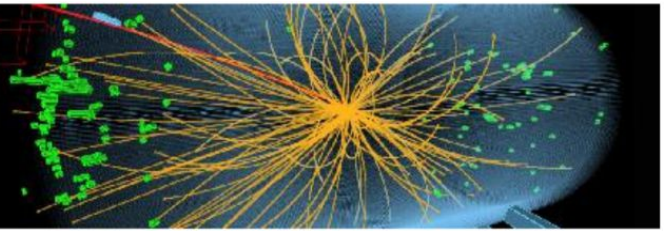


# Particle physics & Open Data



## Phenomenon based learning module on Open Data

Welcome to try your hand with particle physics and open data with authentic phenomena! This module can be utilized with high school students and junior high school pupils, as long as they are familiar with the concept of a mathematical variable. Exercises will contain Python programming, but you don't need any prior knowledge with it at all.

As is currently encouraged by many curricula around the globe, this module is interdisciplinary and combines at least physics, mathematics and programming. If you wish to, it is very easy to apply your newfound skills to other subjects too as the tools given here can tackle quite a diverse field of data.

In the activities, you get to among other things:

- Get acquainted with the smallest building blocks of the Universe.
- Study real particle data from CERN's CMS experiment.
- Learn actual data analysis skills, like making histograms.
- Search and handle different openly distributed data sets.
- Create interactive text / program files with Jupyter Notebook.

The assignments can either be done with Anaconda software that the students can download on their computers or entirely within their web browser via the Binder (<https://beta.mybinder.org>). Anaconda is a preferable choice if the students wish to dabble with programming on their own time too, whereas the Binder is very quick to set up and start with as it doesn't require any installations to work. If done with juniors, who might be a bit more impatient for an example, Binder can save some time and hassle while letting the pupils focus solely on the subject.

We hope that utilizing authentic data and research questions both gives you interesting learning opportunities and helps to motivate the youth towards science studies. This is especially true in junior high, where the pupils might not yet have decided how much they want to take science courses and it is of paramount importance to let them see that things presented in school science are as true in peoples' lives as those of other subjects. Remember to boldly try things out and modify the code in these exercises as you please! Python is no magic nor should anyone think so after trying these out. Remember to make them think a bit about why something changed if you do.

If you wish to try things out with other data sets, look for an example at [www.usgs.gov](http://www.usgs.gov) or other freely distributed info banks. Remember though, that randomly acquired files might not interact kindly with our code. If some trouble jumps up, check if the file's header rows are correct, value separators are of proper type or if the data points are in requested form (changing dates to time units etc.). Help and examples for these situations are provided in the materials.

Happy dabblings!