Engineering in Particle Physics

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SYLLABUS	SYLABUS STATEMENTS	PARTICLE PHYSICS TECHNOLOGY	ENGINEERING COMPETENCIES
UK syllabus for A level	To explain the role of electric and magnetic fields in particle accelerators (linac and cyclotron) and detectors (general principles of ionisation and deflection only)	Particle accelerators Particle detectors	Critical thinking Creative problem solving Curiosity Willingness to try new things Learning skills Information searching skills Leadership Professional behavior Communications Teamwork skills Project management
Indonesian Syllabus	To describe the characteristic of atom nuclei, radioactivity and the implementations in technology.	Electrical power system	
France **&** **Ghana Syllabus** **US Syllabus**	Recognising the relation between the strength of a magnetic field and the intensity of electric current, for a solenoid or a wire	Magnetic field strength and lines Make a simple electromagnet using a copper coil and iron core. Measure magnetic field strength using a compass or electronic device (ex. smartphone with compass app) Design, build and test an electromagnet. Investigate magnetic effect of high currents in straight wires with compasses Perform deductive reasoning.	

Curriculum Around the World

How Scientists See the World

https://youtu.be/jyaLZHiJJnE

Image from:
https://vrscout.com/news/ghostbusters-pokemon-go-ar-game/

How Some Scientists See Engineers

https://www.youtube.com/watch?v=_gVG_sCp9RQ

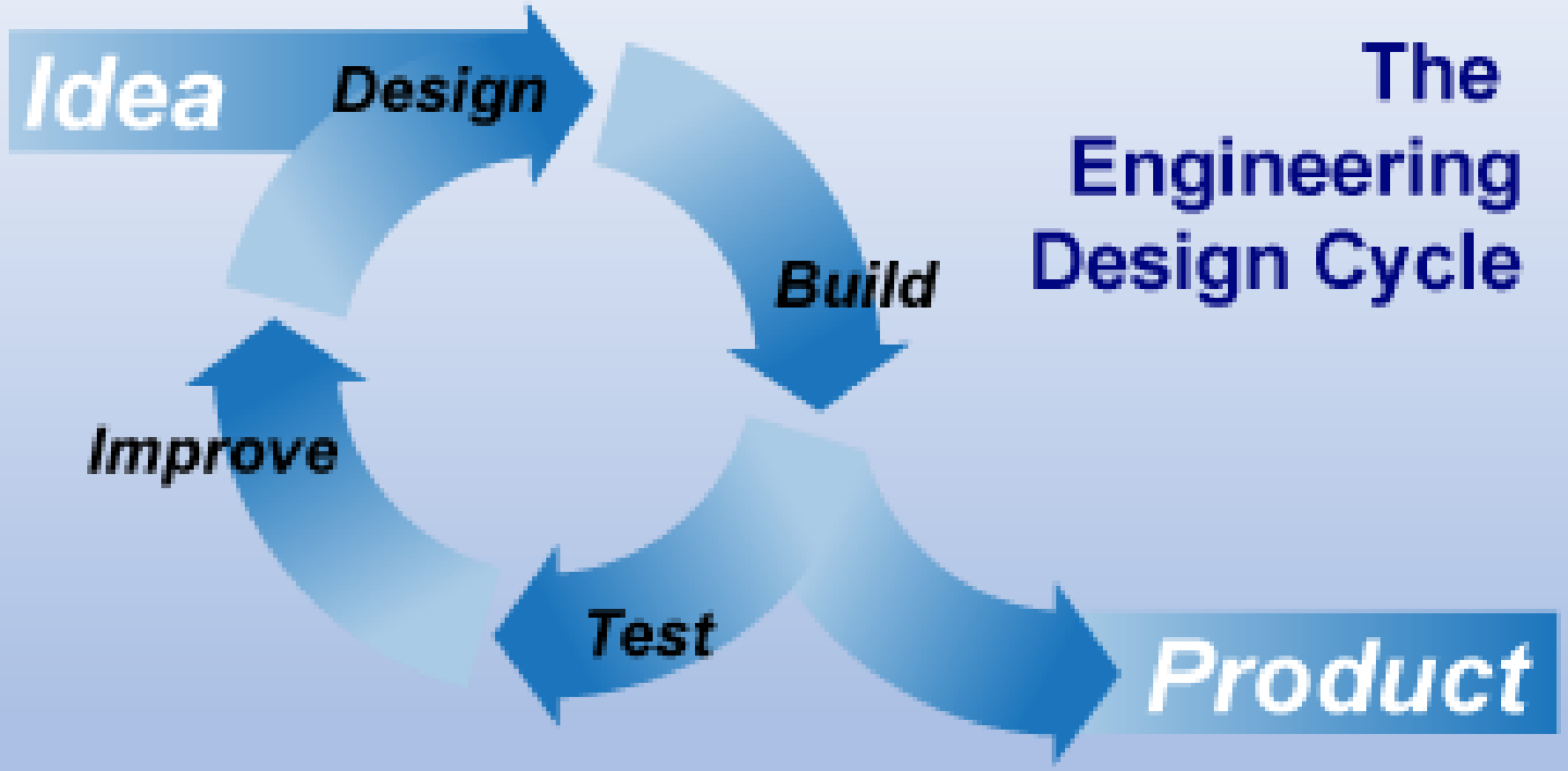
Image from
http://bigbangtheory.wikia.com/wiki/California_Institute_of_Technology

