

Status of THz generation and electro-optical detection at DELTA

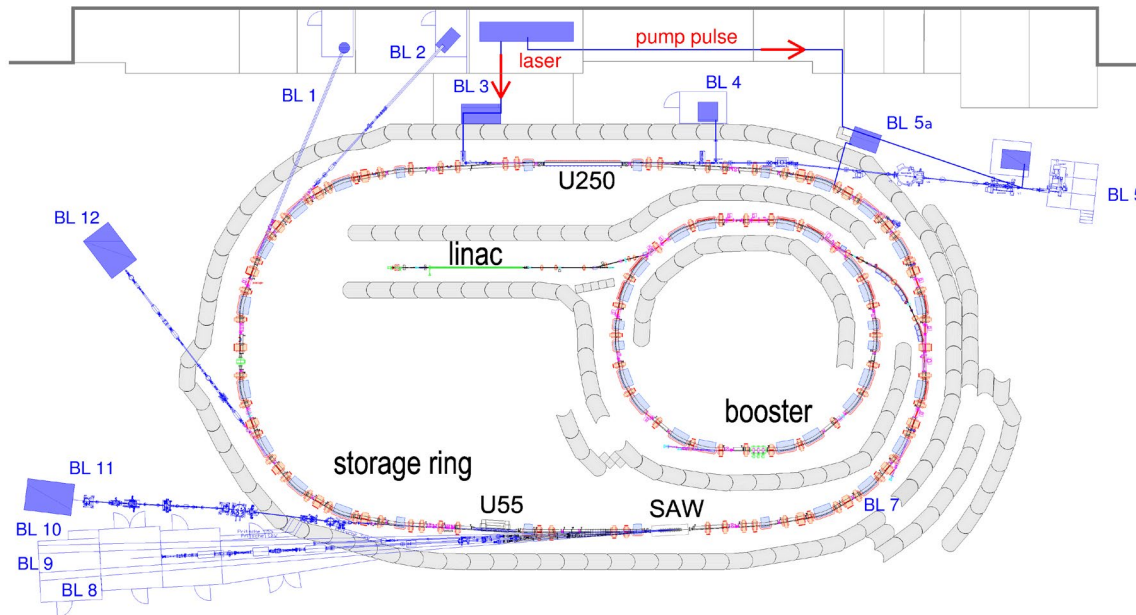
11th Workshop on Longitudinal Electron Bunch Diagnostics, Université de Lille

