



Particle Accelerators



Hellen



Federico



Ragnhild



Salman



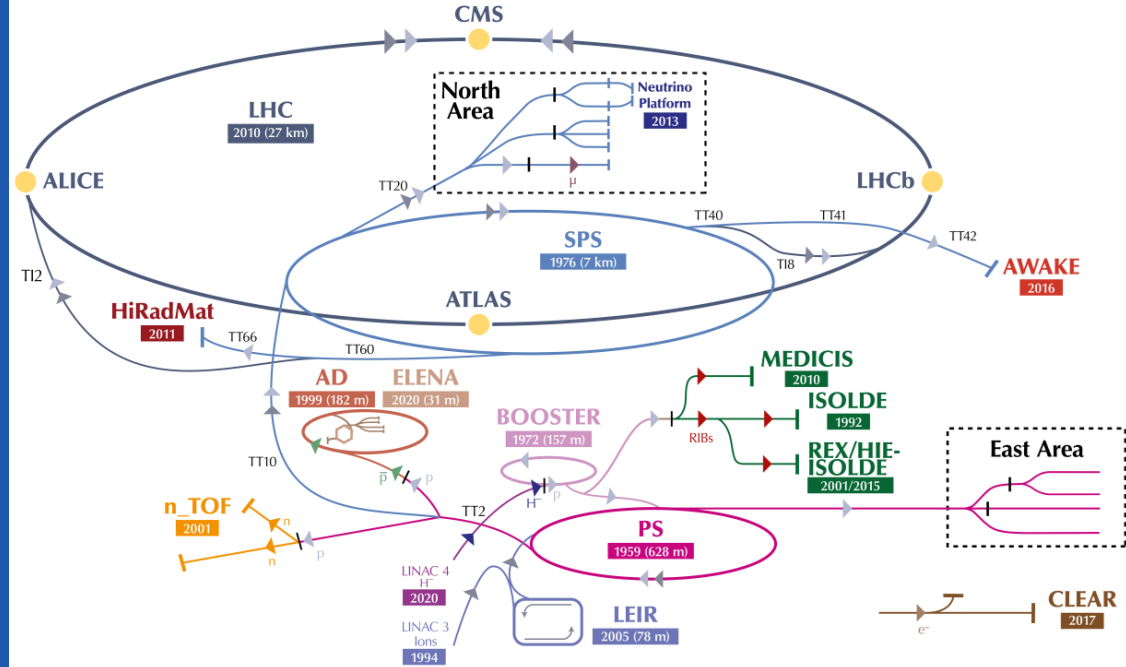
Greg



The CERN accelerator complex Complexe des accélérateurs du CERN

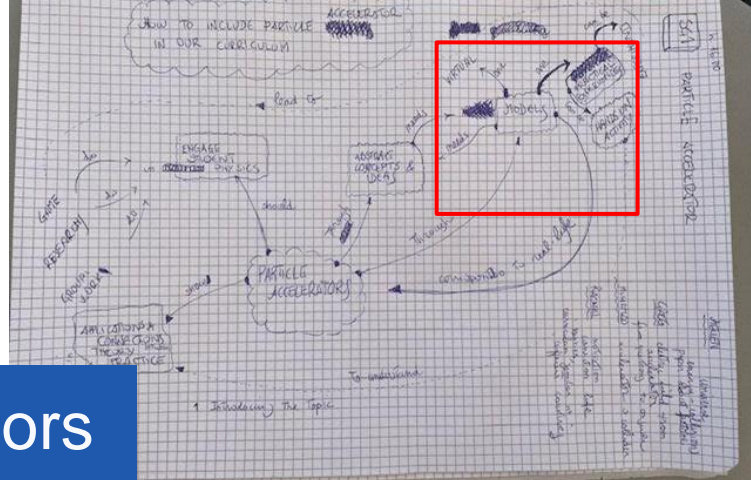
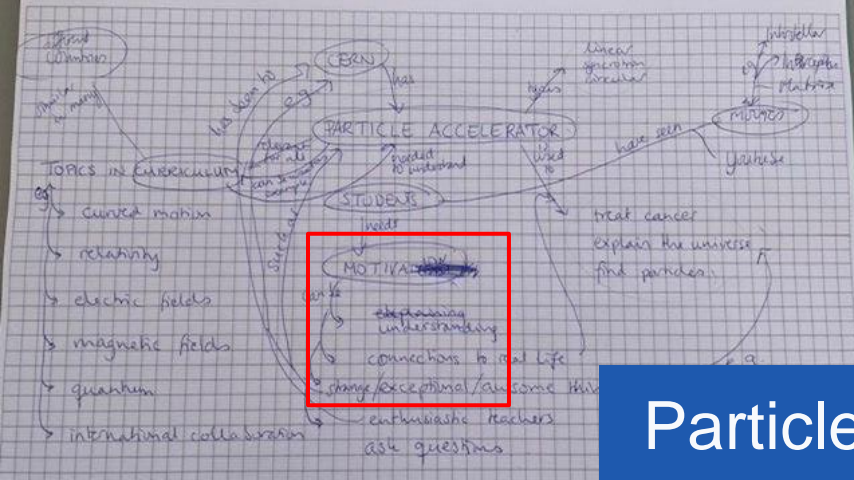
Agenda

