Summary:
Major task for last 4 months: installation into tunnel
260 m beam line, (almost) all new
many different and advanced components
90 % completed; Entire vacuum will be closed mid Febr. 04

Delays mainly for financial reasons → Priority decisions:
1. close vacuum system; complete injector for injector tests
   injector tests during first half of 2004
2. Accept delay of power, electronics, cabling for the rest
   full commissioning during second half of 2004
Status of beamline installations

- RF gun
- Laser 4 MeV
- M1
- Bunch compressor 150 MeV
- M2
- M3
- Bunch compressor 450 MeV
- M4
- M5
- M6
- M7
- Collimator
- Undulator
- Bypass
- FEL
- Experimental area
- 250 m
Electron gun for minimum emittance: PITZ

PITZ gun installed into TTF Jan 2004
TTF 2 Laser Upgrade

- Together with Max-Born-Institute, Berlin (I. Will et al.)
- Upgrade has been tested at PITZ

Note:
longitudinal flat profile by pulse stacker only

Pulse shaper
(T = 5%)

Diode-pumped Nd:YLF oscillator

2-stage diode-pumped Nd:YLF amplifier

2-stage flashlamp-pumped Nd:YLF booster amplifier

Diode-pumped Nd:YLF preamplifier

Pulse picker

fast current control

shot-to-shot optimized

20 ps flat-top
4 ps edges

E_{\text{micro}} = 16 \mu J
P = 16 W

E_{\text{micro}} = 200 \mu J
P = 200 W

E_{\text{micro}} = 30 \mu J
E_{\text{burst}} = 24 mJ
UV (262 nm)
lens 1

mirror (x,y,φ,θ)

lens 2

iris aperture (x,y)

lens 3

mirror (θ,φ)

lens 4

vacuum window (suprasil 1)

fluorescent crystal (Ce:YAG)

CCD

virtual cathode

tunnel wall

transport line

RF gun
Second Laser Hut for the Backup Laser System
Transverse Emittance Measurement @ PITZ

1 nC, -5deg, I_{main} = 305 A

- X
- Y
- sqrt(x*Y)
TTF2 RF System

ACC 6  ACC 5  ACC 4  ACC 3  ACC 2  ACC 1  RF-Gun

3.3 MW  3.3 MW  3.3 MW  3.3 MW  3.3 MW

Mod 4 (10 MW)

3.3 MW  6.7 MW  2.5 MW

Mod 5 (5 MW)

modified in preparation

Mod 6 (10 MW)

SMES

Mod 7 (10 MW)

Mod 1 (5 MW)

3 dB Hybrid

Φ-length adjustment

3 dB Hybrid

Φ

Phaschifter
5 MW, Δφ>20°

Teststand Hall 2

MHFP/c, 16.01.2004
LLRF Requirements:

- Field Calibration
- Beam phase measurement
- Beam loading compensation
- Finite State Machine
- Exception handling
- Cavity frequency tuning
  - motor tuner
  - piezo tuner
- Adaptive feedforward
- Waveguide tuner control

Support by:

ELHEP Group
Warsaw University of Technology
Institute Electronic System

Team:
About 20 people scientists, engineers and students
(Ph.D. and M.Sc.)
working at:
Warsaw, CERN, DESY
Electron beam diagnostics:
  • more standardized
  • have learned lessons from TTF1
1. BPMs (stripline type) located inside quadrupole magnet, vacuum chamber with BPM mechanically fixed to magnet body

2. For each BPM, the position of the electrical center with respect to the magnetic center of the quadrupole was determined on measurement bench
Vacuum test of standard BPM
BPM measurement bench
BPM alignment results

All measurements. Magnetic axis of quadrupoles is in the origin.
Standard TTF2 OTR monitor

