Overview of THz diagnostics at PITZ

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HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

PITZ Photo Injector Test Facility Zeuthen

European XFEL

DESY.

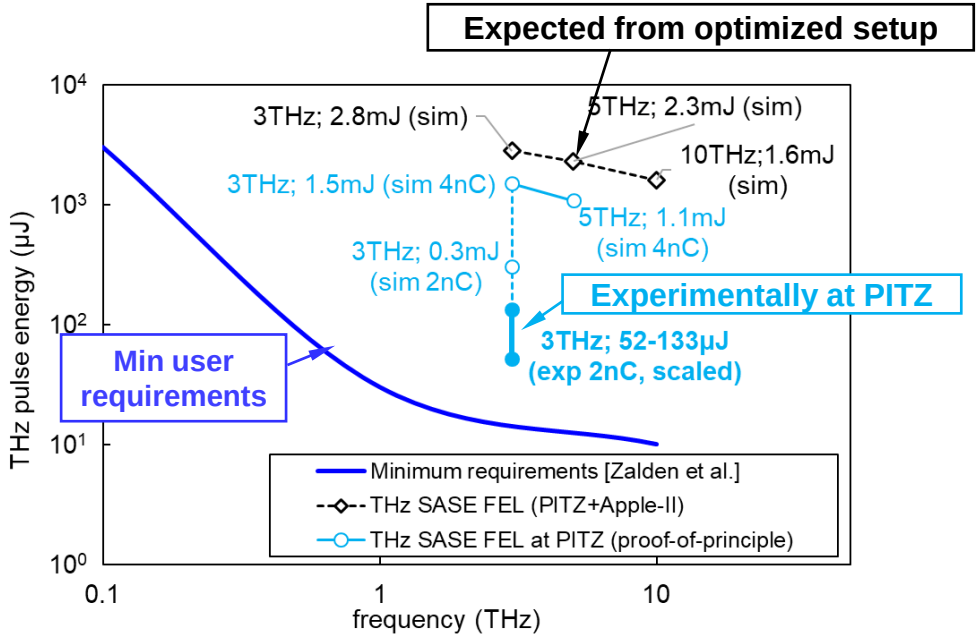
Motivation for THz R&D at PITZ

Accelerator based THz source for pump-probe experiments at the European XFEL

E.A. Schneidmiller, M.V. Yurkov, (DESY, Hamburg), M. Krasilnikov, F. Stephan, (DESY, Zeuthen),
"Tunable IR/THz source for pump probe experiments at the European XFEL, Contribution to FEL 2012, Nara, Japan, August 2012

