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Deutsches Elektronen-Synchrotron
A Research Centre of the Helmholtz Association

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The first continuous wave and long-pulse operation of the XFEL-type cryomodule

Continuous wave (CW) and long-pulse (LP) operation modes of the XFEL superconducting linac are an attractive future option to enhance the experimental potential of this European facility, being currently under construction. On Wednesday 7 July 2011, a two-week test was finished in which the XFEL-type cryomodule, a building block of the XFEL linac, for the first time was operated successfully in both, CW and LP mode with accelerating gradients up to 5.5 MV/m and 11.5 MV/m, respectively.

The stability of the accelerating gradients of all eight cavities, already achieved in that first approach, was better than 10^{-3} rms for both operation with 300 m/s long pulses and for CW. The experiment showed that the stability can be further improved by implementation of dedicated control electronics (LLRF), which should be ready for the second run in fall this year.

The new operation modes require new RF-amplifiers replacing high power klystrons, similar to those used at present in FLASH, which deliver RF-power in 1.5 m/s short pulses only. For the test, we were using a prototype of the 80 kW Inductive Output Tube (IOT), which was designed and built by CPI Company in USA. The IOT was funded by the first EuroFEL program, in which DESY participated in the years 2005-2007, proposing in 2005 the R&D program devoted to the LP operation mode.

This encouraging result is a very first step towards more flexibility in operation of the European XFEL and FLASH and possibly also of other FEL facilities, with driving linacs based on the TESLA technology. These present experiments on the cryo-module test bench (CMTB) were proposed at the first DESY Accelerator Ideas Market in June 2010. The development of superconducting RF technology in CW-mode is part of the recently approved and funded accelerator research programme ARD. This first experiment could be prepared and conducted within relatively short time at DESY in cooperation with the Technical University Lodz, the Warsaw University of Technology and the Soltan Institute for Nuclear Studies in Swierk.

Involved DESY groups:

Energy Supply / Senderstromversorgung (MKK / MKK7),
Radio frequency technology / electrons (MHF-e),
Radio frequency technology / protons (MHF-p),
Radio frequency technology / superconductivity (MHF-sl),
Beam control (MSK) und
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