A Reasonable Request from a CERN Scientist to a CERN Engineer

"Nothing contained by nothing."

https://home.cern/images/2013/03/tunnel-tour

Engineering as a Practice



http://ergopedia.com/ergoweb/pedagogy_engineering.php

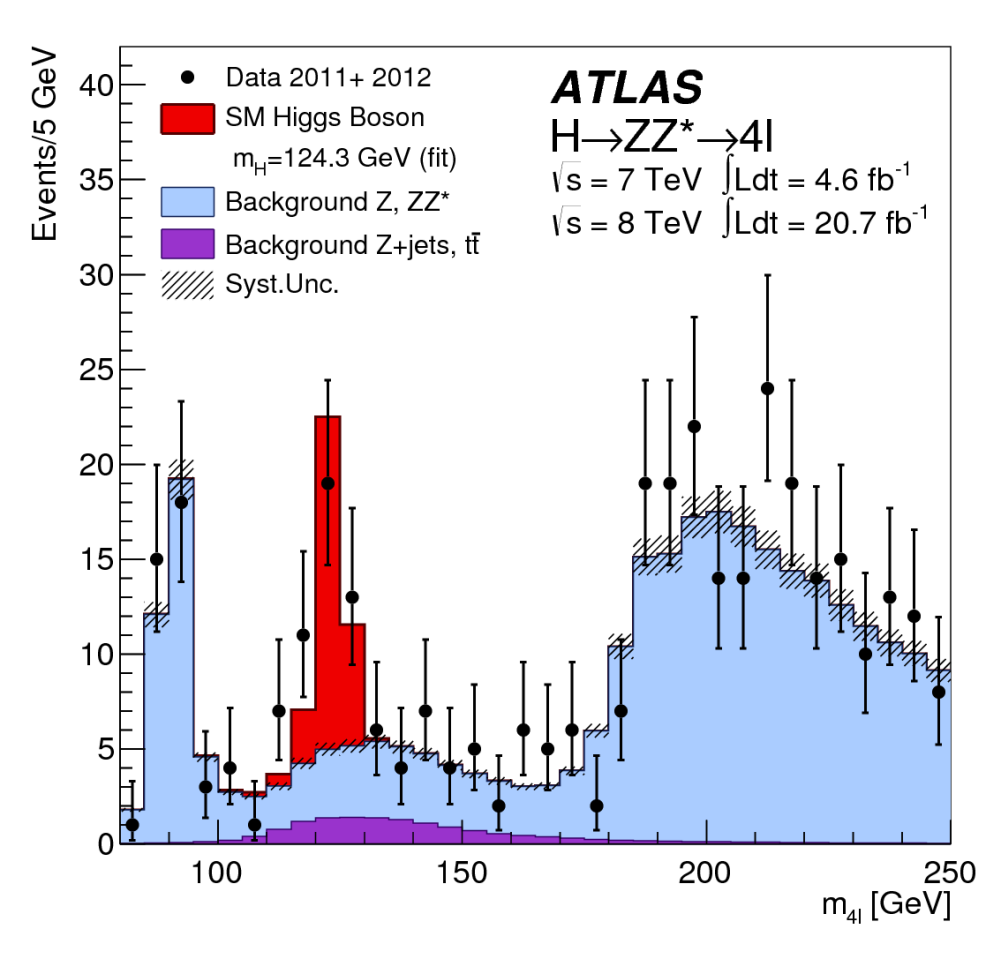
Hypothetical Engineering Job Description of Ray Vaness