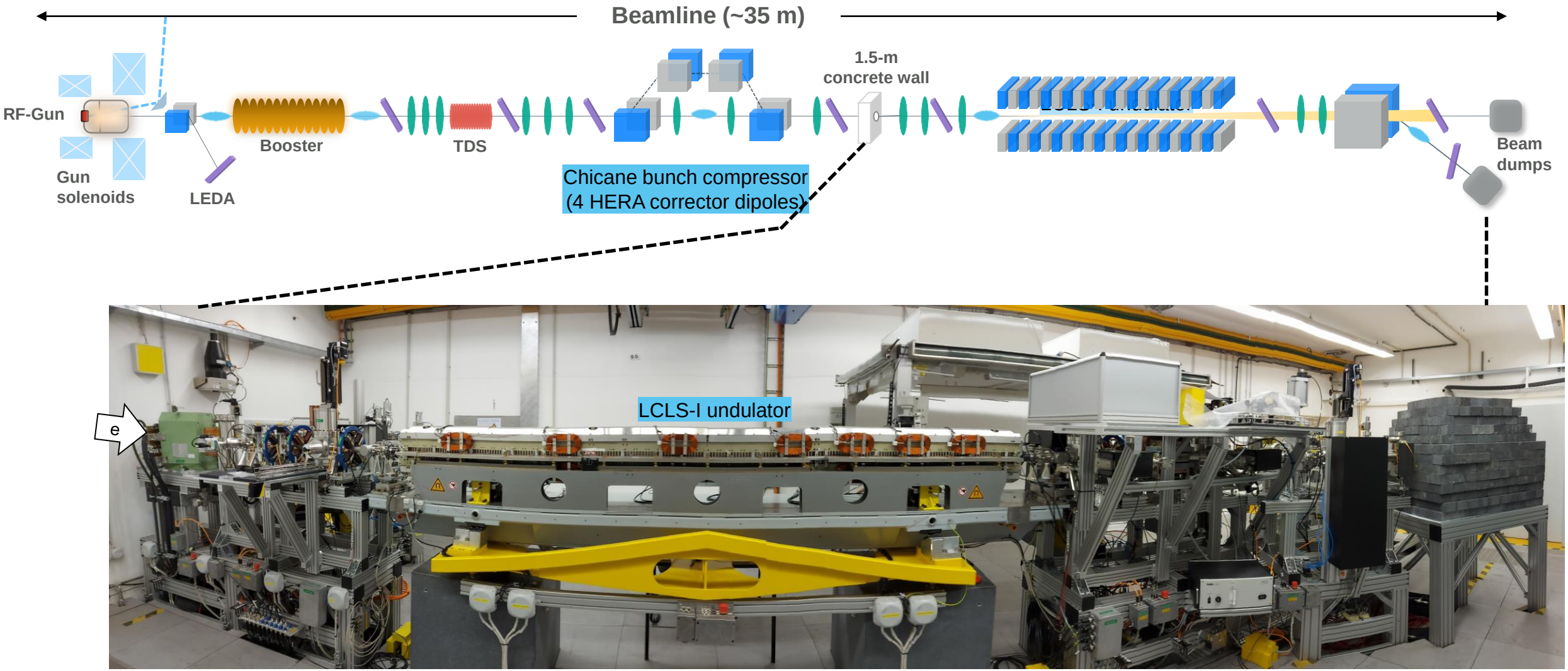
THz source requirements

- **Tunable** → $f = 0.1 \dots 20\ THz$ $(\lambda_{rad} = 3mm \dots 15\mu m)$
- Various temporal and *spectral* patterns, polarization - ideally **narrow-band** → ${}^{\Delta W}/_{W} \sim 0.1 \dots 0.01$
- Time jitter → from **CEP stable** (few fs) for field driven to "intensity" driven dynamics
- **High pulse energy** $W > 10\mu J$ (μJ - hundreds of μJ - mJ , depending on f)
- **Repetition rate** to follow European XFEL → $(600\mu s \dots 900\mu s) \times (0.1 \dots 4.5MHz) \times 10Hz = 27000 \dots 40500\ pulses/s$



