Colquhoun	Rm 333
	Group B: Fundamental properties of the electron	Dr Marcos Miralles Lopez	Rm 323
1500	***The mysterious neutrino***	Prof Paul Soler	East Quad LT
1530	*End*		

Talks, lab, CERN connection

- **Talks**
  - Despite selection being declared as for Adv Higher, many Higher students in attendance. Basically starting from zero
  - Most popular talk was the neutrinos one (I thought they were all good, and that the most complex…)
  - Maybe a bit talk-heavy: better ways?

- **EM lab**
  - EM lab to measure q_e/m_e ratio
  - Mix of responses: private schools had done it before, but schools from poorest areas: “we could never afford this kind of kit”

- **CERN video link**
  - Siyuan Yan provided a re-recorded video and connected via Zoom. Tech issues… lecture theatres not always equipped!



Part 1: Apparatus

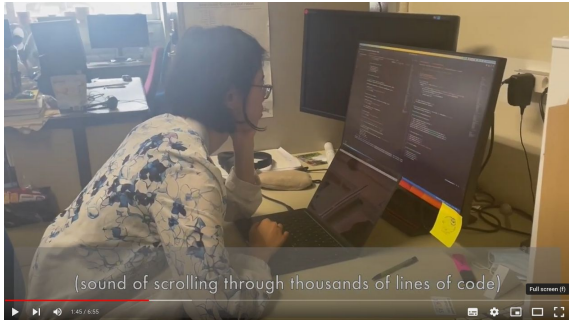
The cathode is heated by current from a 6.3 V a.c. power supply. Electrons are emitted from the hot cathode and are accelerated by the high voltage V between the cathode and the anode, marked A in Figure 1. The electrons emerge through a slit in the anode forming a horizontal beam of electrons at speed v.

The two circular "Helmholtz" wire-coils create a uniform magnetic field perpendicular to the path of the electrons. The resulting force on the electrons is perpendicular both to the magnetic field direction and to their velocity. This causes the electron beam to be deflected into a circular path. The trajectory of the electrons is shown on a luminescent screen inside the electron-beam tube.

Figure 1

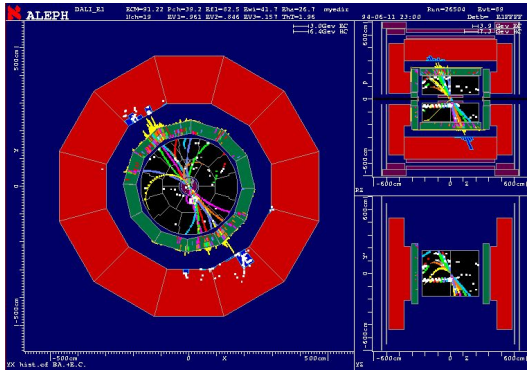
Part 2: Measuring the radius of trajectory, *r*

The *x*-*y* grid on the luminescent screen gives the coordinates of points on the electron trajectory with respect to an origin at the anode slit. In general three points are required to specify a circle uniquely, but we know that the electron beam is horizontal and at the origin as it leaves the anode slit, so we only need to measure one more point. (In general, if you have a number of unknown quantities, e.g. a 2D circle's location and radius = three unknowns, you need the same number of constraints to reach a solution.)



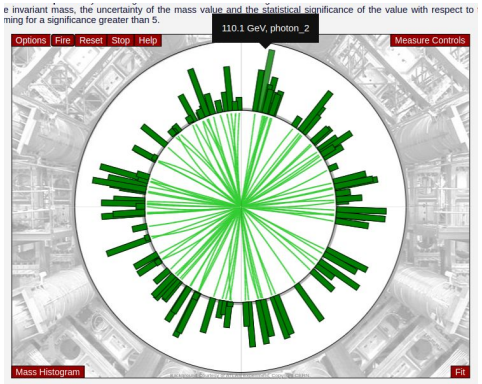
Event-display “quiz” exercise

- **Resurrected very ancient LEP event displays as a quiz**
  - Web app, original (I think) by Rick St Denis
  - Lots of code and content tidying by AB and Jonathan Jamieson, backend tech (now written in Go!) by Gordon Stewart
  - Task is to learn to identify decay type of Z from event displays (and some kinematics/detector data) ⇒ “measure” R = #had / #lep



- **Experience**
  - Students enjoyed the lab, but many didn’t really know what they were doing! Online info page and written sheets, but…
  - Needed a better advance briefing, but how within 45 mins?

- **And then…**
  - Also using Lancaster Particle Physics Package page [Higgs reco]
  - Some issues: too much surrounding waffle on LPPP site, direct link loses user ID, certificate issues, mouse-over reveals answers!

