Karlsruhe Institute of Technology

Status and beam diagnostics activities at ANKA

The XXIII European Synchrotron Light Source Workshop

Marcel Schuh

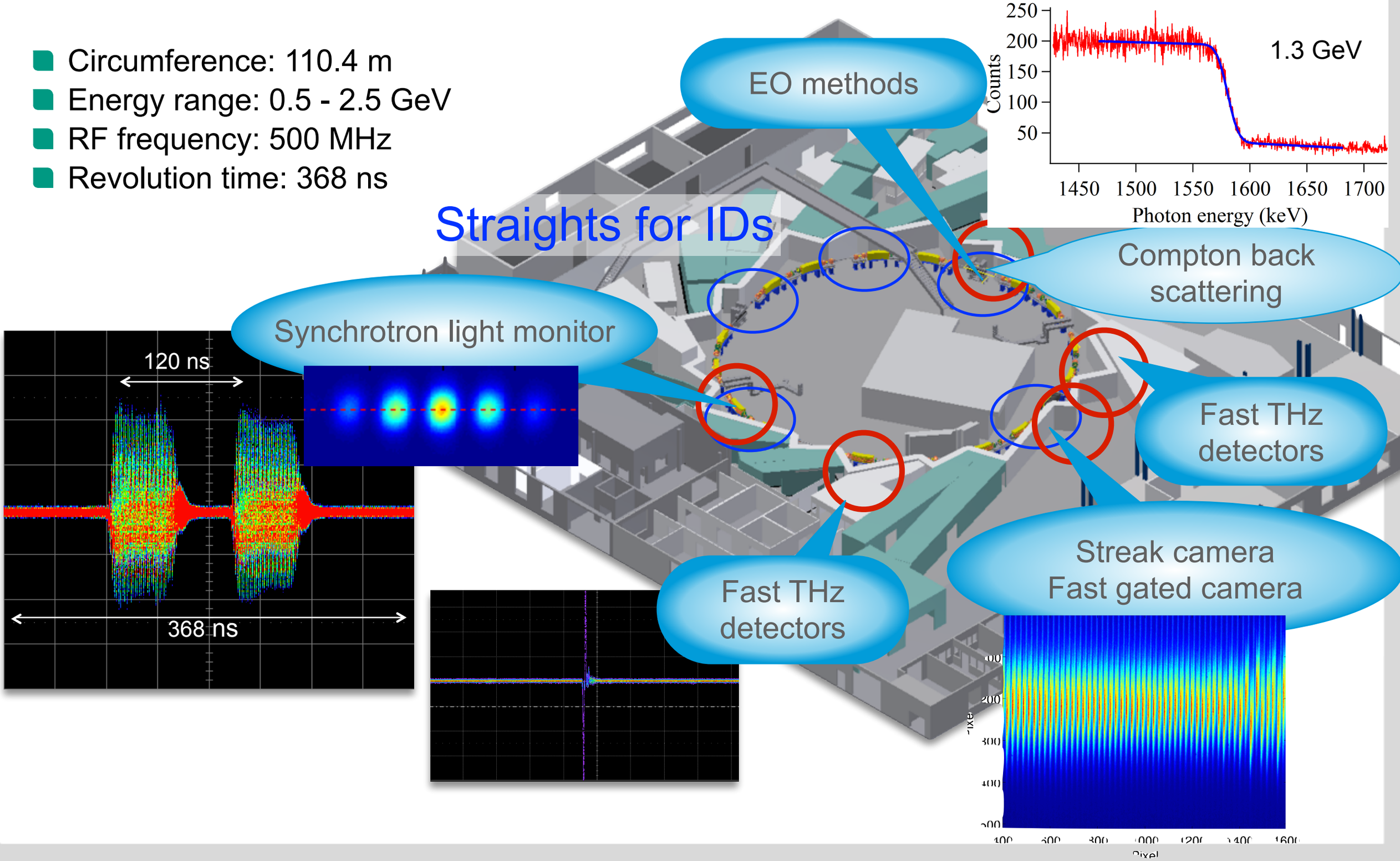
Laboratory for applications of synchrotron radiation

Outline

- Status - new mission
- Refurbishment and upgrades
- Superconducting IDs
- Beam diagnostics