- Review our key takeaways about Particle Accelerators
- Provide Appropriate Resources
- Explain all components of the Accelerator Complex

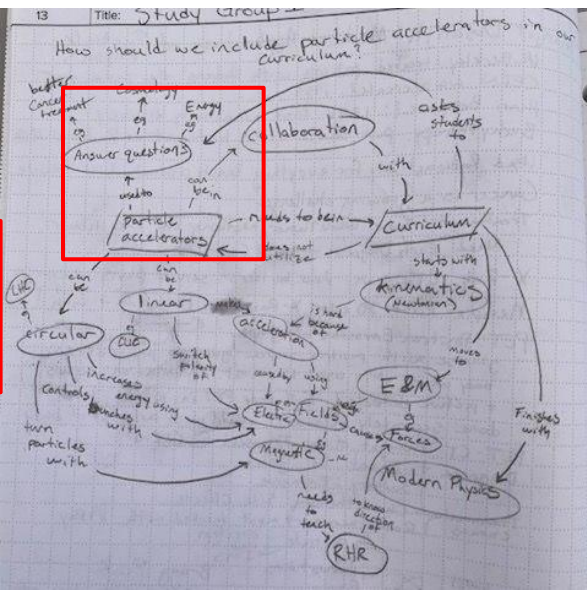
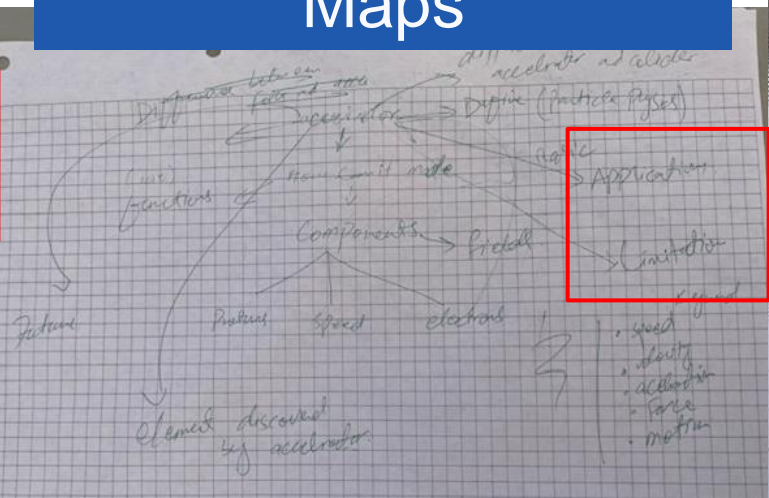
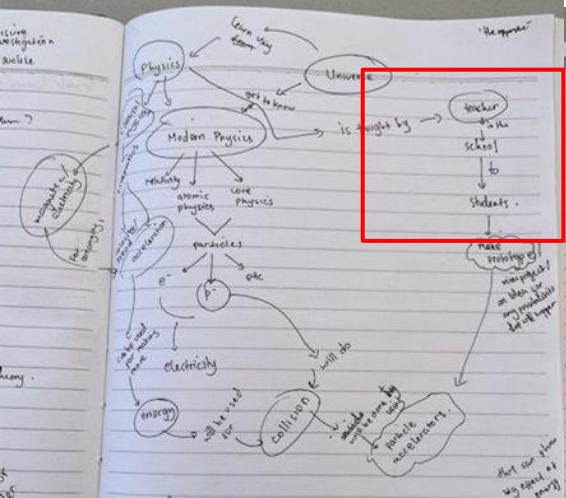


