

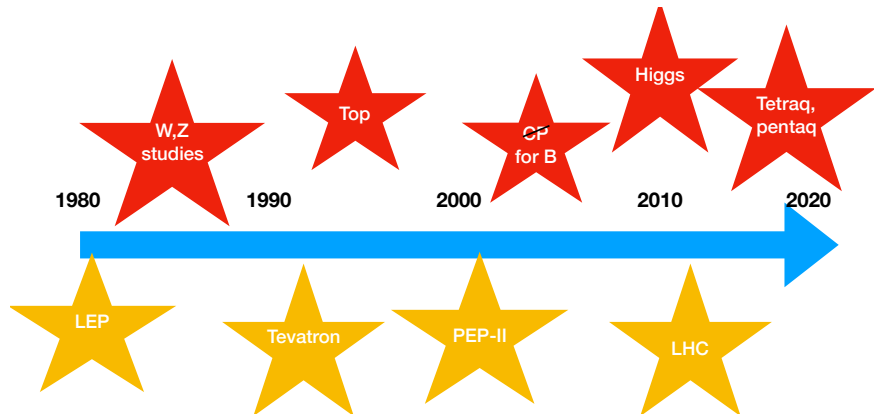
From Brainy Boffins to Cool Colliders: changing the public image of particle physics

Roger Barlow

Schuster colloquium

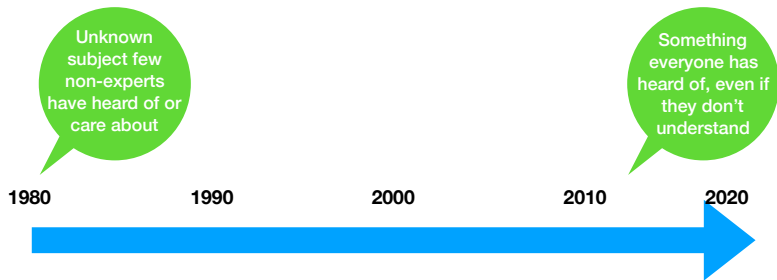
16th November 2022

The Particle Physics story



Fundamental discoveries that will be in the textbooks forever
Amazing technical challenges met and triumphantly overcome

The Particle Physics story



Then: Esoteric subject with no applications, only relevant and interesting for specialists and not for normal people

Now: Everyone knows about the LHC at CERN, and the Higgs discovery

The mission to explain

We all want to do it.

Who?

Different levels: to colleagues, to university students, to school students, to friends and family, to the general public

How?

Different formats: books, articles, talks, TV programmes, YouTube, Twitter, Facebook

Important to choose what works best for you

Why?

Silly question. But because answers to the big questions belong to everyone, not just us.

Yesterday...

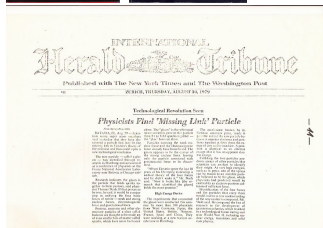
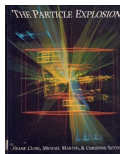
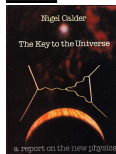
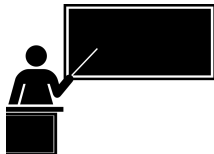
It was called PUS. Public Understanding of Science.

We gave talks
(but couldn't compete with the chemists)

We showed pictures
(but couldn't compete with the astronomers)

Some of us wrote books

We talked to journalists - who weren't really interested, and if they wrote articles wrote about atom-smashers



Yesterday...

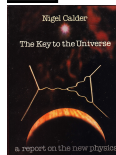
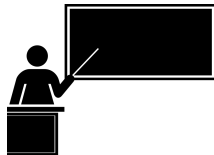
It was called PUS. Public Understanding of Science.