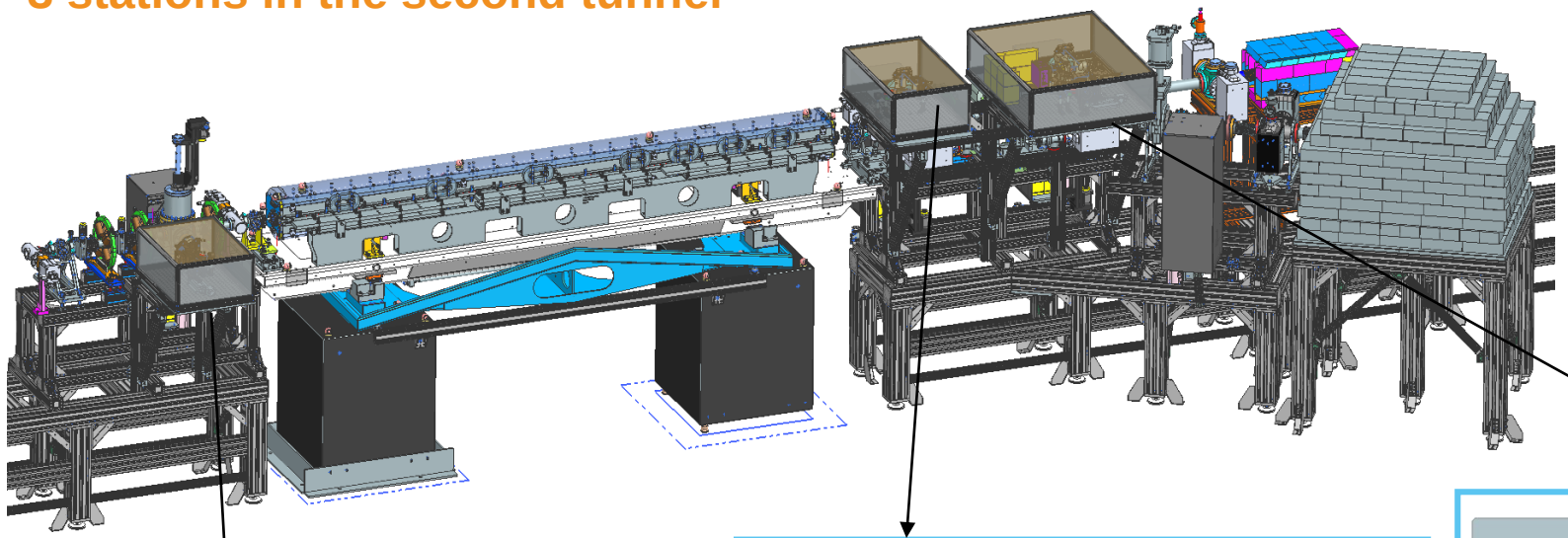
PITZ beamline schematics

Setup for the proof-of-principle experiment on THz source



THz Diagnostics at PITZ

3 stations in the second tunnel

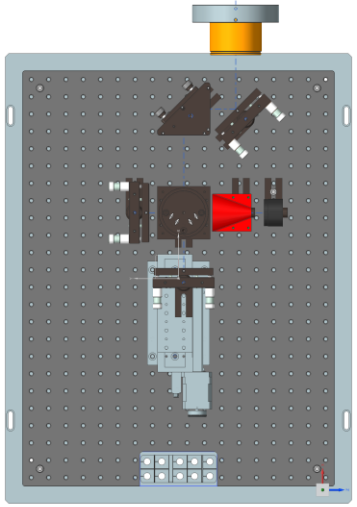


Enclosed system

Pure air circulator unit (Thorlabs) for air purification and humidity reduction.

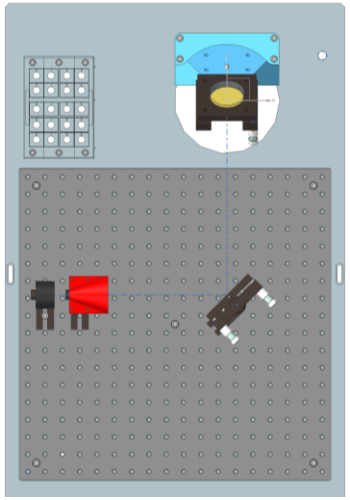
TD1:

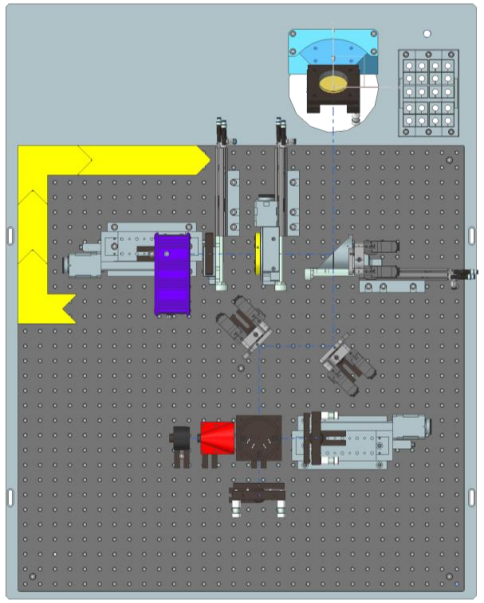
- Pulse energy using pyroelectric detector
- THz spectrum (CTR) using a Michelson interferometer
- Quartz vacuum window
- ~0.2 m transport in vacuum, ~0.5 m transport in air
- Focusing by using 90° off-axis ellipsoidal and parabolic mirrors
- 1 motorized linear stage



TD2

- Pulse energy using pyroelectric detector
- Diamond vacuum window
- ~0.8 m transport in vacuum, ~0.5 m transport in air
- Focusing by using 90° off-axis ellipsoidal mirror