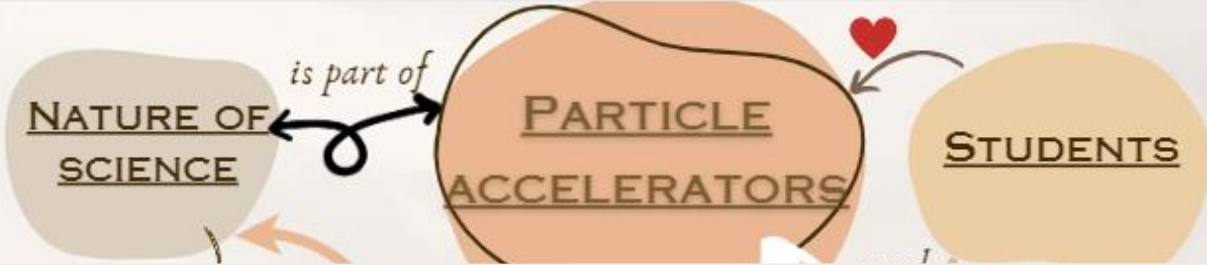
en anions) ▶ p (protons) ▶ ions ▶ RIBs (Radioactive Ion Beams) ▶ n (neutrons) ▶ \bar{p} (antiprotons) ▶ e^- (electrons) ▶ μ^- (muons)