We gave talks
(but couldn't compete with the chemists)

We showed pictures
(but couldn't compete with the astronomers)

Some of us wrote books

We talked to journalists - who weren't really interested, and if they wrote articles wrote about atom-smashers



Today... "Outreach"

Everyone (almost) has heard of particle physics: the LHC and the Higgs
They're used by comedians

(Quite frequently on Have I got News for You)



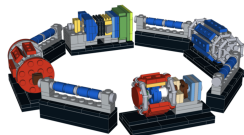
And in video games



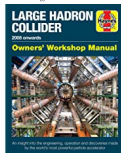
And in cartoons



You can buy
Lego™ models



and books look
different

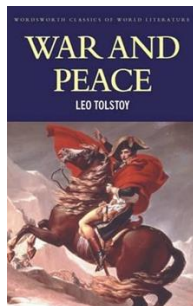


Particle physics is part of popular culture. (As it should be).

How did this change come about?

History (according to Tolstoy)

*“ What is the force that moves nations?
Biographical historians, and historians of
individual peoples, understand this force as a
power inherent in heroes or rulers....
Universal historians ... regard it as the resultant
of a multiplicity of directed forces.
A third class of historians ... see it in what is
termed culture, in intellectual activity.
The only conception capable of explaining the
movement of peoples is that of some force
commensurate with the whole movement of the
peoples ”*



Leo Tolstoy: War and Peace (The appendix)

In a system with high positive feedback, it is impossible to distinguish
causes and effects

History (according to Conan Doyle)



“ There is just one little word of warning which I must give you before I begin. When you hear me speak, you must always bear in mind that you are listening to one who has seen history from the inside. I am talking about what my ears have heard and my eyes have seen, so you must not try to confuse me by quoting the opinions of some student or man of the pen, who has written a book of history or memoirs. ”

Sir Arthur Conan Doyle: The Exploits of Brigadier Gerard

The LHC switch-on

CERN Courier article by Matthew Chalmers, 18 August 2018

<https://cerncourier.com/a/the-day-the-world-switched-on-to-particle-physics/>
LHC switch-on (10.09.08) got MASSIVE coverage: 6000 articles, 2,500 broadcasts, seen by 1 bn
Total contrast to start of SPS & LEP



Reasons

- ‘Black holes could destroy earth’ made a good story
- Quest for Higgs ‘particle that gives mass’ is bite-size understandable
- “God particle” got people hooked
- “Angels and Demons”
- CERN strategy, led by James Gillies, to go for publicity

Before the LHC, no one knew what you were talking about. Now, I can get into a cab in New York or speak to an immigration officer in Japan, and they say: oh, cool, you work at CERN?

– Lyn Evans

The A level syllabus

Yesterday:

Particle Physics was an option taken by final year physics students, after they'd learnt enough relativity and quantum mechanics

Today:

Part of Physics A level, introduced to increase the appeal of the syllabus, when folk realised Rutherford scattering was no longer 'modern' physics

We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development

– Jerome Bruner

Not easy to teach more meaningfully than a set of names and rules. Some of the material out there is pretty grim.

There are lots of kids familiar with words like 'quark' and 'lepton', which rubs off on their families. Our secret arcane language is now public. Good.



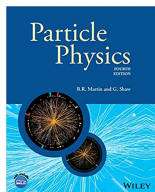
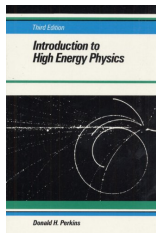
What are the two key types of particle detection?

CLOUD CHAMBER: there is a supercooled vapour which which causes the trail of ions to appear.

BUBBLE CHAMBER: there is hydrogen which is kept above boiling point at a high pressure. When there is a reduction in pressure, bubbles will form due to the ionisation, which means a trail of bubbles will be left.

Changing the name

At some point, "High Energy Physics" became "Particle Physics". The two phrases are essentially interchangeable. 'Particle Physics' explicitly includes low-energy phenomena like the neutron edm and neutrinoless beta decay, but this was never a real problem.



Research groups were mostly usually known as 'High Energy'. This survives in some web addresses: www.hep.manchester.ac.uk

www.hep.ph.ic.ac.uk, www.hep.phy.cam.ac.uk

Now they are all 'particle physics' groups.

Why did it happen? I don't know, but it did.