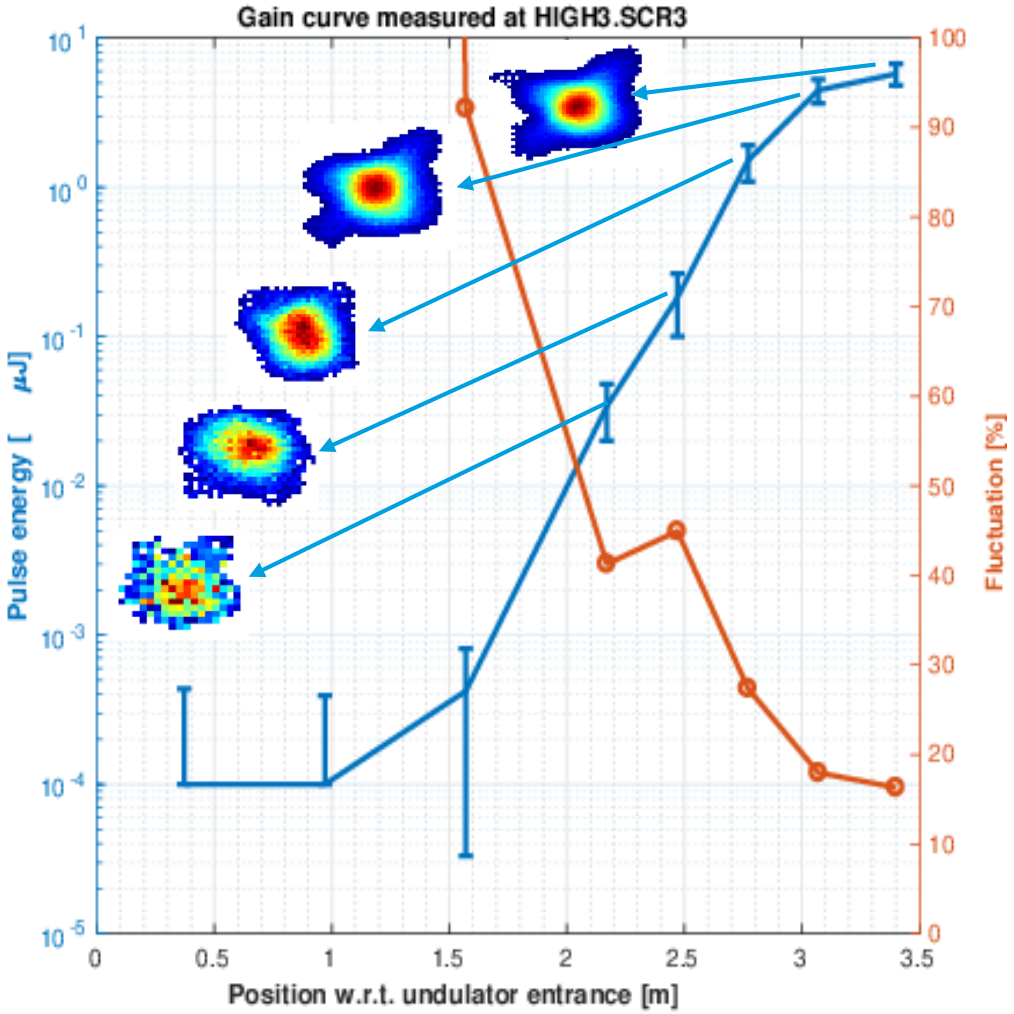


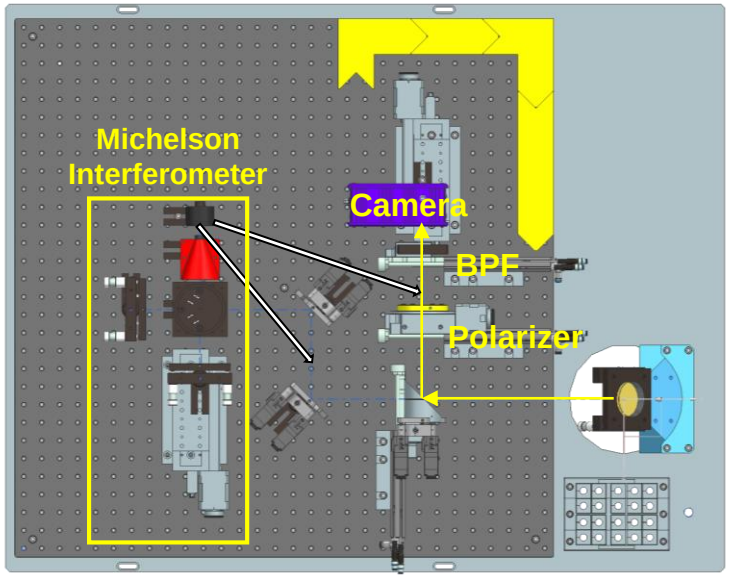
TD3:

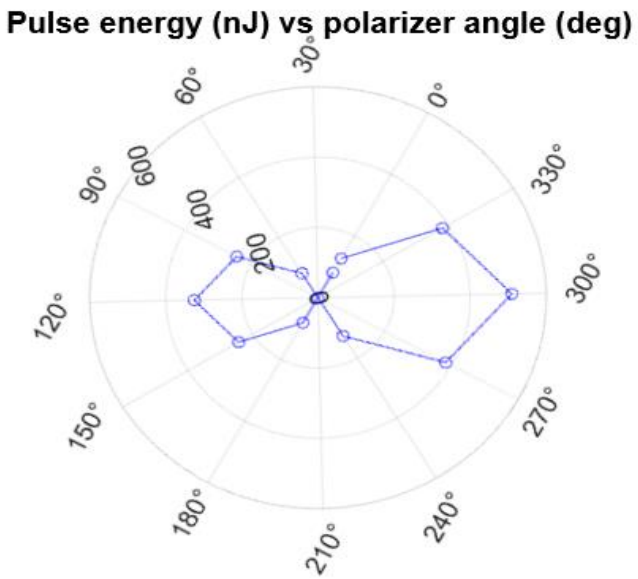
- Pulse energy using pyroelectric detectors
- Transverse profile using a THz camera
- Polarization using a THz polarizer
- THz spectrum using a Michelson interferometer
- Diamond vacuum window
- ~1.8 m transport in vacuum, 1-1.5 m transport in air
- Focusing by using 90° off-axis ellipsoidal and parabolic mirrors
- 3 pneumatic actuators, 3 motorized mirror adjusters, 2 motorized linear stages