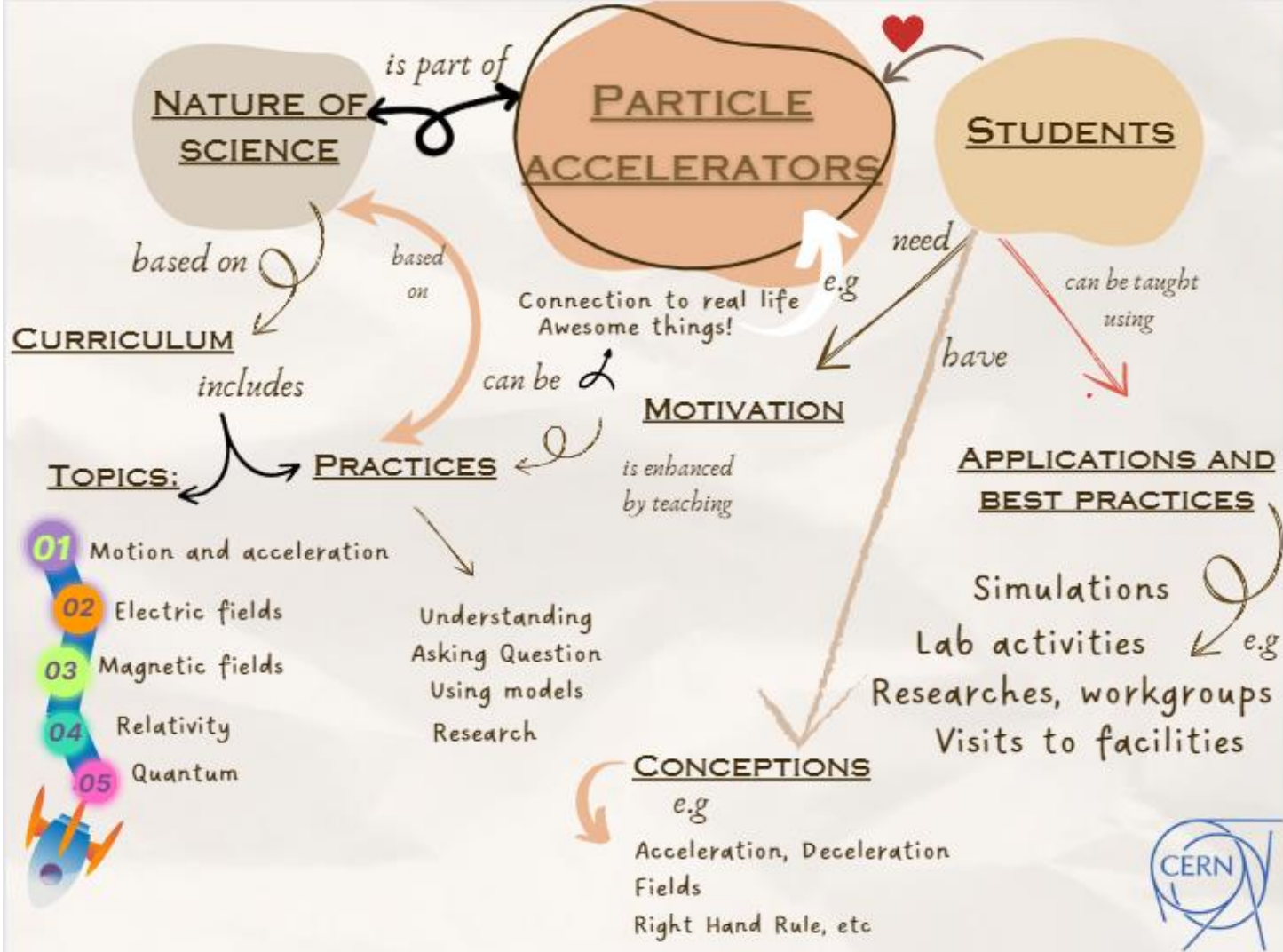
Large Hadron Collider // SPS - Super Proton Synchrotron // PS - Proton Synchrotron // AD - Antiproton Decelerator // CLEAR - CERN Linear Accelerator for Research // AWAKE - Advanced WAKEfield Experiment // ISOLDE - Isotope Separator OnLine // REX/HIE-ISOLDE - Radioactive Experiment/High Intensity and Energy ISOLDE // MEDICIS // LEIR - Low Energy Ion Ring // LINAC - LInear ACcelerator // n_TOF - Neutrons Time Of Flight // HiRadMat - High-Radiation to Materials // Neutrino Platform



Particle Accelerators Through Concept Maps







Best Practice: Use Particle Accelerators as a Example in Each Topic of the Curriculum

Kinematics:

- Have students **Ask Questions** about LHC animation
 - Velocity, Acceleration, Deceleration

Circular Motion:

- **Model** a cyclotron with force probe and lengths of string



Best Practice: Use Particle Accelerators as an Example in Each Topic of the Curriculum

Electric Field:

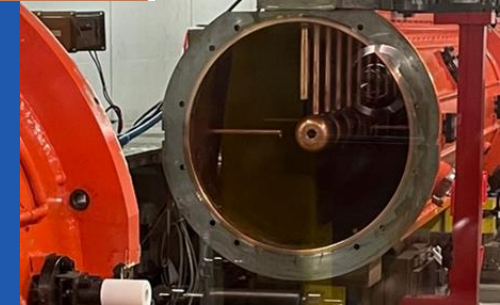
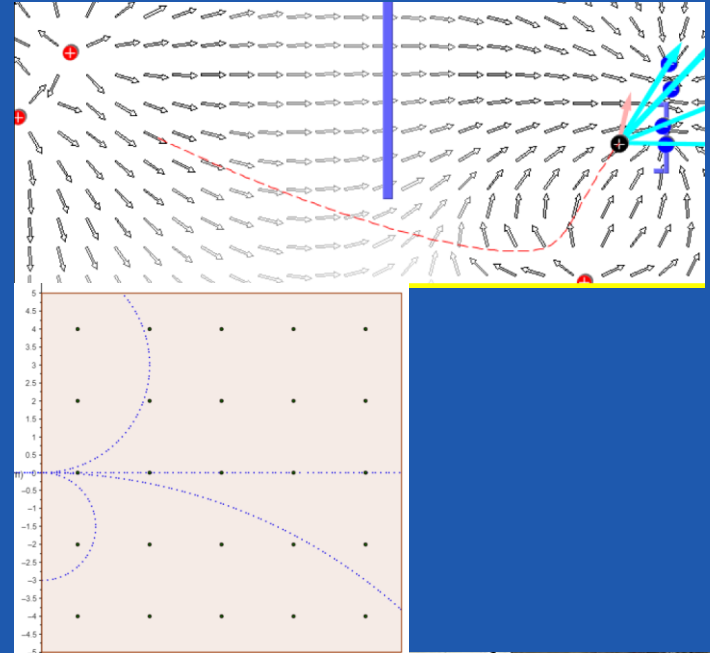
- Focus on Accelerating charges, not static

Magnetic Field:

- Identify particles by their tracks to fill the LHC with the right particles

Waves:

- Discuss radiofrequency cavity properties



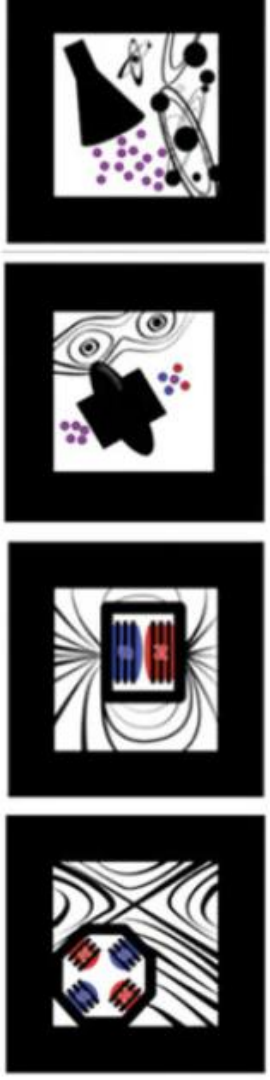
Best Practice: Augmented Reality

acceleratAR can simulate particle accelerators

- A Particle Source
- Dipole
- Dispersion
- RF Cavity
- Focusing Quadropole
- FODO Cell

Materials:

- Phone with AR app
- printable cutouts



Best Practice: Visits to Facilities

Hospital - Department of nuclear medicine

- Therapy via Bragg Peak [L'adroterapia | Fisica e medicina](#)
- Diagnostic Technology [Particle accelerators: why are they important](#)

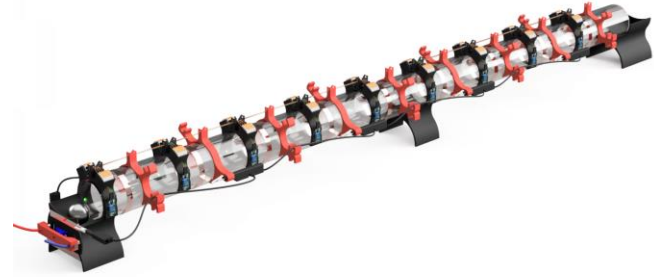
Factories

- Material processing (semiconductors, ...)
- [Preservation and Sterilization](#)
- Element analysis (geology, ...)