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DELTA Storage Ring



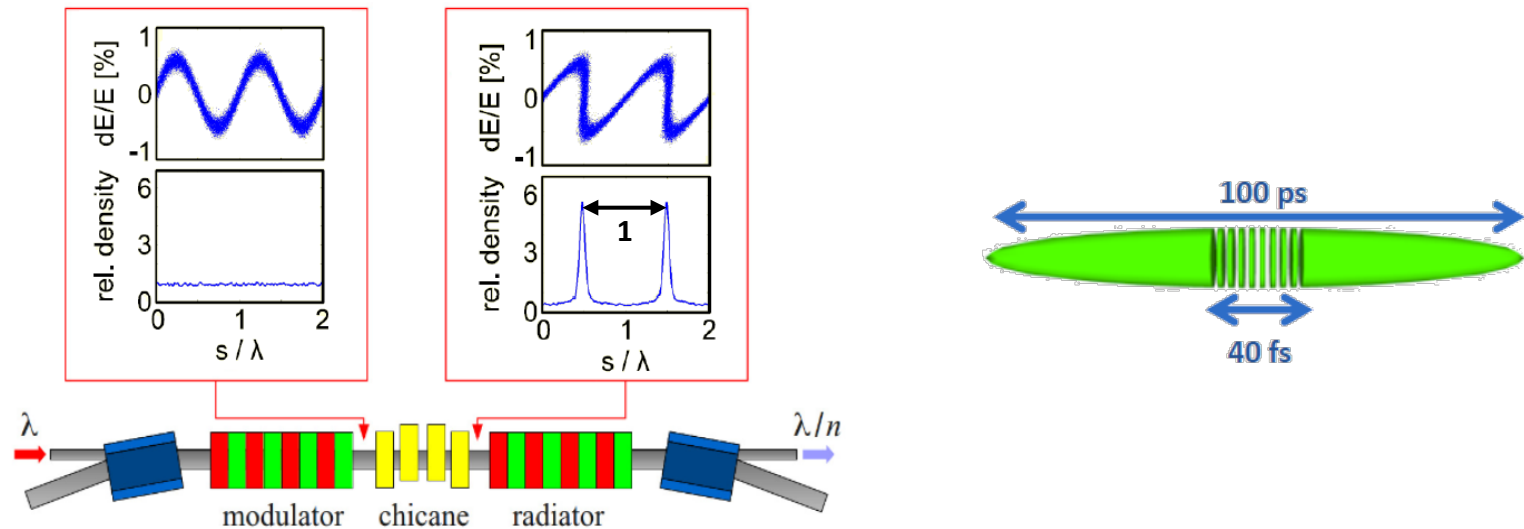
DELTA

Electron energy	1.5 GeV
Circumference	115.2 m
Hor. emittance	16 nm rad
Energy spread $\Delta E/E_0$	7e-4
Beam current	130 mA (mb) 15 mA (sb)
Bunch length	80 ps
Revolution frequency	2.6 MHz

Ti-Sapphire Laser

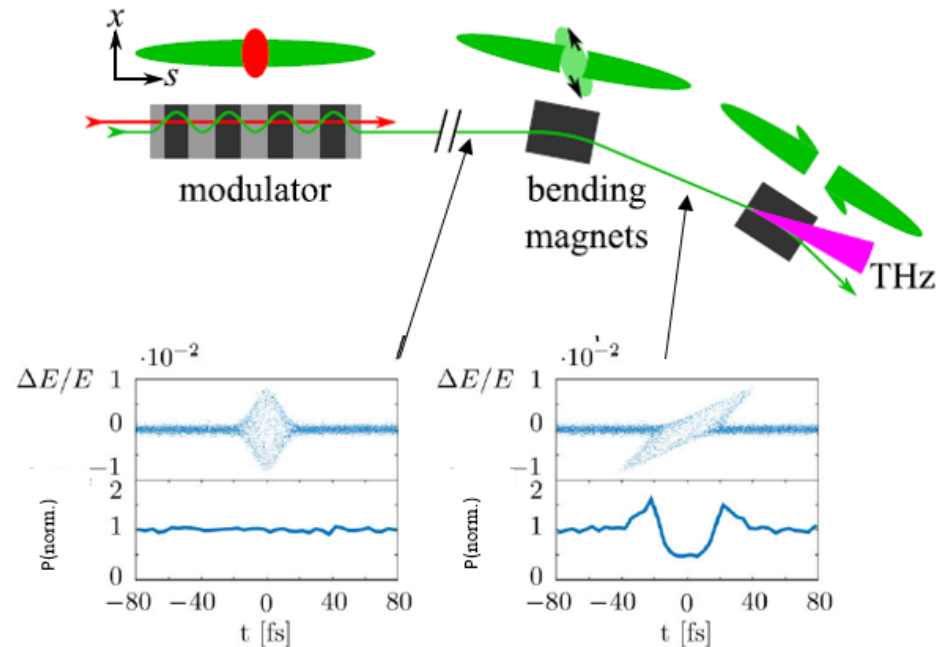
Wavelength	800 nm
Pulse length (FWHM)	40 fs
Pulse energy	8 mJ
Repetition rate	1 kHz

The Short-Pulse Facility at DELTA



Production of ultrashort VUV pulses employing coherent harmonic generation (CHG) scheme

Generation of THz Radiation

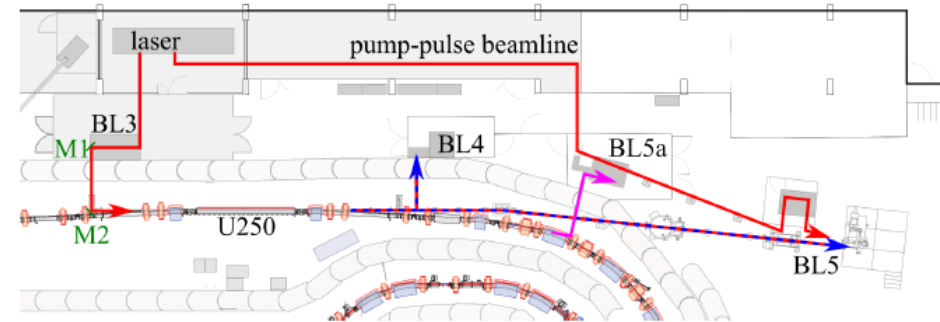
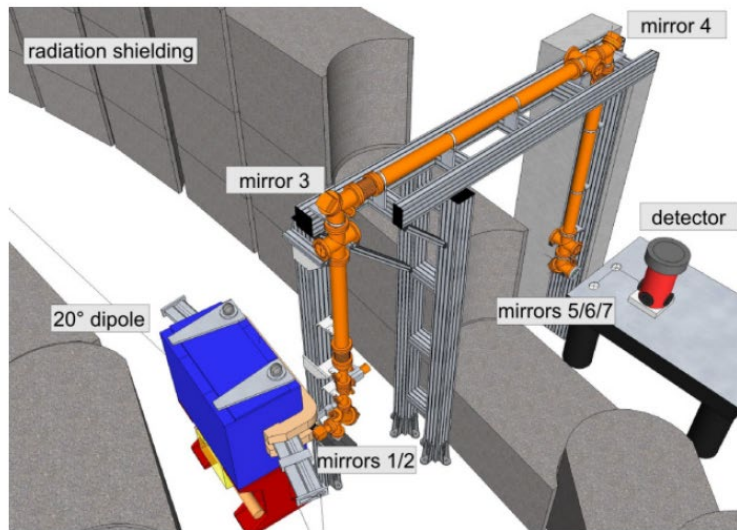