THz diagnostic station 3

THz images along gain curve, polarizer



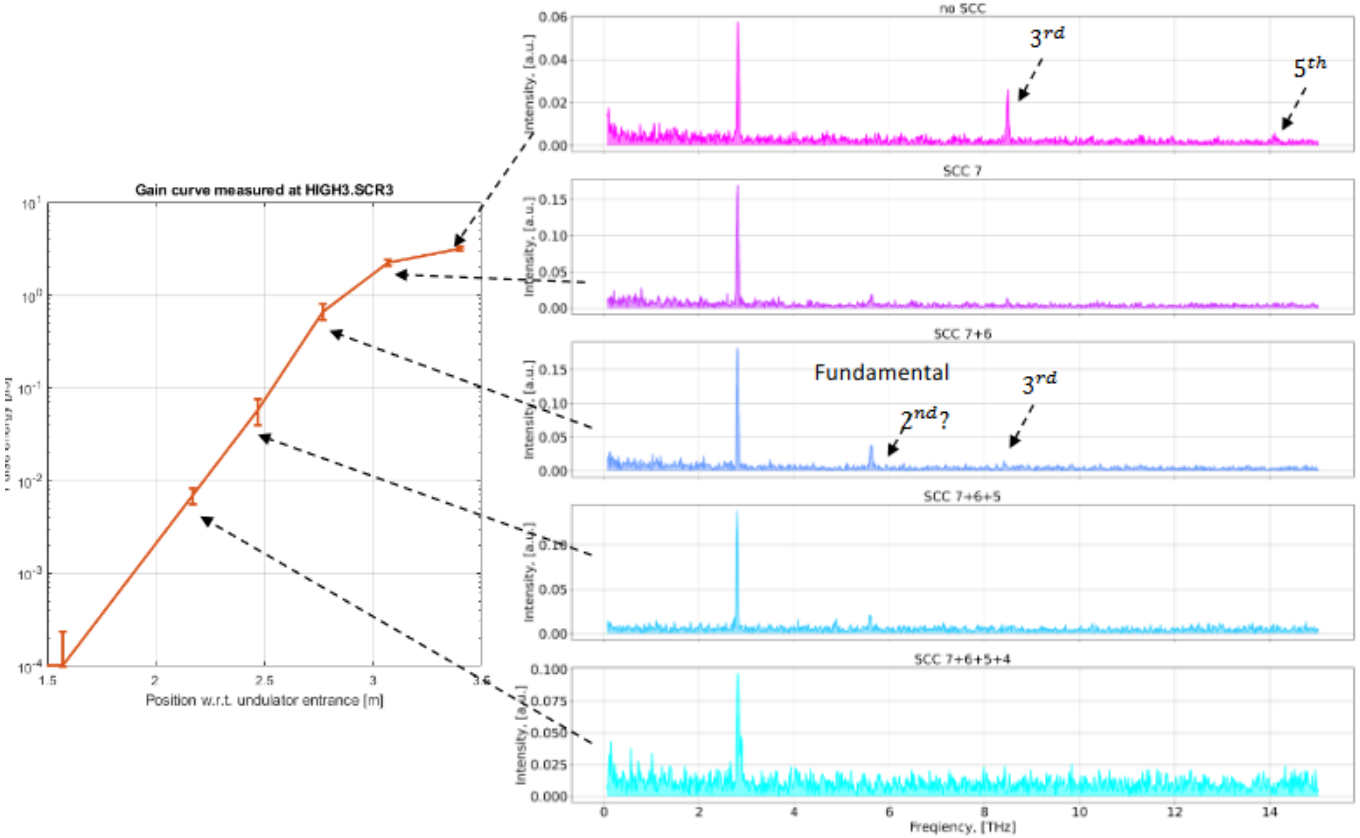




THz diagnostic station 3

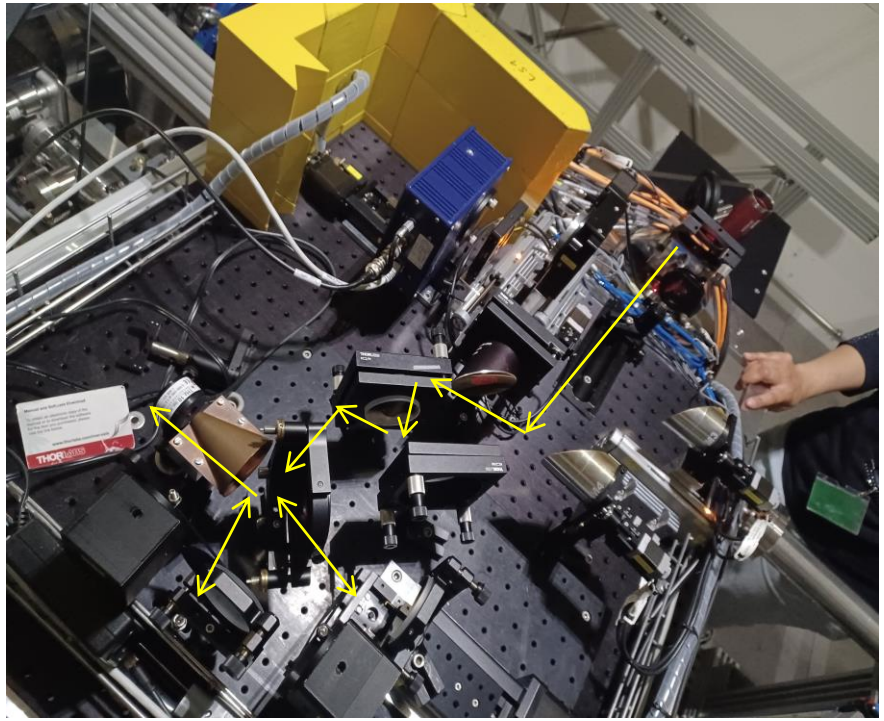
FTIR spectrometer from FLASH (E. Zapolnova, THz beamline at FLASH)

- TD3 with a compact broadband THz spectrometer based on the reflective lamellar grating
- Central wavelength ~ 2.82 THz ($\lambda rad \approx 106.5$ µm)



In-house commissioned Michelson Interferometer

- Michelson interferometer consisting of a fixed and movable arm, a beam splitter and pyrodetector with a collector cone used to measure interferogram.



More information in poster

THANK YOU.

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