Does it make any difference? I don't know that either.

Big Bang theory

Soap opera about scientists

Ran from 2007-2019

At the top of the TV ratings, ~ 20 M viewers in the US, 1-2 M in UK. Still around on streaming services

People watch because they find the characters interesting

Great care taken to get the science right (Scientific situations rather implausible, to provide plots for 279 episodes.)



It all started with a big bang

Very different from previous portrayals of 'scientists' in films/TV: lab coats, test tubes, microscopes.

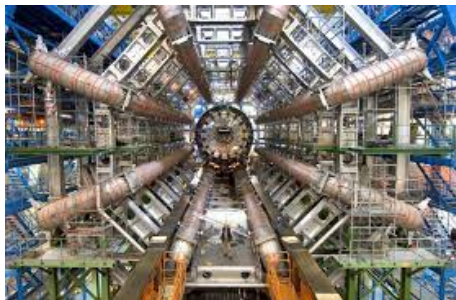
Millions of viewers who know about (particle) physics in the same way they know about doctors from watching *Casualty* and police from watching *Line of Duty*. Or think they do anyway - but with a positive result.

That picture

The iconic image associated with the LHC in the public eye

Articles and programs about the LHC inevitably* use it

Not the LHC at all. It's the ATLAS muon toroids.



Works because it's such an effective picture. So let's not quibble.

* Unless they originate from CERN, which does use pictures of the actual LHC accelerator

The Café Scientifique movement

Many of you will have done these



Talk by 'expert' to wide-ranging audience,
with lots of questions

Usually (in my experience) in a pub rather
than a café...

Sprang up spontaneously, usually centred
round one activist
(support from COPUS, British Assoc.,
Royal Soc. helpful but not crucial)

Sign of general increase of interest in science, not just particle physics?

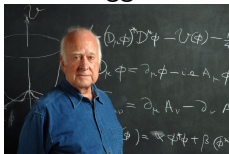
Hit by Covid restrictions, still going in some places

Started in the 1990's

A screenshot of the Knutsford SciBar website. The header features the site's name "Knutsford SciBar" in a large, blue, sans-serif font, with a stylized atom symbol and a flask icon. Below the name is the tagline "Discussing Science in a Bar". The navigation menu includes links for "Home", "About", "Contact", "Founder", and "Past Events". The main content area displays a post titled "1st August 2005 - Antimatter" by Roger Barlow, dated August 1, 2005. The post text discusses antimatter and its potential for space travel. To the right of the text is a small image of a colorful nebula. The website also features a search bar, a "Categories" section with a list of science-related tags, and a "Tags" section with a list of science-related terms.

Personalities

Peter Higgs



Gives personal hook to Higgs story

Engaging personality

Everybody's idea of what a professor ought to look like



Brian Cox



'Ordinary bloke' image
(and voice)
Combined with scientific expertise
and bursting with enthusiasm

Stephen Hawking



Powerful 'Flawed genius' archetype

Great mind trapped in failing body - could make a film about it
But with a sense of fun



Social Media

First there was the internet

Then there was email

Then there was the Web

Then there was Facebook

Then there was Twitter

Then there was LinkedIn

Then there was Instagram

Then there was YouTube

Then there was WhatsApp

Then there was TikTok

Then there was no longer Twitter but there was Mastodon

More and more ways for us to communicate our message, rapidly and effectively, to potentially huge audiences

Everything is changing rapidly and you have to react fast to changing technology to stay ahead of the pack. Luckily we're good at that.

Not a key factor in outreach in the period in question – but it will be in the future

Masterclasses - the idea

It all started

17 October 1996, IOP HEPP group committee meeting coffee break

We had a scheme to support (pay expenses) of speakers going to schools. Funded by COPUS. Very limited take up - and limited efficacy. Not happy

Conversation between me and Ken Long rapidly established some ideas...