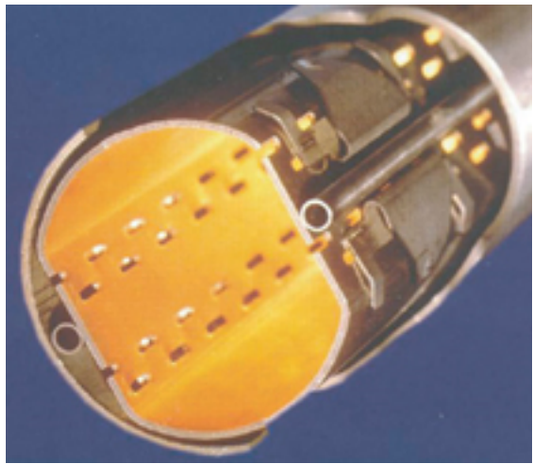
The ANKA synchrotron radiation facility

- Circumference: 110.4 m
- Energy range: 0.5 - 2.5 GeV
- RF frequency: 500 MHz
- Revolution time: 368 ns



ANKA status - new mission 2015

- Photon science facility and technology platform
- New operation/usage strategy in preparation
- Open for R&D
- Operation: two mayor failures in 2015
  - Power cut - main transformer station tripped
  - Resistor in bending magnet power supply burned
- Refurbishment and consolidation continued
- New project: EuroCirCol – FCC H2020 Project – The European Circular Energy-Frontier Collider Study