Energy-modulated electrons leave a short dip in the longitudinal charge density giving rise to coherent emission of THz radiation

R. Niemczyk, Konstruktion eines Aufbaus für elektrooptische Fernfeld-Messungen an der Terahertz-Strahllinie bei DELTA Masterarbeit, Technische Universität Dortmund (2016).

P. Ungelenk, Generation and Detection Schemes for Laser-Induced Coherent Terahertz Radiation at the Electron Storage Ring DELTA, Dissertation, Technische Universität Dortmund (2015).

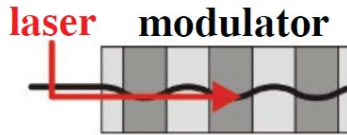
THz Beamline at DELTA



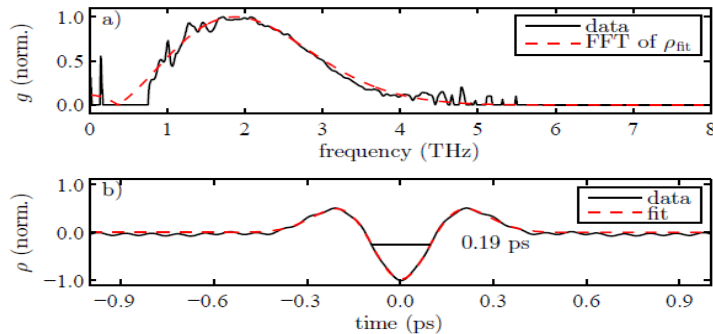
The first 20-degree dipole after the U250 undulator is the extraction point of the THz radiation

Markus Höner, *Optical Design and Construction of a Dedicated THz Beamline at DELTA and Study of Laser-Electron Interaction*, diploma thesis, Technische Universität Dortmund (2011).
 Courtesy: T. Schulte-Eickhoff

