Milestone reached by the AWAKE Collaboration

The AWAKE Collaboration observed the strong modulation of high-energy proton bunches in plasma during the final week of CERN accelerator running this year, signaling the generation of very strong electromagnetic fields. This is a major milestone towards the goal of using the proton-driven plasma wakefield technique to accelerate electrons. This exciting development, the culmination of three years of an intense preparation phase, opens a new era of particle accelerator development at CERN and worldwide.

It has long been known that plasmas are capable of supporting very strong electric fields. The challenge for researchers is to understand the best way to take advantage of this capability to build high energy but much smaller scale accelerators than is possible today. Several groups worldwide have observed the acceleration of electrons either in the wake of a laser pulse or an electron bunch. The results from AWAKE are the first ever demonstration of strong wakefields driven by a proton bunch. This result is of particular interest because of the huge energy carried by the proton bunches. Achieving the acceleration of electrons using this large stored energy via proton-driven plasma wakefield acceleration would be a great step in accelerator science. The plans of the AWAKE Collaboration are to study the proton bunch modulation in detail in 2017, and then start on a program of demonstrating the acceleration of electrons in the wake of the proton bunch. Demonstration of GV/m scale accelerating gradients for electrons is planned until Long Shutdown 2 of the LHC at the end of 2018. The results achieved last week are the first step in this ambitious and exciting project.

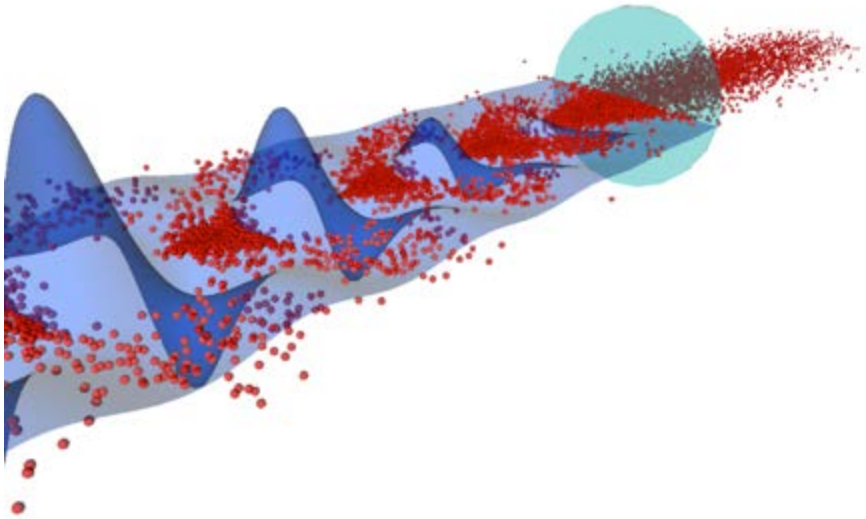
Allen Caldwell, Spokesperson

Edda Gschwendtner, Technical Coordinator

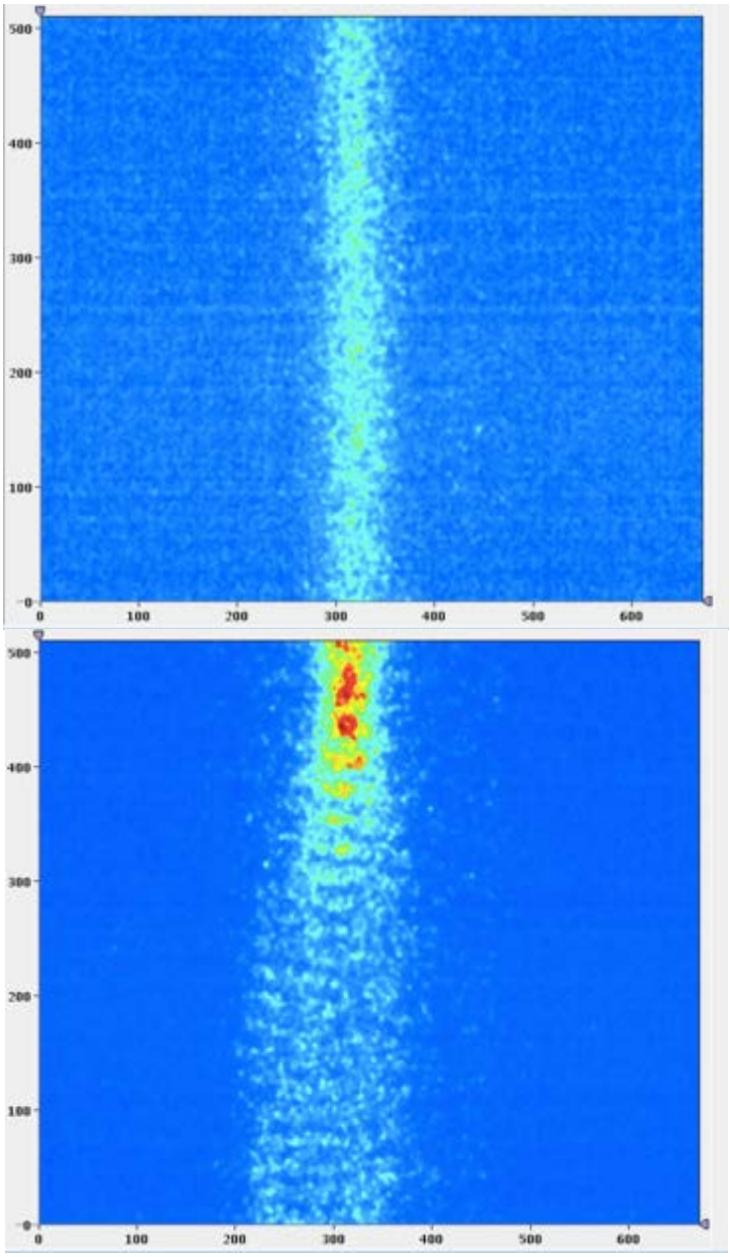
Patric Muggli Physics Coordinator

On behalf of the AWAKE Collaboration

Members of the AWAKE Collaboration in the CERN Control Center having a celebratory drink on Saturday, December 10.



Graphic from a simulation of the modulation process. Proton are shown in red, electric fields in dark blue and the laser pulse, used to ionize a Rubidium vapor and create a plasma, in green. The strong modulation of the proton bunch is seen when comparing the proton distribution ahead of and behind the laser pulse. The bunching of the protons leads to the creation of large electric fields.



Comparison to the proton bunch longitudinal profile (top, no plasma) with the profile for a bunch passing through the plasma (bottom). The strong modulation of the bunch is clearly seen.