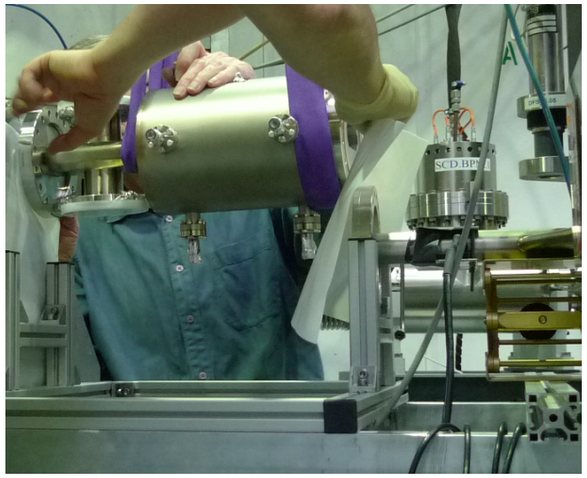


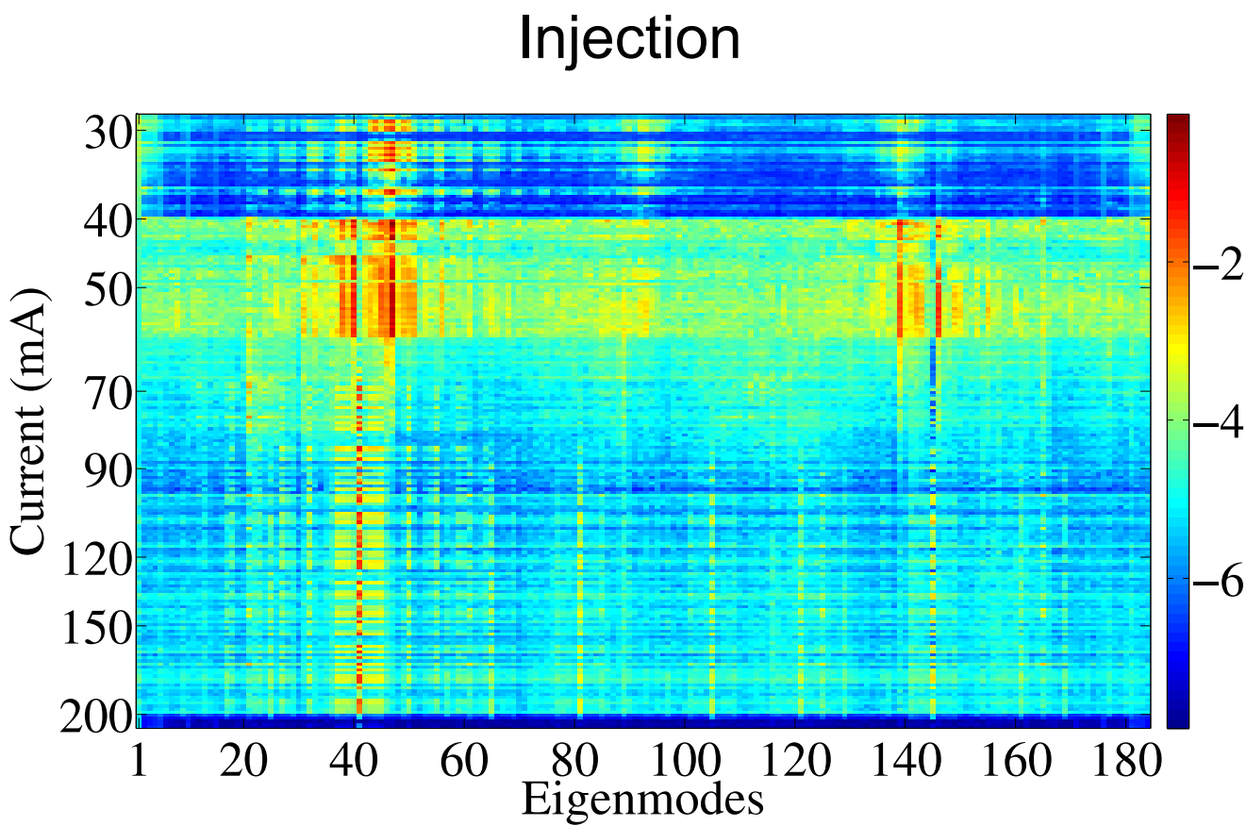
ANKA refurbishment and upgrades

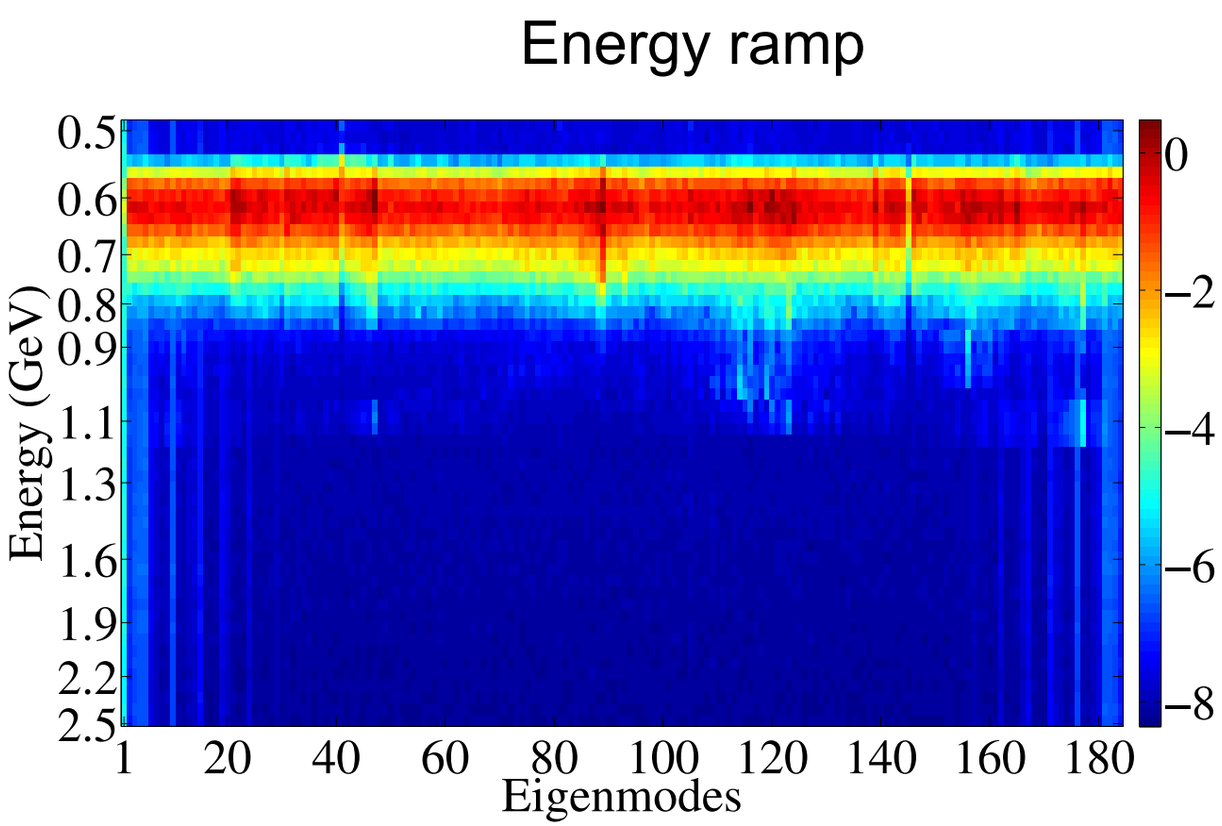
- Orbit correction software upgrade
  - 0.02 Hz ➔ 10 Hz (now hardware limited)
  - No need for triggered ramping corrector power supplies
  - Local correction schemes introduced for IDs for scanning during operation
- Electric load to manipulate quadrupoles to compensate impact of ID
- Continue control system migration to EPICS
  - Vacuum started
  - RF in progress (LLRF completed)
- Refurbishment
  - Replacement of vacuum controllers
  - Continue exchange of power supplies in the injector