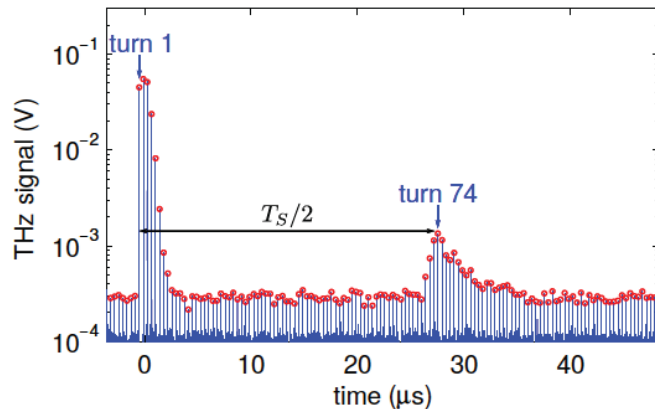
THz as a Diagnostic Tool



As a diagnostics tool for the laser-electron overlap



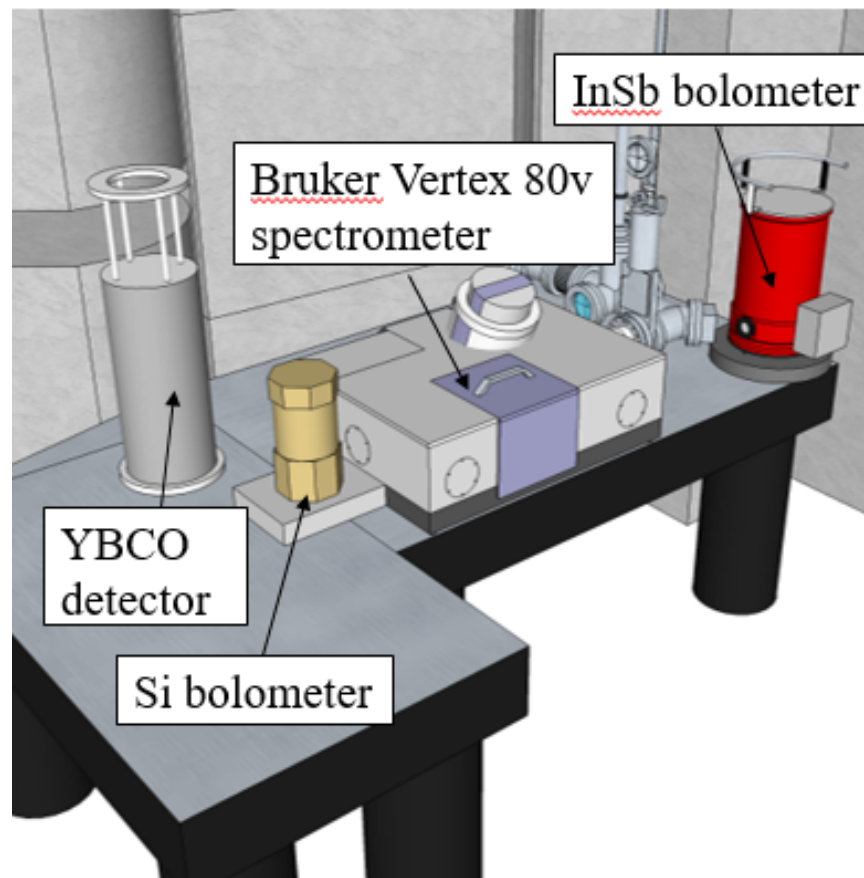
Information about the laser-induced density modulation



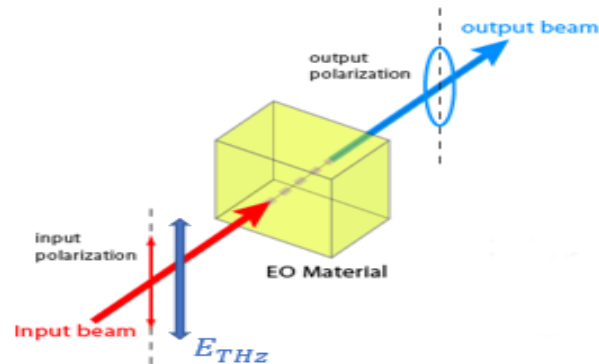
Studies of the Electron beam Dynamics, Turn-By-Turn Observation of Laser-Induced THz Radiation

P. Ungelenk, Generation and Detection Schemes for Laser-Induced Coherent Terahertz Radiation at the Electron Storage Ring DELTA, Dissertation, Technische Universität Dortmund (2015) Proc. Int. Part. Accel. Conf., Richmond, USA, 2015, MOPHA023..

