

THz Streaking of the Primary Electrons

FLUTE

THz Streak Project: Split Ring Resonator

Have

7 MeV beam starting 2019
Standard instrumentation
Laser: Ti:Sa 6 mJ, 1 kHz, and Yb fiber laser
THz generation
Small interaction chamber
Simulations
Lots of beam time
Funding for travel

Want

Ideas for new experiments
New structures
Electro-optical bunch length monitor for cross-check

Existing Collaborations

Uni Bern/PSI: Split ring resonator experiment

Opportunities for Collaboration

Structures → DESY, PSI/EPFL

THz Streak Project: Dielectric Waveguide, Traveling Source

Have

Want

Beams up to 50 MeV
Compression to 200 fs sms @ 100 pC (simulated)
Lasers:
1.5 mJ, 1 kHz, 50 fs Ti:Sa
Up to 500 mJ, 10 Hz, 50 fs Ti:Sa
Additional project: 100 keV gun
4...5 weeks of beam time / year

Independent measurement of bunch length
People, laser in particular
Beam dynamics

Existing Collaborations

Opportunities for Collaboration

Cockcroft Universities and STFC

Yes

SINBAD/ARES

Conventional S-Band Accelerator for Accelerator Research

Have

Want

Installation ongoing
Expect first beam for experiments in 2019
Good neighbours for THz generation and high-power lasers
X-band TDS
100 MeV particle energy
Beam time

Benchmarking of novel methods with TDS

Existing Collaborations

Opportunities for Collaboration

AXSIS, LUX
X-band TDC: CERN-DESY-PSI
EuPRAXIA
LAOLA
ACHIP
AWAKE

Yes, contact Ulrich & Ralph

AXSIS

THz-Powered X-Ray Source: STEAM (Segmented THz Electron Accelerator and Manipulator)

Have

Want

DC injector (55 keV)
STEAM device
THz-based gun
Laser: 76 mJ, 1 μ m, 10 Hz, ~ps
200 uJ single cycle & 600 uJ multi-cycle THz

Funding
People with know-how on electron beam diagnostics
1 J laser (imminent)
Electron diagnostics

Existing Collaborations

Opportunities for Collaboration

ACHIP
SINBAD
LUX
LAOLA
ASU
MIT

Always

High Pulse Energy THz Generation

Have

Want

1 μm pump laser:

80 mJ, 50 Hz, 500 fs (200 fs under construction)

6 mJ, 1 kHz, 200 fs

Near future: Ti:Sa with a few 100 m"

Different crystals for THz generation: 300...600 GHz, 10 μJ 400 μJ achieved with OPA in Vienna

Steve's laser

Electron source with high electron energy and available beam time

Electron diagnostics

Existing Collaborations

Opportunities for Collaboration

ELI: 500 mJ laser

Micro-structuring of optical materials

SwissFEL

Free electron laser user facility

Have

Want

3 GeV particle energy
Ti:Sa laser: 7 mJ, 100 fs, 1 kHz
OPA: up to 2 μ m, 400 μ J
Standard diagnostics, including RF TDC with 1 fs resolution
Very limited beam time
Micro-machining of fused silica (EPFL)
Electron beam lithography

Shape the electron beam
Measure bunch length with THz structure
THz acceleration

Existing Collaborations

Opportunities for Collaboration

ACHIP
CHART
KIT/Uni Bern: FLUTE SRR
Lots of informal collaborations

Yes, on topics mentioned above

Hot electron bolometer
(6 K) ns response time
-DKIT

Pyroelectric
Array
→ ELI

Electro-optical
Spectral decoding:
linear detector array
KIT

Superconducting
detectors @ 1.8K:
Si bolometer (slow)
KIT

High temperature
Superconductors
KIT

MCT: 128 pix
2...18 μm
DESy 32px PSI

YBCO detector
@ 60K
KIT

Electro-optical
detection

time
domain
STFC DESy
Pécs KIT
PSI

Broadband
Schottky diode
array (4x4 pix.)
MHz...GHz readout
200 GHz... 1.2 THz
TUD

imaging
STFC, (Pécs)

Golay Cell
(KIT, PSI)

THz-FET
Darmstadt → PSI

Photo-
conductive
detectors
PSI
Pécs

Spiricon
Pyro-Camera
(10 kpix)
KIT, Pécs, CFEL, PSI, (STFC)

Calibrated power meter
KIT

Narrowband
&
Broadband
Schottky-Diode
KIT, TUD
PSI, TUD, KIT

Spectrometer-
on-a-chip
(8 points: 50...700 GHz)

DELTA
FLASH
TUD → PSI
HZR
STFC

Terasense camera
(1 kpix)
KIT

THz Streaking

- THz streaking of high-energy electrons has gone from an idea to reality
- Next steps: adapt for ultra-relativistic electrons (MeV...GeV range)
- Beam dynamics considerations
 - Transverse dependency of fields
 - Wake fields
 - Effect of THz field on energy spread
- Consider the generation of secondary electrons in a gas
- Possibility of using THz structures for electron beam manipulation upstream of the FEL