3D bunch by bunch feedback system

- Longitudinal kicker cavity installed 2015-01
- 3D BBB feedback system in operation
- Diagnostic features are heavily used in MD shifts
- Multi bunch instability analysis





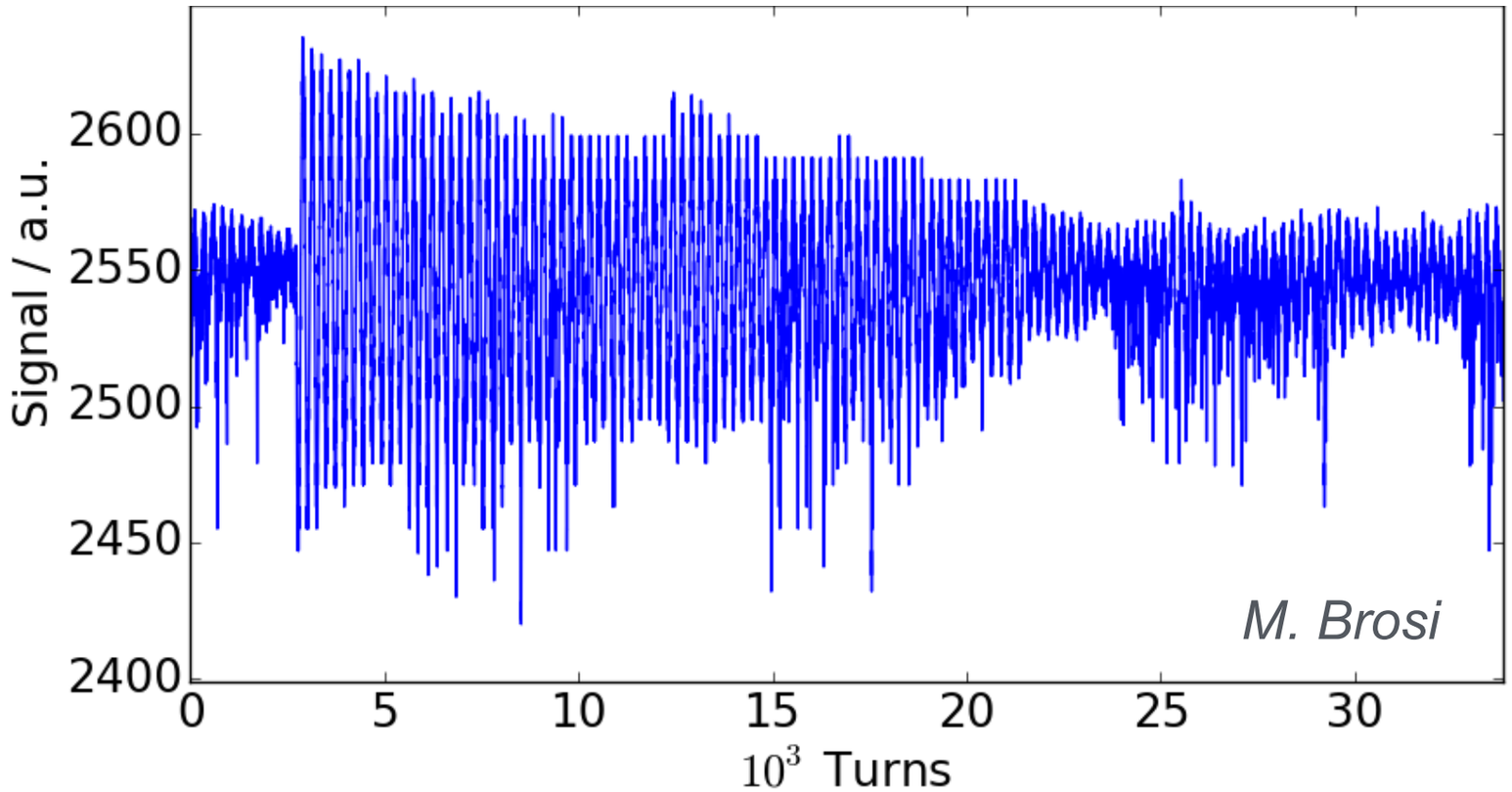


E. Blomley

New digital LLRF system

- Dimtel LLRF9/500
- Installed and commissioned 2015-09/10
- Better diagnostics and control
- Operation aspects
  - Keeps synchrotron tune constant during ramp
  - Amplitude and phase modulation to excite the beam