THz Detectors at DELTA

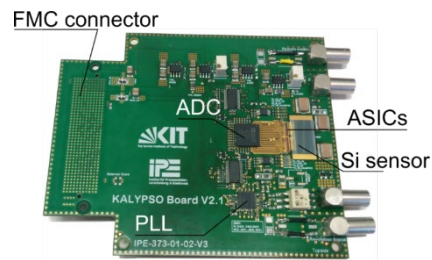


Electro-Optical (EO) Detection



Better temporal resolution

Amplitude and phase information of THz radiation

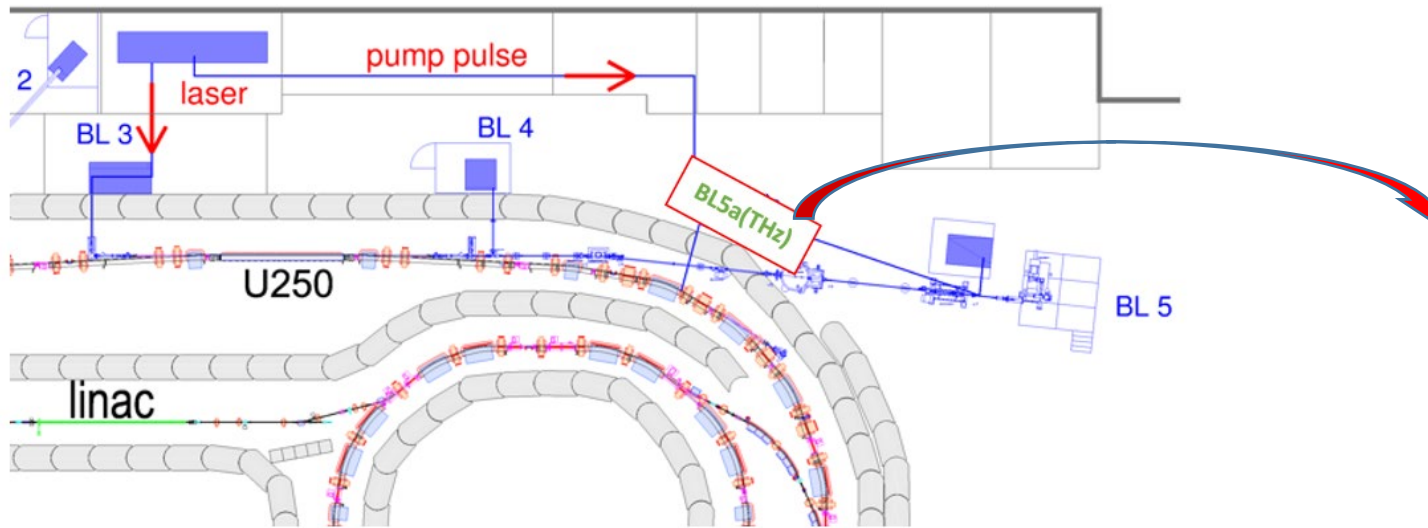


Courtesy : ANKA ,KIT

Electro-Optical Spectral Decoding : Turn-by-turn observation of THz profile with the help of KALYPSO developed by IMS, KIT