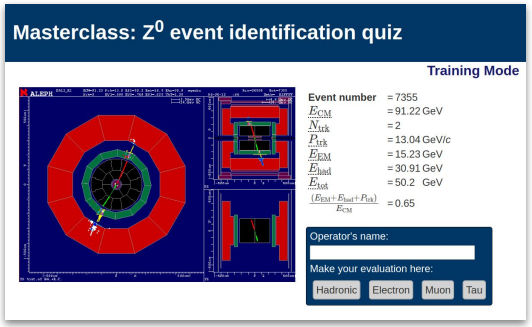


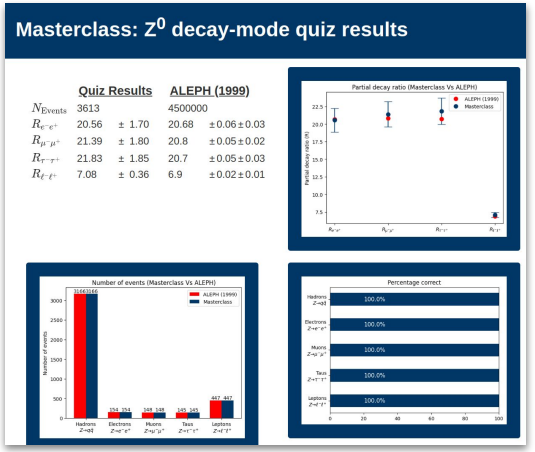
Masterquiz

- **Live: https://www.ppe.gla.ac.uk/masterquiz/**
  - Temporarily unlocked access for today
  - Have a play!

- **Some details**
  - Quiz can be run in “balanced” and “full-dataset” modes
    - First for training, second for measurement
    - Controlled via admin panel — with rudimentary security!
  - Crowdsourced results across class, compared to ALEPH at end
  - Ends when events run out (quite quick) or with admin override

- **Wider use**
  - Works quite nicely for one group, needs work to be openly usable
  - Happy to take on ideas, new developers, merge requests
    - Currently on UofG Gitlab, can grant access or maybe migrate to a public system
  - Also feel free to install on own systems, but please preserve attribution. Forking isn’t ideal… TBD



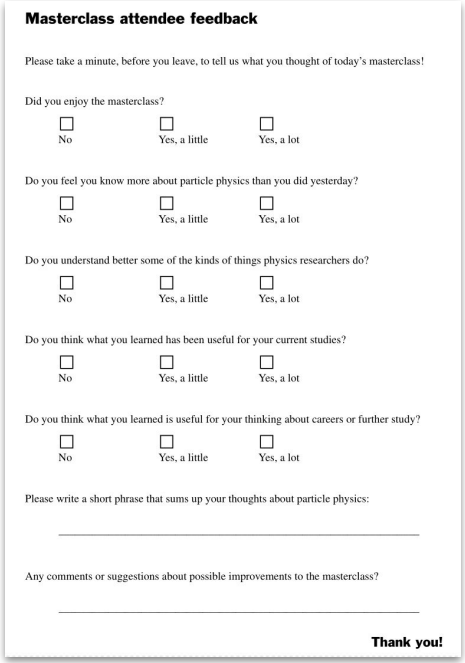


Summary / discussion

- **We're back!**
  - Really good to be running the Masterclass again
  - And to have tidied up the main material
  - Though there's a *lot* of room for proper updates and modernisation
  - **Demand was 2x capacity, planning to run again in Dec with Nuclear+Hadrons group**

- **Feedback**
  - Sheets issued in final talk
  - All positive feedback, 70% positive, 30% very positive
  - But a lot of comments like "interesting but very complicated"... good/bad?
  - Few interested to take it further
  - LUNCH!

- **Very interested/open to ideas on improvements**
  - In particular, we have a nice app… maybe crowdsourcing development of more: 3D displays, open data for non-programmers?



Masterclass attendee feedback

Please take a minute, before you leave, to tell us what you thought of today's masterclass!

Did you enjoy the masterclass?

☐ No ☐ Yes, a little ☐ Yes, a lot

Do you feel you know more about particle physics than you did yesterday?

☐ No ☐ Yes, a little ☐ Yes, a lot

Do you understand better some of the kinds of things physics researchers do?

☐ No ☐ Yes, a little ☐ Yes, a lot

Do you think what you learned has been useful for your current studies?

☐ No ☐ Yes, a little ☐ Yes, a lot

Do you think what you learned is useful for your thinking about careers or further study?

☐ No ☐ Yes, a little ☐ Yes, a lot

Please write a short phrase that sums up your thoughts about particle physics:

_____

Any comments or suggestions about possible improvements to the masterclass?

_____

Thank you!