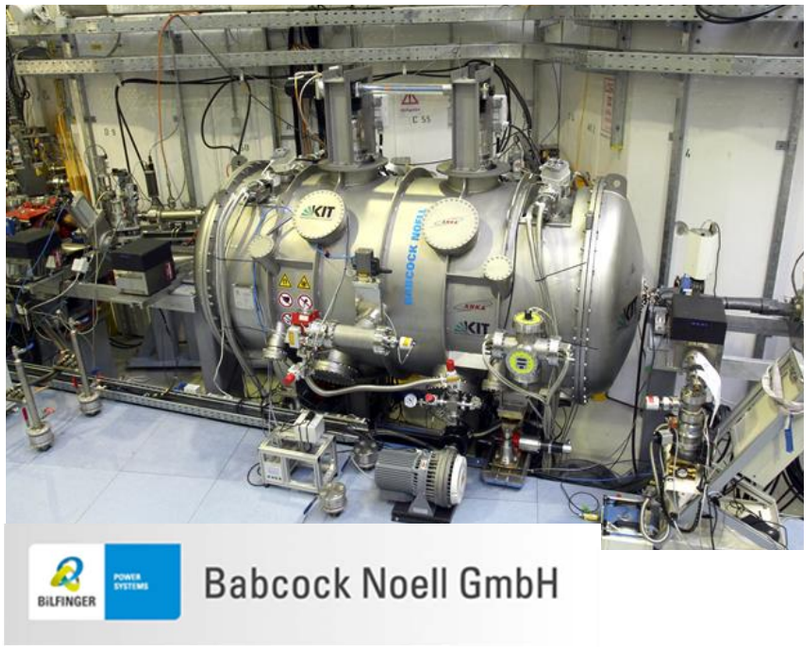
Beam kicked by one deg phase jump



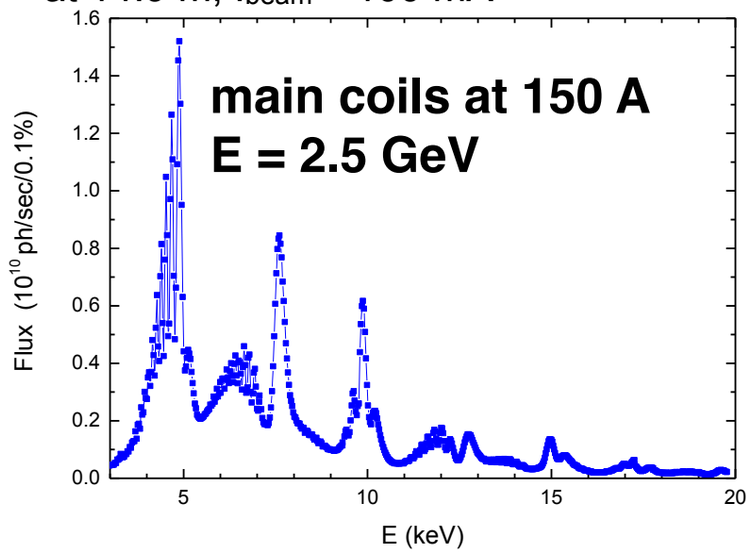
M. Schedler

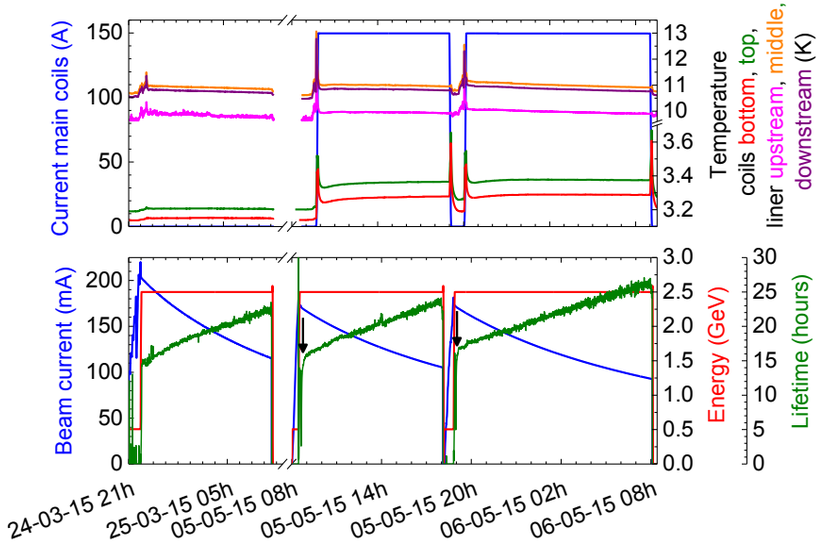
SC IDs @ ANKA

- SCU15: In operation since January 2015

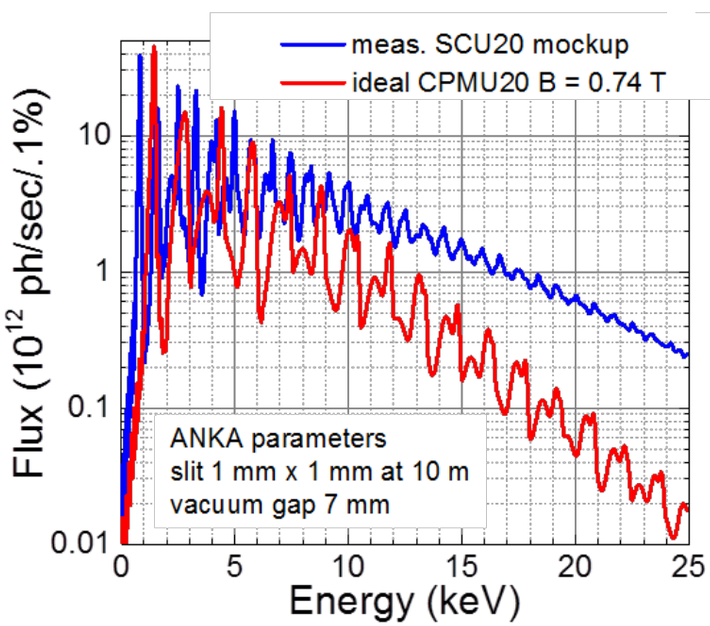


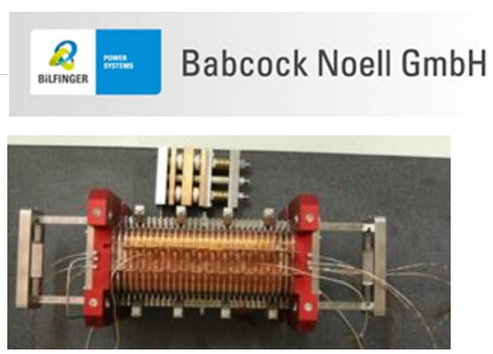
Flux through 50 µm diameter pinhole at 14.9 m; I_{beam} = 100 mA