S. Casalbuoni et al., *Phys. Rev. ST Accel. Beams* 11, 072802 (2008)

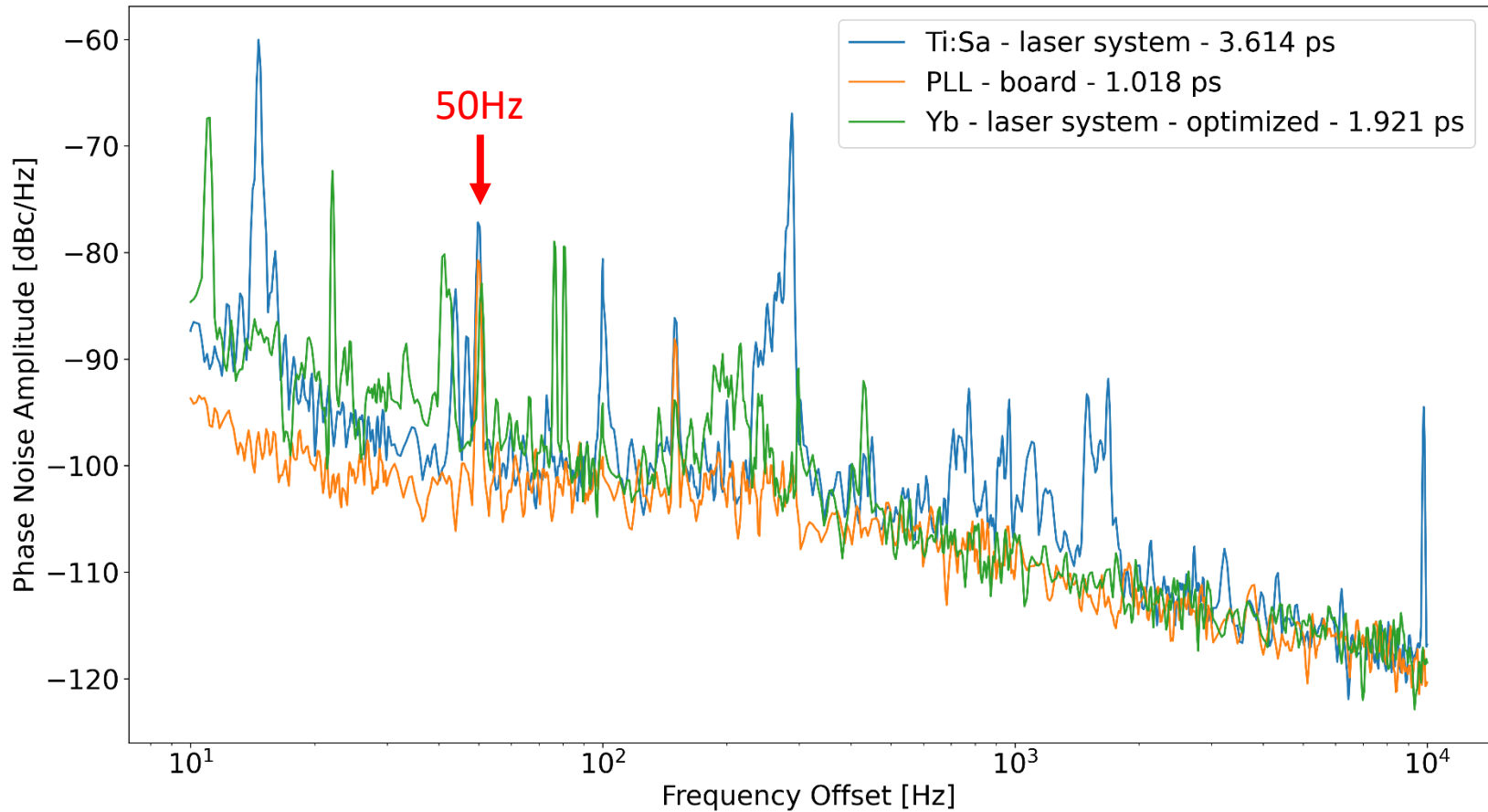
EO Detection Using 1030 nm Fiber Laser



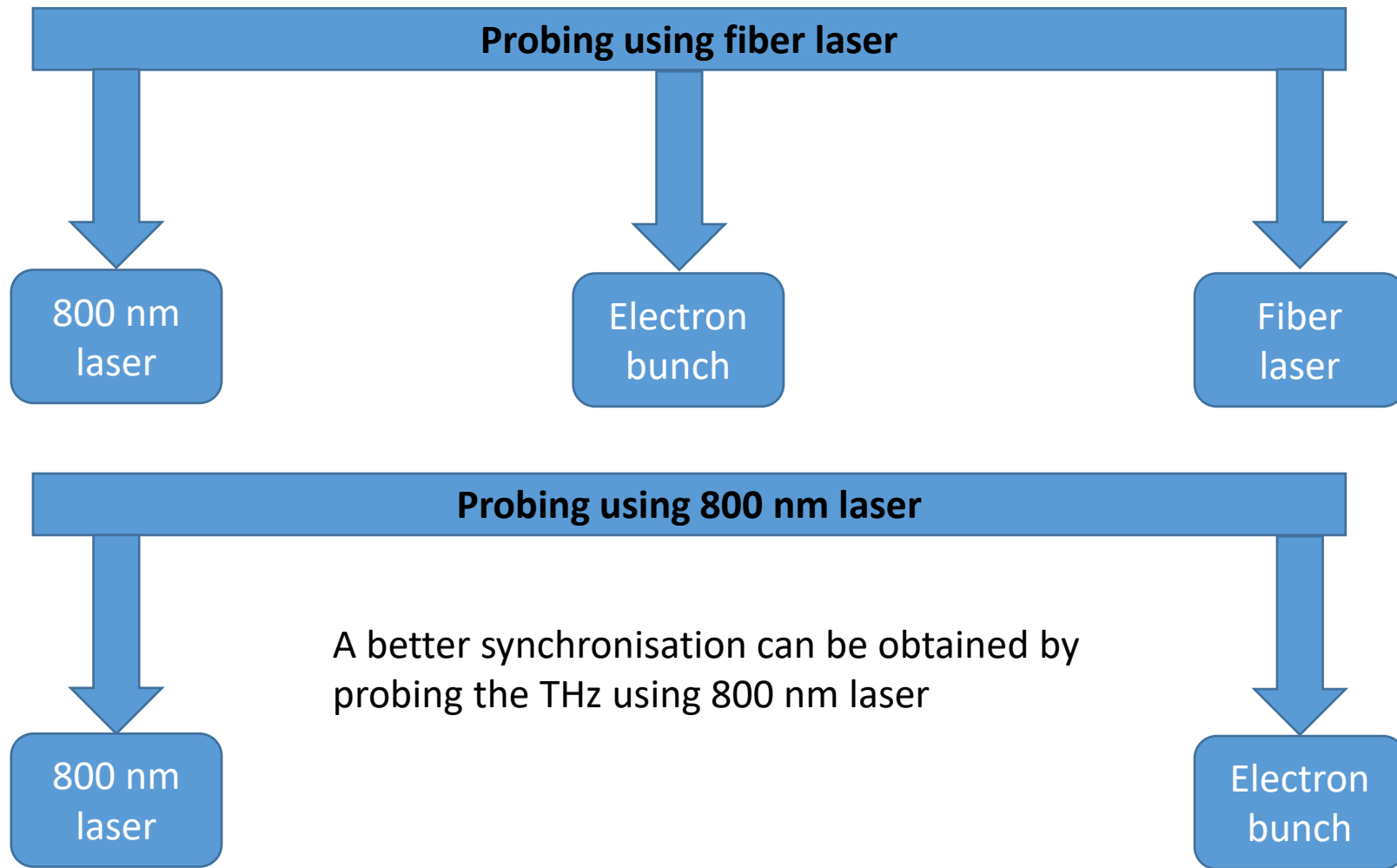
Yb-doped fiber laser system at DELTA

Could not detect EO signal because of the relative arrival time jitter between the laser pulses and electron bunch