Helpful Material and Resources

- CERN
 - [3D Printed Linac](#) and other fun from cern.ch/per
 - [Applications of Particle Physics - CERN- 1994](#)
- [QuarkNet](#): Making It 'Round the Bend (Qualitative and Quantitative)



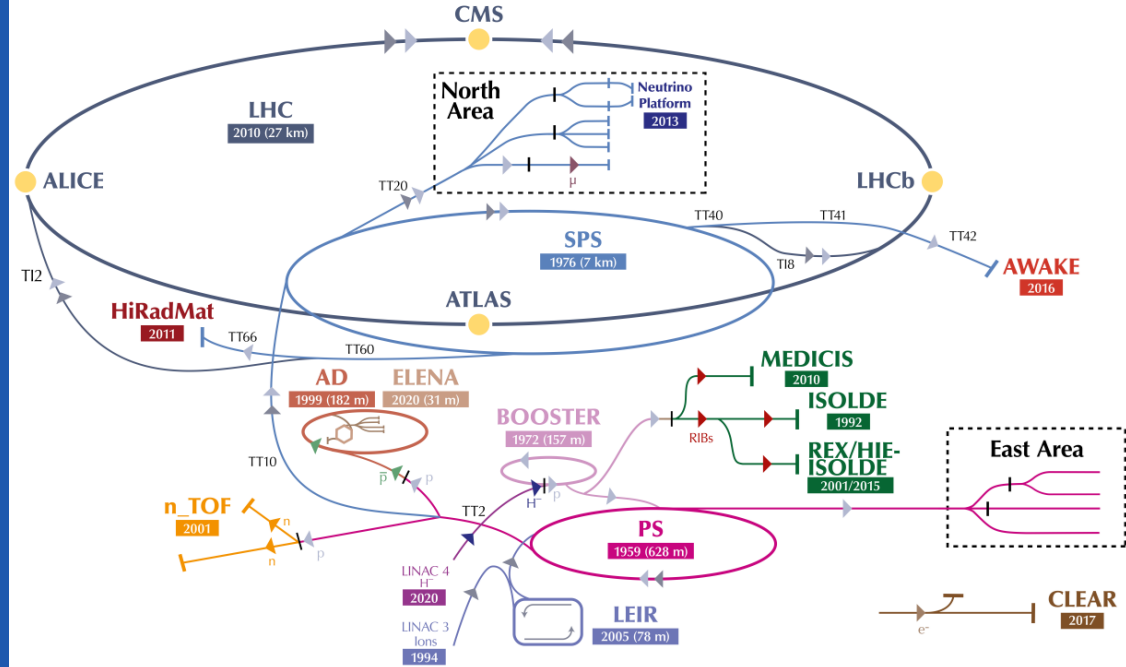
QuarkNet		ABOUT	DATAACTIVITIES		
	Making it 'Round the Bend - Qualitative Students explore the effects of electric and magnetic fields on particles.	LHC	Level 1	Electricity & Magnetism, Kinematics	1, 2, 3, 4, 6, 7

- Great E&M Simulations like the Cyclotron
 - [PhET: Electric Field Hockey](#)
 - [HTML5 Simulations for Physics](#)
 - [Physics: E&M Simulations](#)
 - [Physics Aviary](#)

The CERN accelerator complex Complexe des accélérateurs du CERN

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References

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<http://physics.bu.edu/~duffy/sims.html>

