

Please do not disturb the electrons

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Accelerators are huge machines (up to tens of kilometers long) dedicated to accelerate particles, such as protons and electrons, up to very high energies which makes them travel almost with the speed of light. Worldwide there are many different types of accelerators used for a wide range of applications and research. CERN is probably the most well-known research center related to accelerators in the world. At CERN, there are mostly high energy physics experiments running with accelerators called colliders, named after the particle collisions that occur in this case. This means that the purpose of those collisions is to seek answers to fundamental questions, such as which are the blocks that the universe is made of.

On the other hand, MAX IV uses accelerators for different reasons. Electrons are accelerated in order to produce light which makes MAX IV a big photon factory. This type of accelerator is called a light source and it is more common than colliders. The photons are produced in magnetic devices called insertion devices and they are X-rays, like the rays used in the airport security. However, the intensity of the X-rays produced in this case is huge and hence, they can be used for experiments of a great variety. For example, by using this light we can study the structure of proteins. This information can explain their functions and therefore, it will offer an insight into how human body works. In addition, the light produced can be used for research in many other disciplines such as material science, environmental science and archaeology.

Some experiments running at MAX IV require light of very specific properties. Normally, the insertion devices consist of a large number of pairs of magnetic poles, like earth has the north and south pole, which are placed in a constant distance from each other. This leads to two girders with magnetic poles parallel to each other. However, in order to produce this different type of light the two girders of the insertion device must not be parallel to each other but open like a fan. This mode of operation is called tapering mode. The spectrum of the light produced in this case consists of high intensity light that consists of a wide range of energies. Therefore, this light is not as monoenergetic as before and it can be used for scanning within a range of energies when the optimum energy for the experiment is unknown.

However, using the insertion devices in both normal and tapering mode produces a magnetic field that disturbs the electron beam and hence all the experiments running in the laboratory. For example, using this mode without

any correction applied can possibly "kick" the electrons outside of the aperture of the accelerator in which electrons can move. In this case the electrons would be lost and no experiment would be able to run. The first goal is to test and offer the tapering mode to the experiments at MAX IV. Afterwards, the orbit of the electrons is corrected back to the desired one when the insertion devices operate both with tapering and without. This correction can establish that the electrons are in the right design orbit along the accelerator and therefore the experiments at MAX IV are running without problems.