C Communicate and Colaborate
E Educate
R Reasearch
N New technologies
I Ingenious
N Nurture
G Guarantee

Engineering Considerations at CERN

- Data Visualization
- Data Acquisition
- Computer Hardware and Network Infrastrucure
- Microelectronics
- Magnets
- Cryosystems
- Power Supply
- Ultra High Vacuum

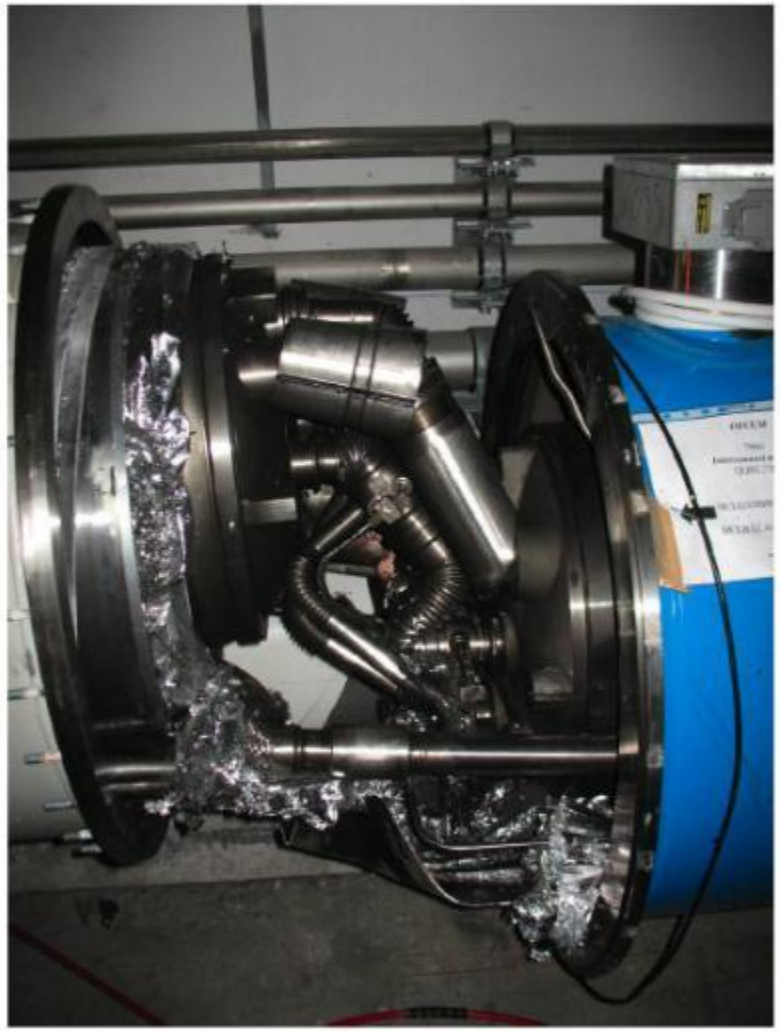
Scientific Tolerance



Average 19 +/- 5

5 σ

LHC Weld Failure



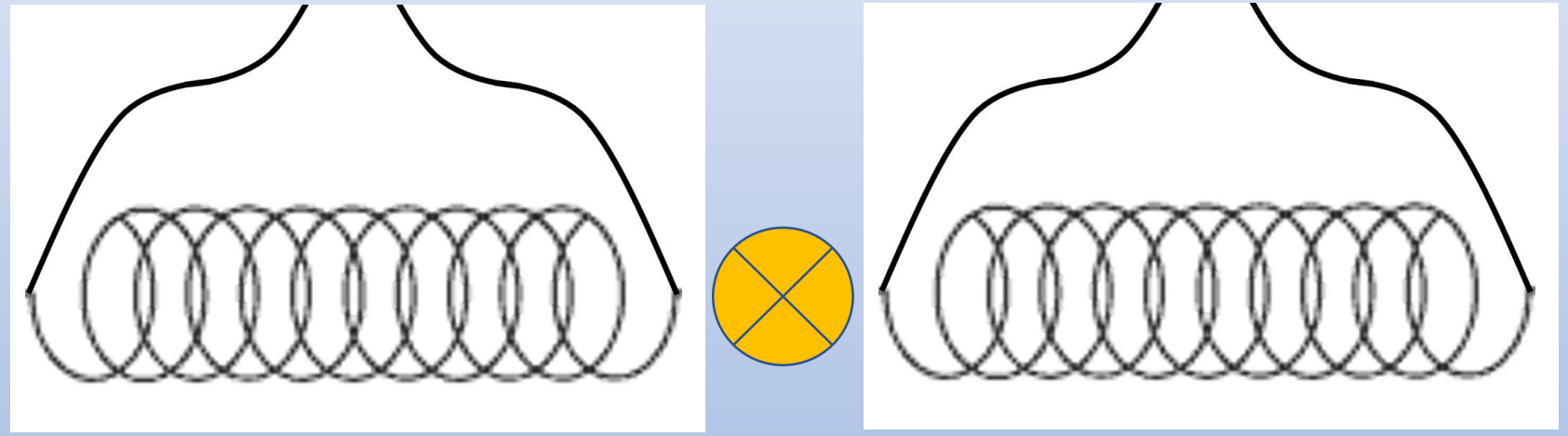
Weld Tolerance: 2464 +/- 0

(Mis)Conceptions about Key Ideas

- Magnetic field and Electric Charge
- Conventions
- Application of Faraday's Law
- How to recognize Electricity and Magnetism
