

Making the top quark open in the CMS open data

The top quark is one of the building blocks of the Standard Model, and the heaviest known particle. Up to now, top quarks have been only visible at the Tevatron Collider at Fermilab and at the LHC. Top quarks are important to many studies of the strong force and the production probabilities are sensitive to the ratio of gluons and quarks in the protons.

The goal of this summer student project is to, for the first time, design an analysis that isolates top quarks on the CMS open data, so the rest of the world can also study the top quark. This would involve:

- designing an analysis to select top quark events in the CMS open data, using the guidance of the first top quark observations at the LHC. In practice this would mean selecting LHC collisions with an electron, muon and two b quark tagged jets. To achieve this, substantial work will need to be performed on the level of software and coding, both in c++ and python, and the work will need to also include accessible documentation. When successful, this work will be made available to physicists worldwide, including students, via open science collaboration tools such as the CERN open data portal. There already was a previous project using the open data, and that will help to make an excellent start to this exiting topic.
- A more advanced later step would be to perform this selection including a study of all theoretical and experimental uncertainties, which could lead to a measurement of the top quark pair production cross-section in the open data at different energies, with exactly the same theoretical assumptions for all years. Such a complicated analysis has not been performed on the CMS open data and may potentially lead to a journal publication.

Field

B1: Particle physics analysis (software-oriented)

DESY Place

Hamburg

DESY Division

FH

DESY Group

CMS

Special Qualifications:

python

c++

willingness to learn the CMS framework CMSSW

basic particle physics

special relativity

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