- Vacuum chamber (DESY)
- Stepper motor mover (INFN) + motor driver (DESY)
- Screen + screen holder (INFN)
- Optical set-up (INFN)
  - Mechanical components
  - Optical components
  - Electronics
- Support structures for vacuum chambers and optical set-ups (DESY)
- Read-out electronics + software (INFN, DESY)
- Control and acquisition software (INFN, DESY)
- User interface (INFN, DESY)
Requirements of the OTR monitor at TTF2

- High resolution to measure beam sizes down to 50 µm (sigma)
- Robust, reliable, and remotely controlled
- Possibility to change remotely magnification of the imaging system and attenuation of the OTR signal
Mounting of an optical set-up to the linac
OTR monitors along TTF2 linac

- 13 standard OTR monitors
- 8 combined OTR and Wire scanner monitors
- 3 special OTR monitors in bunch compressors
- 3 Ce:YAG screens in RF-gun section
- 1 Diffraction Radiation (DR) radiator
Resolution tests

- Resolution corresponding to 10 µm (sigma) measured with a diaphragm of 20 mm on the first lens (1:1 magnification)
- Resolution without diaphragm about 30 µm
Hasylab-Zeuthen wire scanners

- 7 wire scanner stations in the undulator each having two scanners (horizontal and vertical)

- Each scanner has 3 wires:
  10 µm Carbon,
  10 µm and 50 µm Tungsten

- Maximum speed 1 m/s
- Expected resolution for a 10 µm wire ~ 5 µm
Hasylab-Zeuthen wire scanners
Test measurement in Zeuthen

Wire scanner at PITZ

\[ \sigma = 248 \, \mu m \]
\[ x = 3335 \, \mu m \]
\[ C = 1 \, pC \]

M. Sachwitz et al.
Longitudinal bunch shape measurements at TTF2

- Streak camera
  - FESCA 200 (Hamamatsu)
- Transverse deflecting cavity
  - S-band travelling wave cavity from SLAC
- Coherent radiation
  - Interferometer from RWTH Aachen
- Electro-optical sampling
LOLA Shipment from SLAC to DESY

- Vertically deflecting cavity for bunch length measurements at TTF2
- Built in the late 60ies by G. Loew et al.
- SLAC contribution to TTF2

“Intra-Beam Streak Camera”
LOLA shipment

LOLA installed
Interferometer Measurements at TTF2
RWTH Aachen, Univ. Hamburg

- Use of coherent synchrotron radiation from dipoles (e.g. bunch compressors) and a far-infrared interferometer from RWTH Aachen
- Possibility to use coherent transition, diffraction radiation after the second bunch compressor
- Plan to install IR-undulator after FEL undulator
Far-infrared spectrometer from RWTH Aachen

Pyroelectric detectors removed
Electro-optical sampling at TTF1

- Ti:Sapphire laser (15 fs) and ZnTe crystal
- Electron bunch can be scanned by varying the delay of the laser
- Polarization of the laser changes depending on the amplitude of the "beam fields"
Magnetic chicane for longitudinal compression
Installation work under local clean room conditions
6 undulator modules
4.5 m each
Required field quality achieved
Temporary beamline for seeding

Beam dump
New clean room (class 100) for cleaning of vacuum
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<tr>
<th>Task Name</th>
<th>Jan '04</th>
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<th>Mar '04</th>
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**Major schedule for TTF2 installation and commissioning**

More detailed schedule (400 items) to be presented in WG3 by M. Körfer
Further planned schedule:

- Saturation in wavelength range 30-120 nm  
  July 2005
- User operation (extended period)
- Operation with full electron beam current (to be defined; 2.25 MHz?)  
  Dec. 2005
- User operation (extended period)
- 3rd Harmonic RF system and ACC6 installed  
  Feb. 2006
- 1 GeV beam energy  
  April 2006
- Saturation 6 nm  
  June 2006
- User operation (extended period)
- Seeding Option installed
- Seeding demonstration

beam time allocation:
To be discussed and approved by Beam Time Committee to be installed late spring time 2004
members from TESLA, FEL users, DESY