- Get them to come to us
- Get audiences of hundreds, not just single classes
- Take a whole day, not just a single lesson slot
- We can then lay on something special
- National publicity for local events all at roughly the same time
- Can provide material (freebies, goody bags)
- We can get them to do stuff as well as just listening to talks

Masterclasses - the first year

January 1997: Ken and I presented plans for Manchester & Imperial to IOP-HEPP. Joined by Oxford, Durham and Liverpool then Swansea and Lancaster

Called them 'Masterclasses', even though that seemed a bit pretentious. But the name worked and has stuck



Annual IOP HEPP meeting in Cambridge that year, which had talks by Frank Close and Stephen Hawking. Videoed these, showed video at Masterclasses and gave copies to schools

Not just talks but doing experiments - using computers. Clusters of PCs installed for undergraduate use - available for other stuff in spring vacation We used the Lancaster package, simulating relativistic kinematics and Terry Wyatt's package

Support from groups

Lots of help from local staff (e.g. in computing cluster)

All available PhD students + staff roped in to help on the day. And nobody complained.

Useful for the school students to see exemplars of where they could be in a few years time.

Only problem was running out of food at lunchtime - learnt the importance of providing small plates.

National + Local

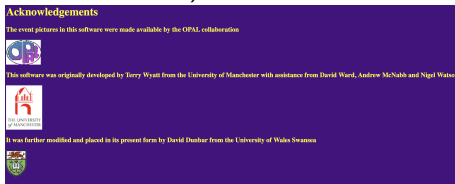
Idea was always 'Think globally, act locally'. National publicity, resources provided, but groups free to do their own thing.
(Oxford used events from DELPHI rather than OPAL)

People did their own thing, but co-operated. (This is from Swansea)

Local groups used lists of schools nearby (letters addressed to 'The head of Physics') known from admissions and open days.

IOP-HEPP provided national co-ordination. Students or teachers could find website giving dates of all Masterclasses in UK universities/institutes

PPARC/STFC provided glossy literature and freebies (such as the BaBar cube)



Masterclasses - across the country

Within a couple of years, most universities with a particle physics group (plus a few more) were running a Masterclass

Also Daresbury and RAL



Every year, thousands of 6th formers, plus teachers, had a whole day of real particle physics.

Healthy tension between needs of learning for exams and the live subject. (“The danger of learning something not on the syllabus”)

They evolved. In due course, LEP events gave way to LHC events

Masterclasses - and beyond

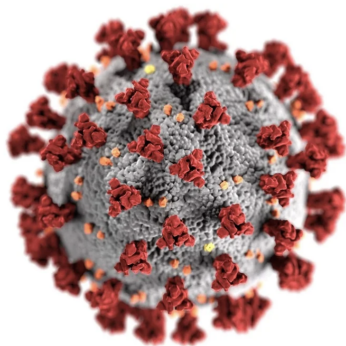
Masterclasses spread to other countries...

Included a joint video-conference to pool results

That requires co-ordination between sites

Dates chosen (Feb-March) incompatible with our need, at the time, to have them in UK spring university vacation





And then there was Covid

Masterclasses - the future

Some places have restarted, but...

This is from the current
UKRI website

Particle Physics Masterclass programme

Particle Physics Masterclasses are one-day events hosted by particle physics groups at universities and laboratories across the country. They are aimed at students taking particle physics modules at AS or A level, but are open to any student interested in studying particle physics. Some universities also run days specifically for GCSE students.

The different masterclasses include a selection of the following activities, run by particle physicists:

- lectures
- 'hands-on' workshops
- computer sessions
- laboratory tours
- live video chats with CERN and international masterclasses.

Every masterclass is slightly different, but all provide excellent support for particle physics in the curriculum and deliver a fascinating insight into this exciting field of physics.

There are currently no events scheduled.

Many of the Particle Physics Masterclasses are oversubscribed. Teachers who would like their students to participate should contact the appropriate person as soon as possible.

There appears to be no national co-ordination. Which there needs to be (in a loose, non-prescriptive way).

Does the IOP HEPP group still exist? Last website update 2019

Final thoughts

Particle physics is part of today's popular culture

As it should be

But this is not a given. Things could revert.

We need to work to make sure it stays that way

Masterclasses are one way of doing this.

Long may they continue!