

# Particle Physics

ITW2024 Study Group 8



Cheers! Salud! Prost!

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# Curriculum & Classroom Connections

*We come from different places with different curricular frameworks.*



# Where to Sneak Particle Physics in

## Curricular Opportunities (Physics)

Radioactivity  
Units and Prefixes  
Introduction of Forces  
Magnetic Forces  
Electric Forces  
Circular Motion  
Antimatter experiment (kinematics)  
Vector Addition  
Optics

## Curricular Opportunities (Math)

For younger students: angles in tracks, radius, finding shapes in tracks, bubbles  
For advanced students: Series

## Curricular Opportunities (Chemistry)

Standard Model

## Curricular Opportunities (Technology)

Graphs  
Statistics and Errors

## Other Curricular Opportunities

In Health, talking applications  
In economics or ethics, equality in access to detectors and accelerators  
In astronomy, cosmological predictions

## Beyond the Curriculum

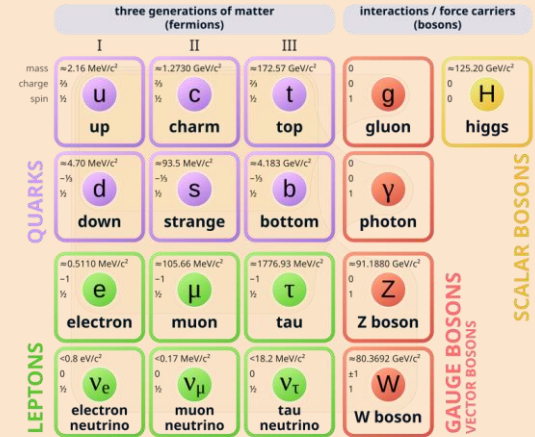
Workshops, Master Classes through Quarknet or other programs  
Clubs and other programs  
3D printing, Maker Space

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# 3 Key Ideas for Students

1. Particle Physics tries to answer the deepest questions humans ask.
2. Evidence (data) confirms the standard model of elementary particles.
3. Scientists have achieved through collaboration a standard model that is very successful.

## Standard Model of Elementary Particles



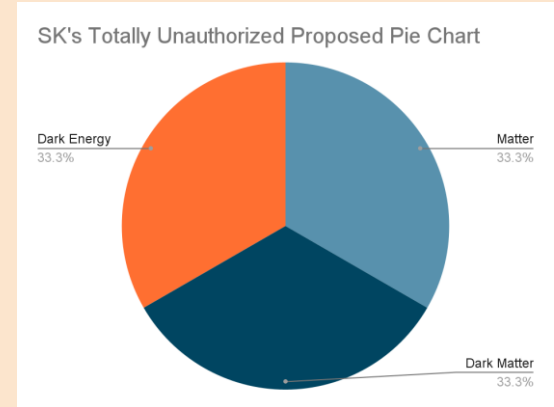
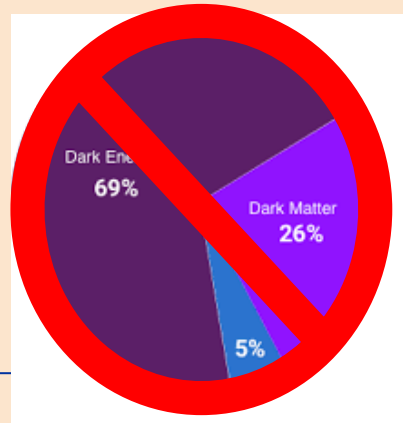
But there are lots of questions left to answer...

Dark Matter / Dark Energy

Where did the antimatter?

What about gravity?

And neutrinos?



# Potential Students' Conceptions & Challenges

Particles are divisible.

There are only 3 subatomic particles.



If we look really hard, we could see forever.

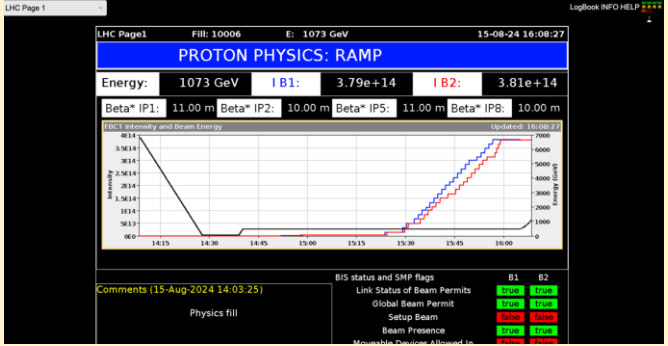
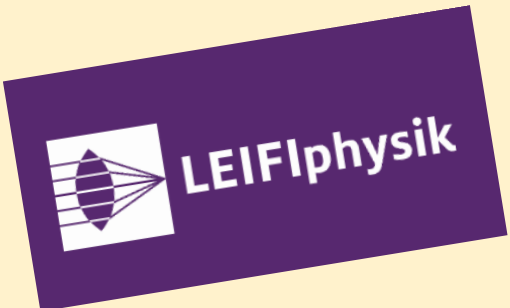
If I try hard enough, I can build something to go faster than  $c$ .

Scientists are crazy! And usually are dudes working alone.



Seeing a small thing requires a small tool, right? Like a microscope?

# Useful Material & Resources



Physics Education Research

[cern.ch/PER](https://cern.ch/PER)



# ITW2024 Study Group 8

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One way in which our thinking has changed...

Cooperation and collaboration is a possible in productive, positive work environment, even in the context of competition.



Highlights, snapshots, final words...

Feynman Diagrams, AWAKE lectures

CERN trusts us, cares about us

CERN as Swiss Physics Resort

Science is fun and all about collisions



Mahalo! Gracias! Dankeschön! Dhanyabad!