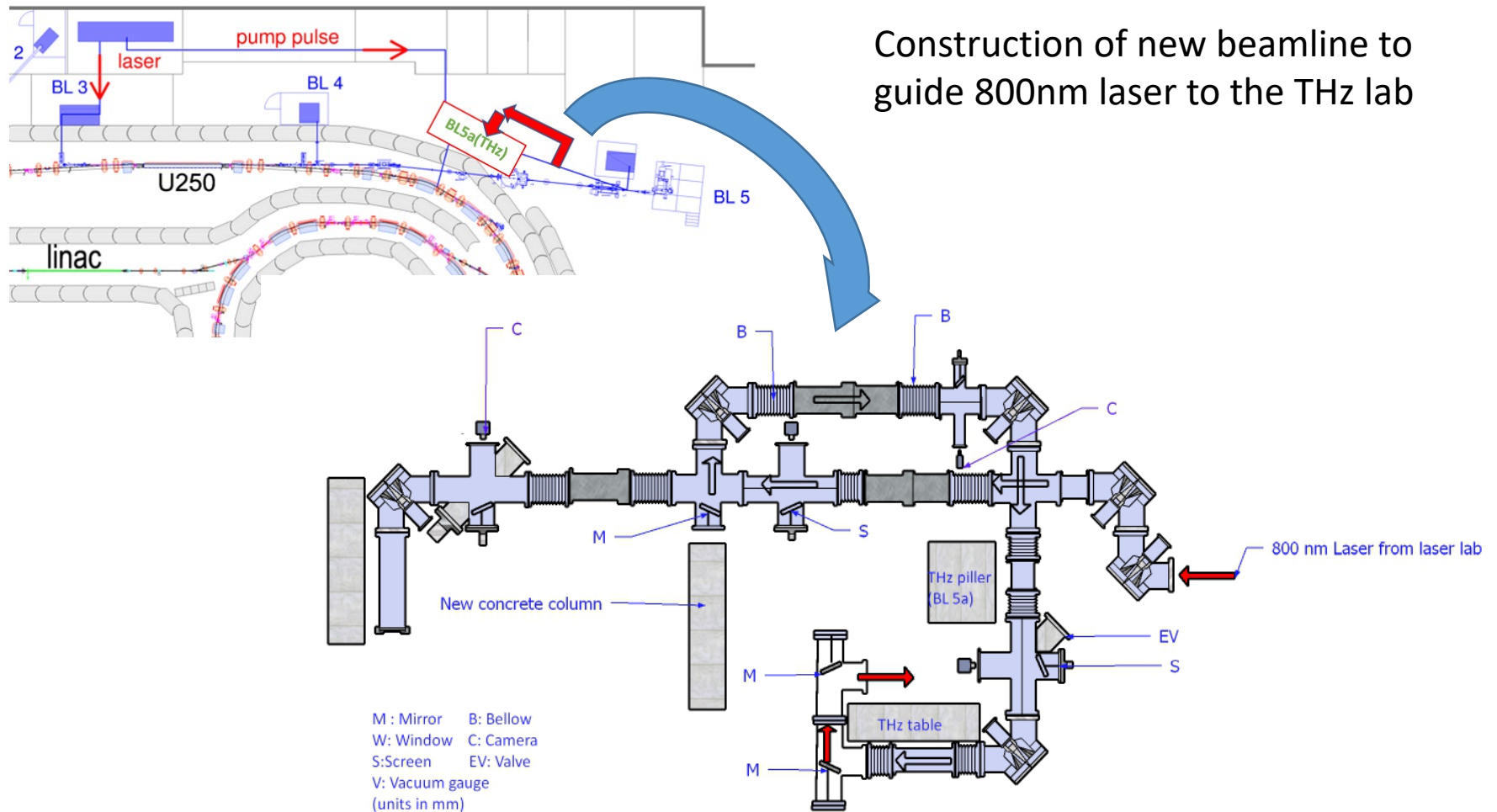
Phase noise measurement



Sources of Jitter



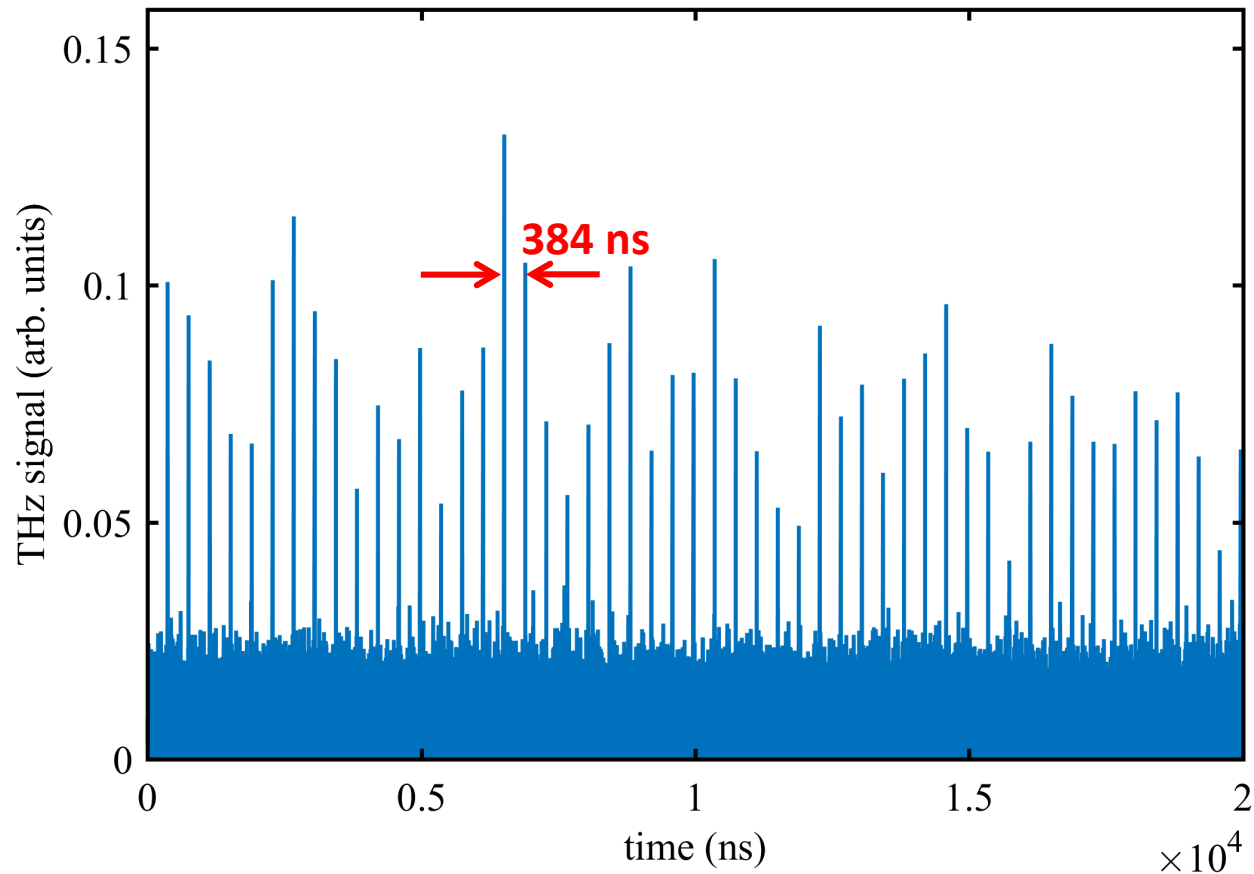
Construction of new Laser-Beamline



Recent Observation of Bursting THz at DELTA

Reduction of beam energy from 1492 MeV to 900 MeV

- THz bursts with repetition rate of 2.6 MHz



Thank You!

This project is supported by:



Bundesministerium
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und Forschung

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