- SCU20: Mockup tests

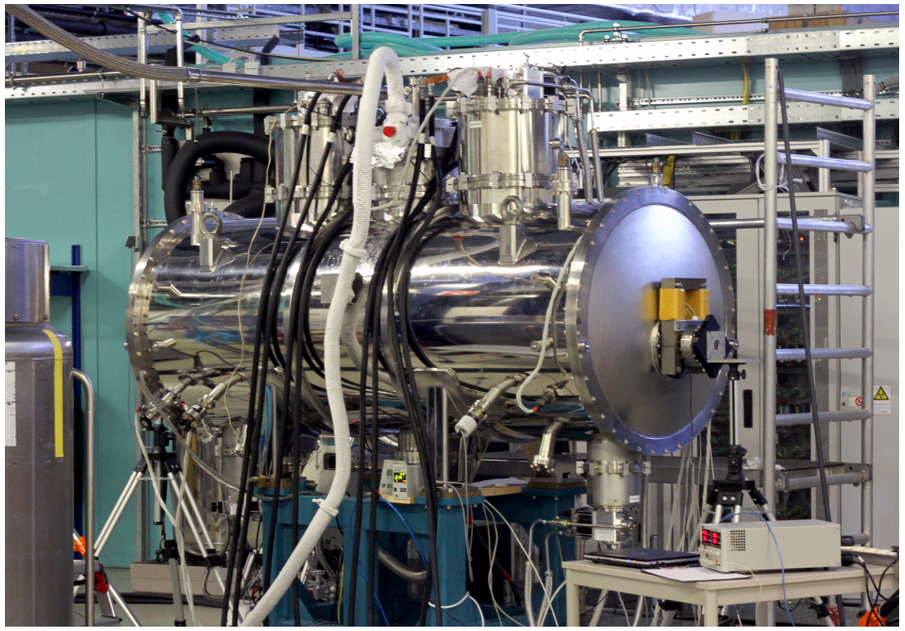




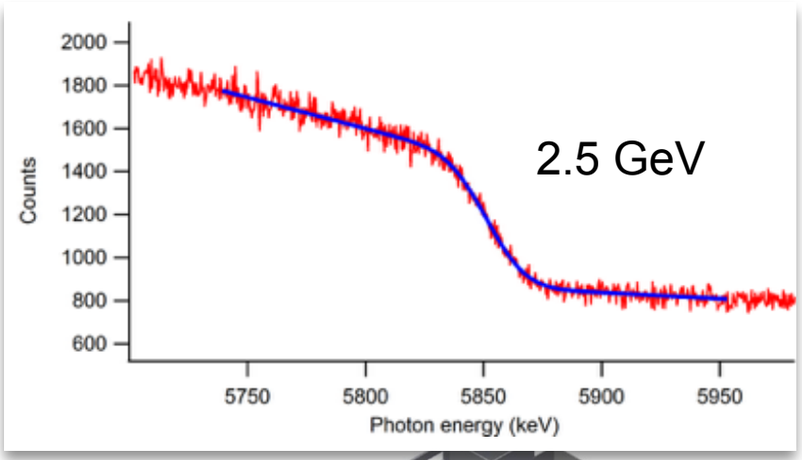
SCU20 Mockup 2

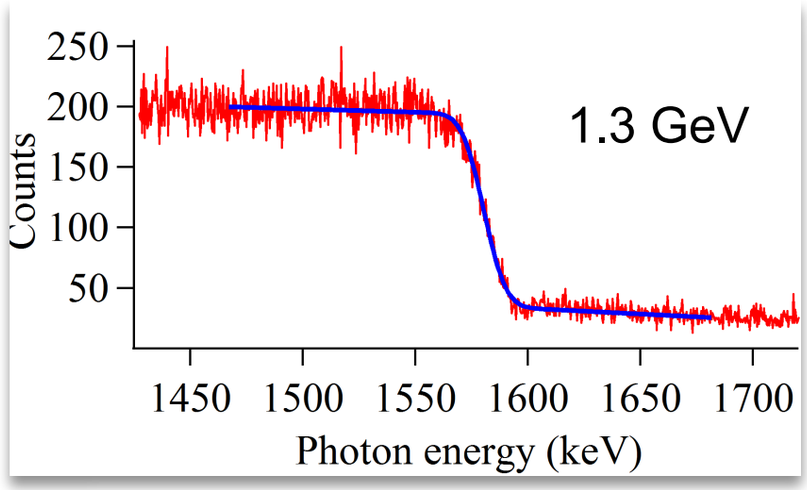
S. Casalbuoni et al.
SRI2015, IPAC2015

- CLIC wiggler: On site tests

