

Particle Physics for Primary Schools: Enthusing future physicists



Prof Cristina Lazzeroni
& Dr Maria Pavlidou



UNIVERSITY OF
BIRMINGHAM

SCHOOL OF
PHYSICS AND
ASTRONOMY



Science & Technology
Facilities Council



making physics matter

The beginning



Amanda Poole
Primary School Teacher and
Ogden Teacher Fellow



Maria Pavlidou
UoB Physics Liaison Officer
and Ogden Fellow

And me, a Particle Physicist
with strong interest in
Public Engagement

Why primary schools

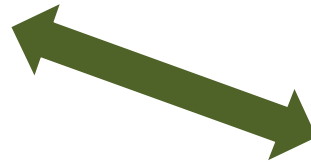
Although Particle Physics is not part of the UK primary school curriculum, it offers exposure to cutting edge research and current discoveries - inspiring !

Very valuable skills in understanding how science works

Importance of enthuse young children to science as soon as possible

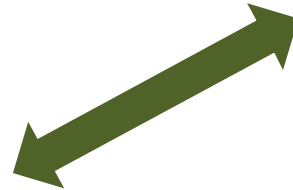
A collaboration was born !

Amanda knows
what works best
with primary pupils



Maria understands
particle physics and
can dumb-it-down
to the required
student level

Cristina knows what
particle physics
knowledge can be
delivered to students



Idea:
The World of Particles



Important link
between academics
and teachers

The trials And the result

- Amanda's pupils were the subject of the first trial
 - Amanda gave feedback
 - Resources were shaped and improved
 - Workshop was rolled out to more primary schools
 - Feedback was consistently excellent
 - More schools started to ask for it
 - A need for more people to deliver it, to make it sustainable....
-
- The resource became part of the UK Ogden Trust portfolio for Physics Teachers, available free from the Ogden web page
 - The UK Institute of Physics is also interested

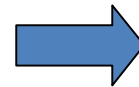
The activity in more detail....

Based on creative and game
learning

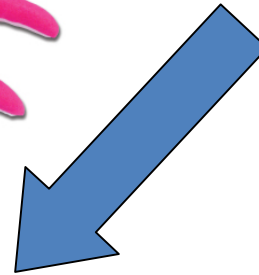
Brief Introduction to concepts: Interactive, with a few props



The PARTICLEZOO



Atom model



Russian dolls



Scattering balls

The world of particles : ideas

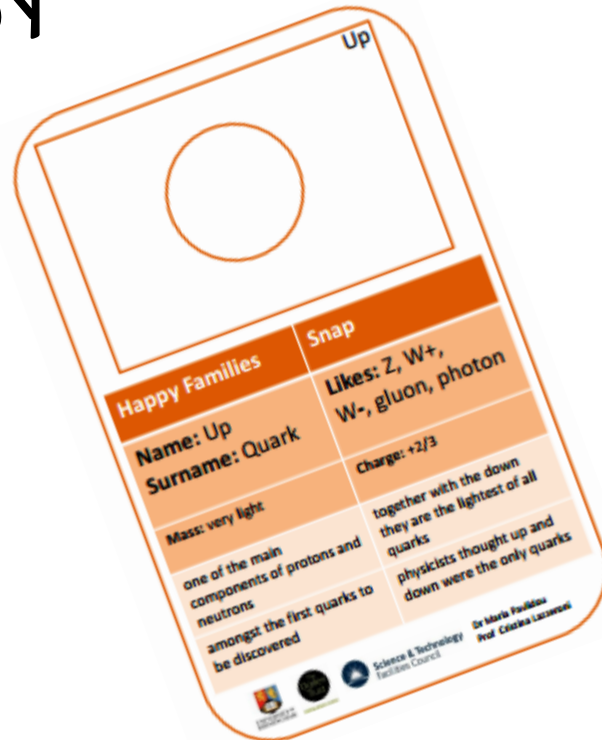
- **PARTICLES:** All matter is made out of small particles (atoms) which are made out of even smaller particles (protons), which are made out of even smaller particles (quarks) - smaller than anything else you can think of !
- **ACCELERATORS:** the LHC is like a particle motorway where particles are accelerated to very high speed
- **SMASHING PARTICLES:** just like you may take apart a toy, we smash particles together, to see what's inside and how they work
- **DETECTORS:** the detectors are like very fast digital cameras

