

# Crystal calorimeter

## Summary

In this proposal, we will outline why we want to come to CERN, what our main goals are and what our experiment involves.

We have come up with the unique idea of growing our own crystals, with the aim of making a *calorimeter*. The calorimeter will initially be tested at the Radboud University in Nijmegen to ensure that the experiment functions as it should. We then hope to bring our experiment to CERN to see how our calorimeter performs with high energies.

Our ultimate aim is to make ordinary high school students as enthusiastic about physics as we are. We want to show them that physics really can be interesting, challenging and fun!

## Why do we want to come to CERN and what do we hope to take away from the experience

We want to win this competition for a number of different reasons;

Firstly, we are all extremely interested in subatomic research. We have already learned a lot about particle physics whilst putting our plan together but we would really like to broaden our knowledge in this area. We feel the best way to do that is by running our experiment first-hand at CERN." *The only source of knowledge is experience*" – A. Einstein<sup>1</sup>

Secondly, we want to come to CERN to learn more from the researchers themselves. Not only would we like to know more about how to set up a large experiment, but we want to ask the researchers how they came to work at CERN and what they had to do to achieve their current positions. In addition, we are interested in finding out more about the work the researchers are involved in and their daily activities at CERN.

Thirdly, we want to run experiments at a level that is impossible to do within a school environment. This experiment challenges us; both in the field of theory and in the field of practical skills. If we won the competition, it would allow us to come to CERN and increase our knowledge and experience and to *write upon the blank slate through experiences in order to increase our knowledge*, as philosopher John Locke said.<sup>2</sup>

Finally, our most important goal is to engage other students. Through our experiment, we hope that other students will become interested in the wondrous world of physics, just as we are. We want to let students see that physics is interesting, challenging and fun. We want them to realise that physics is accessible too; everyone is able to set up and run an experiment. In short, we want our unique calorimeter to be an inspiration to other students!

---

<sup>1</sup> <http://www.brainyquote.com/quotes/quotes/a/alberteins148778.html>

<sup>2</sup> *An Essay Concerning Human Understanding* – John Locke

## Initial thoughts

The experiment will be carried out as follows:

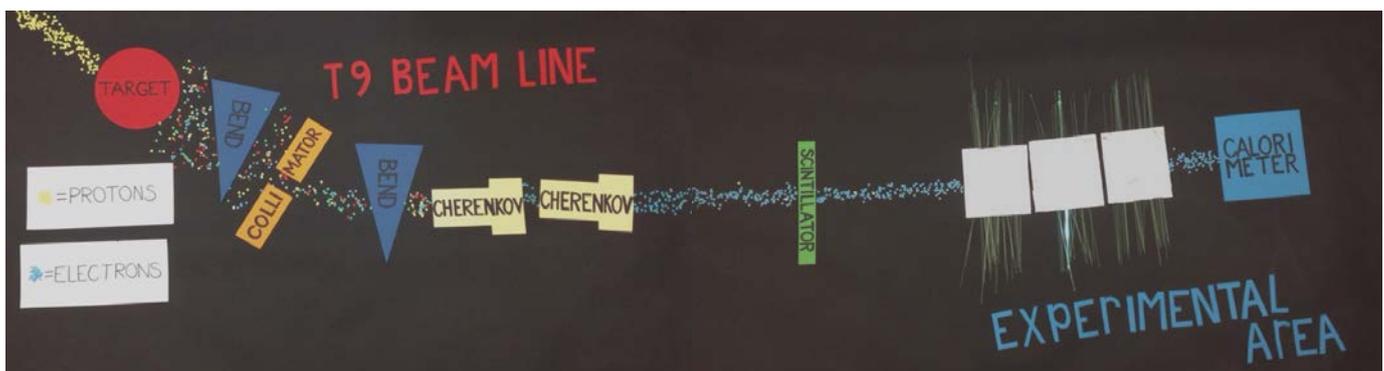
### Building the calorimeter

1. Grow crystals at school, we have already experimented with this. We will be growing the crystals using heavy materials, like lead. In this way we will need fewer crystals to absorb a greater amount of energy.
2. Put glass fibres around them, to collect and transfer the light emitted by the crystals to a photo sensor. The fibres will be glued in slots engraved in the crystal, in such a way that the beam line doesn't go through the fibres.
3. Wrap the crystals in tinfoil to prevent the light from escaping or entering other crystals.
4. Hook up a photo detector to the fibres, to detect the light emitted by the crystals. We will either use photo multiplier tubes or photo diodes.



### Testing and calibrating the calorimeter

5. Test the calorimeter with cosmic rays to make sure it actually works. It would be very embarrassing if it doesn't work in CERN.
6. Bring the calorimeter to CERN to calibrate it with the different quantities of energy that can be provided by the T9 Beam Line. We will use the calorimeter in an experiment using electron beams with energies of 500MeV/c up to 10GeV/c.
7. In conjunction with our calorimeter, we will also use the CERN calorimeter, in order to measure the amount of energy we missed in our calorimeter, and to compare the performance of our calorimeter to the calorimeter from CERN.



After returning from CERN

8. We will present our scientific journey at our school.
9. Other students can benefit from our experience through the lab courses we will organise.
10. In a short documentary, we will show what we achieved at CERN and how we used this knowledge at school.

We want to thank CERN for this wonderful opportunity. We really enjoyed designing the experiment and we are incredibly happy with the knowledge we have already gained.

Best regards,

Lisa Biesot

Milou Engelen

Guusje van Haren

Rolf van Kleef

Olaf Leenders

Team Dominicus College Nijmegen, The Netherlands



We would like to thank the following people:

- Dr. Charles Timmermans (department of Experimental High Energy Physics, Radboud University Nijmegen) for teaching us the basics of elementary particle physics and high energy physics ,
- Our teachers: Rachel Crane (physics teacher) for coaching us, Mirjam Jentjens and Chris Laheij (ICT) for assisting us with the video, Nadia Lolli (English teacher) for checking the proposal,
- And of course our family for their support, especially Richard Hijmering for the brainstorming session at the start of our project.