THE FEL PROGRAM AT DESY: FROM FIRST RESULTS AT 100 NM WAVELENGTH TO A TRUE 1 Å X-RAY LASER

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Free electron lasers (FELs) based on self-amplified spontaneous emission (SASE) have made enormous progress since the mid 1990s. Recently, saturation has been observed in the vacuum ultraviolet (VUV) spectral region between 85 nm and 125 nm at the TESLA Test Facility (TTF) at DESY. The radiation pulses have been characterized with respect to pulse energy, statistical fluctuations, angular divergence and spectral distribution, both in the linear gain and in the saturation regime of the FEL [1]. The results are in good agreement with theoretical simulations, providing a solid basis for other projects aiming at still shorter wavelengths down to the 0.1 nm range [2,3]. The GW level VUV pulses have been used for first exploratory experiments on gases and solids demonstrating the unique properties of the new source [4].

Currently an energy upgrade of the TTF linear accelerator to 1 GeV is being prepared which will make radiation wavelengths down to 6 nm available for users. At the same time other important projects for the VUV FEL user facility are in progress such as online, pulse-resolved photon diagnostics, a synchronised optical laser system for time resolved measurements, and components for seeding to improve the temporal coherence of the radiation. The FEL user facility is planned to start operation in 2004. A photograph of the facility is shown in Fig. 1.

The final goal is to reach 0.1 nm wavelength and to build a multi-user X-ray laser facility with several independent FEL sources serving a number of experiments simultaneously.

Figure 1: The VUV FEL facility at DESY with the experimental hall on the lower right.

References

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