- **FAMILIES:** fundamental particles belong to three groups: quarks, leptons, bosons
- **MEMBERS OF ONE FAMILY:** within a family each member has its own name but they all share the same surname e.g. up quark, down quark, charm quark etc.
- **CHARACTERISTICS:** e.g. the top quark is the most massive of all quarks
- **BEHAVIOUR:** particles like and dislike other particles; they play (interact) only with the ones they like
- **ANTIFAMILIES:** antimatter differs from matter

And some scope for the latest research news as well !

Using Games to embed knowledge

Happy Families



Snap

Creativity in action: particle making



Very light	Light	Heavy	Very heavy
Photon	Strange quark	Charm quark	Top quark
Gluon	Muon	Beauty quark	Z boson
Up quark		Tau	W plus boson
Down quark			W minus boson
Electron			Higgs boson
Electron neutrino			
Muon neutrino			
Tau neutrino			



Creative approach to learning



“I did this because gluons are “sticky” and this is why all the feathers are stuck!”



“When I grow up I want to be a particle physicist and find more anti-particles!”



Creative writing

- **Create a short story that shows the behaviour of the particles you have made, and act it**

Should not put limits to creativity:

we also had **poems, songs and raps** !
(an example in my last slide)

All enjoyed the story acting

Evaluation

Engaging strength, enjoyment, level of learning

After the session, all were able to easily answer:

What does the LHC do ?

How do scientists find out about the structure of small things like atoms ?

How many particle families do we have?

How many quarks can you name?

Can you remember any special feature of a particle of your choice?

Can you tell us something about how science works?

“We might find that there are smaller particles inside quarks”

“Maybe there are more particles than these”

The outcome So far

- Sets of resources produced, ready to be distributed to Educational Officers in the form of a box
- First ever training day for Educational Officers
- Due to the creative nature of the workshop, we have incorporated it into the EU project
- Educational paper written and accepted for publication in IoP magazine *Physics Education*
- CERN workshop to be delivered to EU teachers during their summer school



Extension to low secondary schools (in progress)

- Approach is very similar but pitched to an higher level
- Additional concepts include Rutherford Experiment of alpha scattering
- Conservation of charge
- Matter-antimatter annihilation
- Examples of allowed and forbidden interactions

Conclusions

- New activity, truly based on particle research, successfully delivered to primary schools in UK
- Excellent outcome, children enjoy and learn
- Engagement with local school teachers and Educational Officers and PE Fellows
- Push the boundaries of what has been tried so far in university outreach - different approach
 - challenge colleagues with a different type of audience
 - Impact through quality of interaction

The Particle Song

by N Rukandema and A Moody, 13 yrs old

(sing to the tune: "I will survive")

One day a little muon
Walked out his door
He had opened up his curtains
And swept the floor

But after getting up
And recovering from his dream
He opened up
And this is what he's seen

It was a muon
Muon neutrino
He was walking down the street
Drinking vino

And once their eyes met
For the first time muon thought
He found love
And wasn't scared at all

And poof like that
They disappeared
They ran away inside
Could not be heard

And in their place
Was a W-minus
It just appeared
No reason to be feared

It ran outside
Onto the street
Until it bumped into a lamppost
And fell onto its feet

But coming in the distance
Could be seen an anti-charm
What was this?
A beauty on its arm

Another pair
With loving hearts
They rode off into the sunset
Arm in arm

And here is the end
Of our classic tale of chance
We say goodbye
Goodbye from us!