The SASE FEL at the TESLA Test Facility as user facility

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Abstract

During the past years, the experience gained with the TESLA Test Facility FEL resulted in several changes of its design. In addition, as the FEL is developed further to become a user facility during 2003, more details of future development of the FEL and the complete experimental hall for the users is taking shape. In this contribution, some of the aspects re briefly mentioned.

1. Layout of the facility

The TTF-FEL experimental hall will give space to 5 user experiments (see fig. 1). Each position has its specific characteristics of offered radiation properties, such as radiation spotsize and spectral properties. In addition, space is foreseen for preparation of experiments, on-line diagnostics and a synchronized optical laser for pump-probe experiments.

2. Electron Beam parameters

As compared to the original TTF-FEL design, there are now tree modes of operation foreseen

- Short wavelength mode (<30 nm), which uses full compression and the 3rd harmonic RF section.
- Long wavelength mode (>30 nm), which uses only the first compressor.
- Femtosecond mode (>30 nm, <100 fs), using a leading spike in the bunch profile, using only the first.

Phase-1 of the TTF-FEL has been run in the last mode, which will also be the starting point for commissioning of the user facility. Further details can be found in Ref. [1].

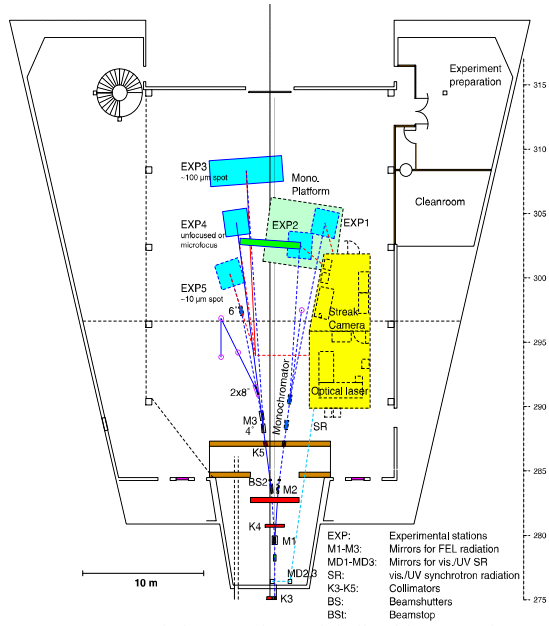

Figure 1: Layout of the experimental hall with space for 5 experiments

3. Proposed Experiments

So far, a number of experiments have been proposed, of which a fraction is shown in the table below. Requested is a variety in power, spectral properties, timing/pulse structure and pulse length.

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Project Title	Photon Energy	Intensity		Pulse Timing & Pump-Probe		Category
	Preferred energy range (eV)	Acceptable spot size	Intensity variation	FEL pulse timing requirements	Requirements for Optical laser	
Pump-Probe Experiments in the Gas Phase	15-200					Developments for pump-probe
Single-Shot FEL Cross Correlator	>12	30 m		up to 9 MHz	10 J	
Quantitative Investigation of Photoionisation Processes on Free Atoms in a Focused VUV FEL Beam	>12		up to 1E16 W/cm^2			Atoms, ions, molecules, non-linear effects
High-Frequency Stabilisation of Li	>10,<70	several m	>1E16 W/cm^2	<50 fs	own diode and YAG laser	
Multiphoton Ionisation and Excitation	10-150	up to 1 mm	<1.5 mJ, 1E13-1E17 W/cm^2	100-200 fs, 200ns distance		
Resonant Single- and Multiphoton Excitation and Photoionisation of Highly charged Ions by FEL Radiation	20-140	100 m	>0.05 mJ, >1E15 W/cm^2 desirable	<100 fs preferable		
Multi-Photon Multiple Ionisation	30-70	<20 m	0.05-1 mJ, 1E13-1E17 W/cm^2	< 250fs		
Molecular Ion Photodissociation	7-40	~3 mm	0.1-1.6 mJ	1-10 kHz at 5 Hz		
Cluster FEL Interaction: Interaction of Intense Soft X-Rays with Atomic and Molecular Clusters	>12	~10 m	>1E14 W/cm^2	<100 fs, 10 s distance		Clusters
Structure of Mass-Selected Clusters	10-100	0.1-1mm, down to 10 m	>10-100	single pulse or 10 s separation	0.1-1 mJ	
XUV Laser Desorption	8-20	1-5 mm	>100 J, >factor 100	<300 fs, <1 s distance in pulse trains	own ns-laser	Surfaces and solids
VUV FEL Nanospectroscopy	10-200	several 100 m, info on beam profile and	some orders of magnitude	none initially	not needed	
IHED-DESY Beam Investigation	10-400	1-20 m	1-100% of full intensity	50fs	<1mJ	
Warm Dense Matter Creation: Isochoric Heating of a Thin Foil	60-400	uniform spot up to 100 m	none	timing of FEL to optical laser with the accuracy of .le. pulse length	0.1J	
Equation of State Measurements	60-400	uniform spot up to 100 m	none	timing of FEL to optical laser with the accuracy of .le. pulse length	0.1J	
Coulomb Explosions of Biological Samples	20-600	1-20 m	1%-100% of full intensity	no special requirements	N/A	
Diffraction Imaging of Biological Samples	100-600	1-10 m	1%-100% of full intensity	no special requirements	N/A	
Studies of Interactions of XUV-FEL Pulses with Solids: Optics Damage and High-Field Effects	85-600	1-20 m	1%-100% of full intensity	50 fs	< 1 mJ	

4. References

[1] The TTF-FEL team, 'SASE FEL at the TESLA Facility, phase-2', TESLA-FEL report 2002-01 (see also http://www-hasylab.desy.de/facility/fel/