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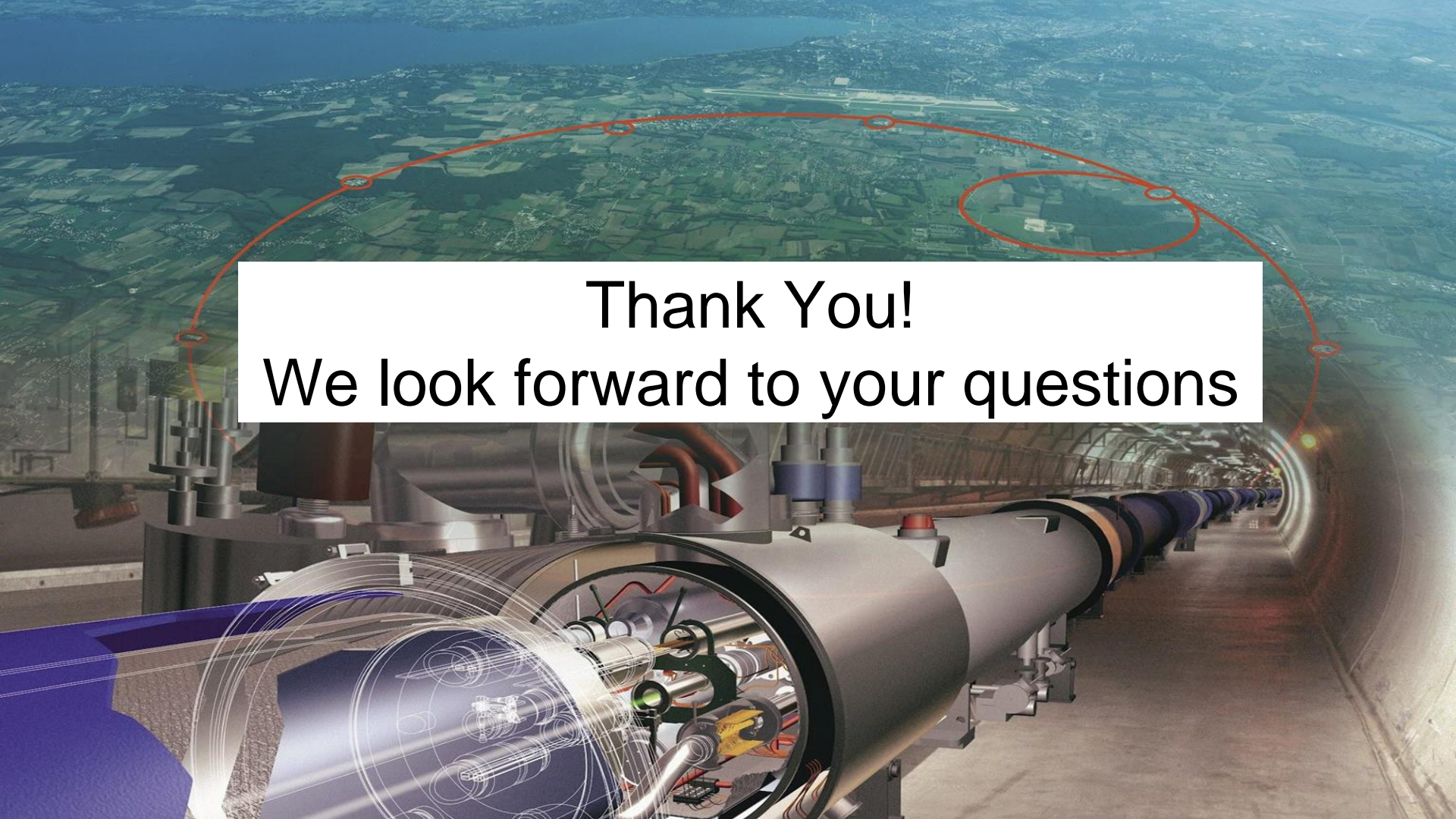
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Media Citations

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- <https://cds.cern.ch/record/2800984/files/CCC-v2022.png?subformat=icon-1440>
- <https://www.youtube.com/watch?v=pQhbhpU9Wrg>
- <https://www.youtube.com/watch?v=mIEABZVTge0>
- <https://www.youtube.com/watch?v=gZEBE6cCOjM>
- <https://www.youtube.com/watch?v=vleRLeQq7V4>
- https://www.youtube.com/watch?v=Tv4KreXY_RU
- <https://scoollab.web.cern.ch/linac3D>
- https://cms.cern/sites/default/files/field/image/LHC_and_mountains-0503019-1-nice.jpg

The image is a composite. The top half shows an aerial view of a green, hilly landscape with a blue body of water in the distance. A red line with several circular nodes traces a path across the landscape. The bottom half shows a long, dark tunnel with a particle accelerator inside. The accelerator consists of a series of large, cylindrical sections connected by smaller sections. The tunnel is lit from the end, creating a perspective effect. The text is centered in a white box over the middle of the image.

Thank You!
We look forward to your questions