Examples for Experiments that can be done at the DESY Beam Lines

Beamline for Schools 2020

Note
Please note that in order to succeed in Beamline for Schools you can either propose a creative experiment or idea yourself or take one of the examples and work out the details of that experiment.

Contents

Example 1: Explore the world of antimatter

The particles in the beam at the DESY beam line are either electrons or positrons. Some of the properties of antimatter have only been theoretically predicted but never been measured in an experiment. Right now professional physicists at CERN are preparing experiments to measure the effect of gravity on antimatter or to observe its hyperfine structure. While such experiments are not feasible within the boundary conditions of BL4S, you could compare the properties of electrons and positrons, for example by observing how they are deflected in a magnetic field.

Example 2: Characterization of MicroMegas (or other) detectors

Recently, the Beamline for Schools scientists built four state of the art MicroMegas detectors. Studying them in full is a long ongoing process that requires a series of measurements in a number of conditions. What is the maximum rate of the detectors? What is their spatial resolution? How do the environmental conditions affect their performance? Many more questions are waiting to be answered. Propose a series of measurements at the DESY beam lines that will allow the characterization of the detectors and will expose their limits. This is your chance to drive our continuous R&D efforts.
MicroMegas are not the only detectors at your disposal. Feel free to browse the "beam and detectors" document and propose a series of measurements to study any one of them and help us to improve them.

Example 3: Measure the beam composition of the DESY beam line at various beam momenta

The 6.3 GeV/c primary electron beam of DESY II impinges on a carbon fiber target producing photons, which are then converted again into electron/positron pairs. The secondary beam line is set up to select the particles of various momenta, between 0.5 and 6 GeV/c. This selection is based on the deflection in the bending magnets and the collimators.

The momentum composition of the beam is well known but we at Beamline for Schools have never measured it. Propose a series of measurements to measure the momentum distribution or to identify different particles and in the process you may discover rare particles that are not described in the “Beam and detectors” document.

Example 4: Measure beam absorption properties of materials

Find out how many electrons survive different materials! Can you look inside an object using the electron beam as it can be done with x-rays? Please note: Only non-combustible, non-biological materials can be tested at DESY.
Can you measure the energy of a particle after it has passed through some material?

Example 5: Generate your own photon beam

While we cannot generate a photon beam directly, you could generate photons by using the electron beam scattering at a target, generating a Bremsstrahlung photon and then use a magnet to remove the remaining electrons. How can you measure the energy of the photons?

Example 6: Searching for new particles

Many theories predict new very weakly interacting particles, which pass through matter almost without any interaction. These particles can be produced by dumping a particle beam onto a beam dump and then searching for particles behind the dump. No known particles besides the occasional muon should pass through the dump, so if one is detecting particles there, this could be evidence for new physics.

Example 7: Build and test your own detector

Design your own detector and calibrate it with the beam at DESY! A particle detector does not have to be a high-tech device that is beyond the reach of a team of students. In the early days of particle physics, cloud chambers and photographic emulsions have been used as particle detectors. Even some electronic detectors are not that complicated to make.