Examples for experiments that can be done at the T9 beam line

Example 1: Explore the world of antimatter

The particles in the beam at the T9 beam line are a mix of matter and antimatter particles. 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 decay rate of pions with the decay rate of antipions or those of muons with those of antimuons. Think of how the particles can be identified and how their decay can be observed with the detectors available.

Example 2: Help us to improve the T9 beamline

As described in the "Beam and Detectors" document there are two Cherenkov detectors in the T9 beamline. The Cherenkov light that is created inside of them is currently detected with some general-purpose photomultiplier tubes (PMTs). The problem is this: Cherenkov light has a very short wavelength (it is blue) but our old PMTs are most sensitive to green and red light. We have recently purchased new PMTs that are more sensitive to blue and UV light. Think about a procedure to test these new PMTs and to compare their performance under different conditions with the old PMTs.

Example 3: Characterisation of Micromegas (or other) detectors

Last year 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 in the T9 beam line that will allow the characterisation 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 in our disposal. Feel free to browse and propose a series of measurements to study any one of them and help us to improve them!

Example 4: A look into medical physics

The scientific and technological challenges that we face at CERN drive the developments in accelerators, detectors and computing. These developments have in turn historically contributed to the field of medical and biomedical technologies. If you want to know more or get an inspiration please visit:
https://kt.cern/medtech
At T9 we can study the way a particle beam leaves its energy inside an absorber, much like the proton beams irradiate diseased tissues in proton therapy used for the treatment of tumours. The energy of these beams has to be adjusted to the location of the tumour, so that as little healthy tissue as possible is damaged. Tag the proper particles and tune the beam momentum to achieve maximum energy deposition inside the absorber. Design your own irradiation therapy facility! (Please note that it is not possible to expose any organic material to the beam.)

Example 5: Measure the beam composition of the T9 beam line at various beam momenta

The incoming 24 GeV/c primary proton beam from the PS impinges on a target. The collisions of the protons with the target nuclei provide a variety of particles. The T9 secondary beam line is set up to select the particles of various momenta, between 0.5 and 10 GeV/c. This selection is based on the deflection in the bending magnets (Bends 1-3) and the collimator, and is further refined by quadrupole lenses.

The composition of the beam in T9 is largely known but we at Beamline for Schools have never measured it. Propose a series of measurements to identify the different particles and in the process you may discover rare particles that are not described in the "Beam and detectors" document.

Example 6: Measure beam absorption properties of materials

Find out how many hadrons and electrons survive different materials! Some particles travel through matter and loose only little of their energy and speed, while others are absorbed completely. Please note: Only inorganic materials can be tested at T9.

Example 7: Build and test your own detector

Design your own detector and calibrate it with a beam at CERN! 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.