

Update of the vacuum system of the European X-ray free electron laser XFEL

T. Wohlenberg, S. Lederer, L. Lilje

Abstract. The European X-ray Free Electron Laser XFEL, a new international research facility, will be built at DESY. The XFEL will generate extremely brilliant and ultra short pulses of spatially coherent X-rays with tuneable wavelengths down to 0.1 nm, and exploit them for revolutionary scientific experiments at various disciplines. The basic process adopted to produce the X-ray pulses is SASE (Self-Amplified Spontaneous Emission). Therefore electron bunches are produced in a high-brightness RF-gun, brought to high energy of about 17.5 GeV through a superconducting linear accelerator, and transported to up to 250 m long undulators, where the X-rays are generated. The beam vacuum system of the accelerator contains sections operated at room temperature as well as at 2 K in the areas of the superconducting accelerating structures, thus requiring an insulating vacuum system. In addition to standard UHV requirements, the vacuum system for this facility needs to preserve the cleanliness of the superconducting cavity surfaces. Therefore the preparation of all vacuum components for the 1.6 km long main linac includes cleaning of the components in a clean room to remove particles, installation into the accelerator in local clean rooms, and special procedures for pump down and venting. Further challenges are the undulator vacuum chambers filling more than 700 m, where a high surface quality with respect to surface roughness and thickness of oxide layers is mandatory to reduce wake field effects, and the vacuum systems for the various beam dumps, where exit windows acting as vacuum barriers of sufficient reliability need to be developed. In addition, a large amount of about 1.7 km of transport beam lines is required. The layout of the various vacuum sections as well as experience with prototype components will be described.