- Permanent vs Electromagnets

Beam Line Challenge (BLC)

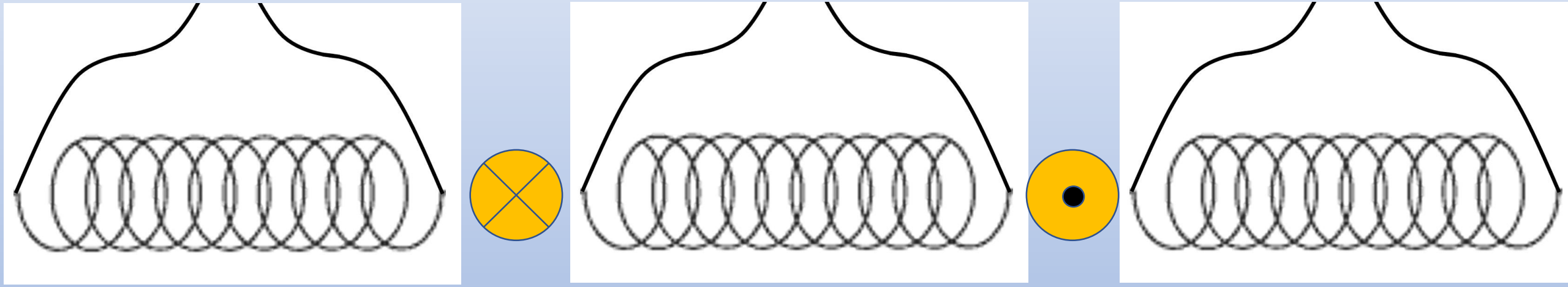
Students must design, build and test an electromagnetic system to adjust the position of a “particle beam” system.



Beam Line

BLC II

Students must design, build and test an electromagnetic system to adjust the position of a “particle beam” system.



Beam Line

Beam Line

Useful Resources

- PhET
- Exploratorium Snacks Portal
- My Favourite Experiments (shameless plug)
- Times Educational Supplement (tes)
  TeachEngineering.com
- NASA.gov
- S’Cool Lab: Electron Beam
- Minute Physics-Magnets-How do they work