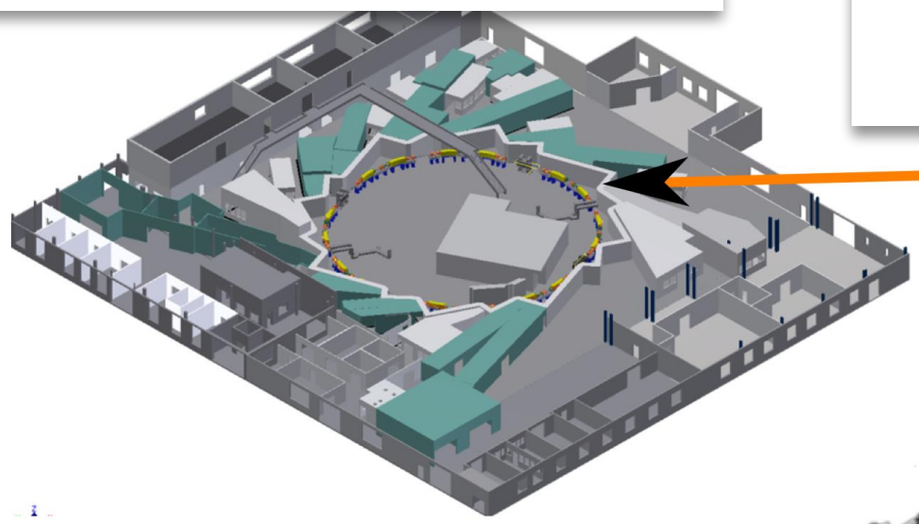


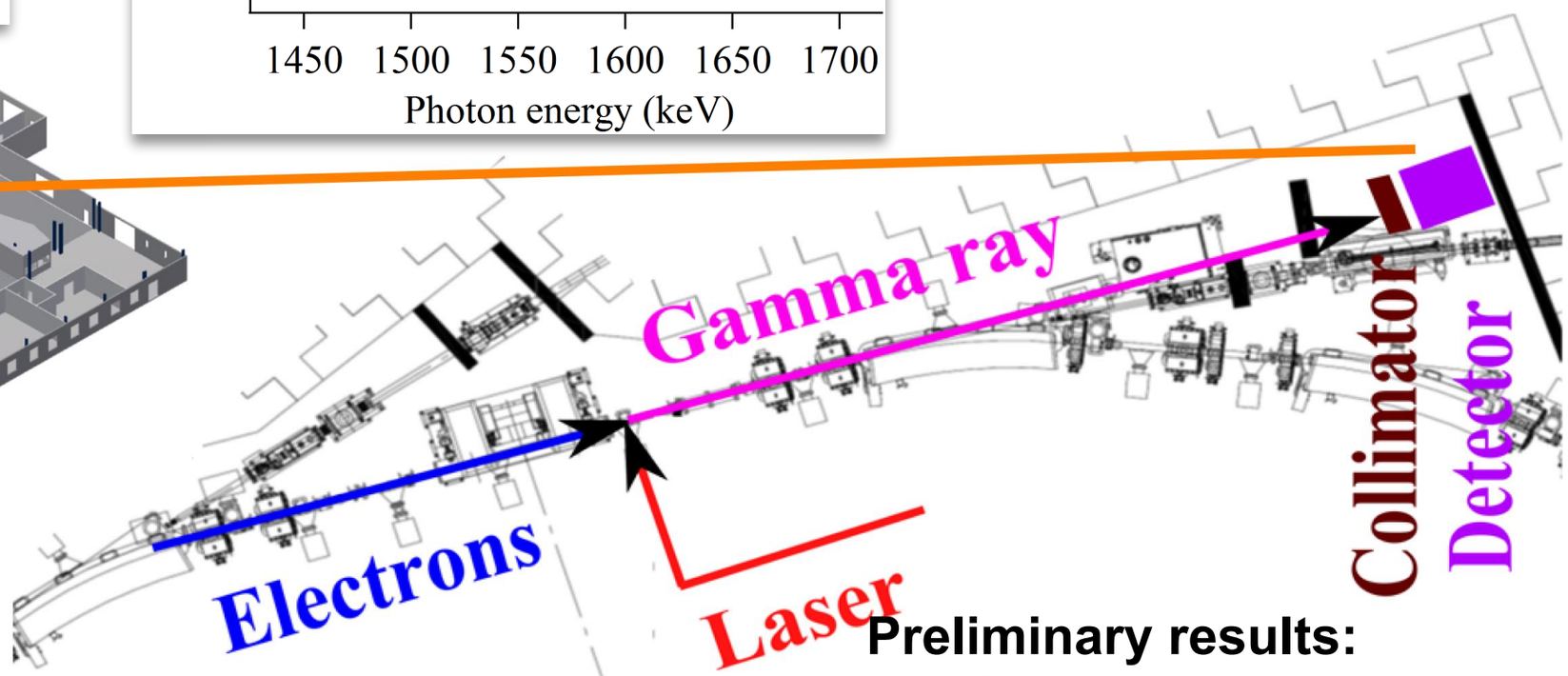
Compton backscattering setup @ ANKA





Educating Students & Outreach
CBS@ANKA:
https://youtu.be/0OPmkPef5y8





- 90° collision angle
- 0° scattering angle
- Very compact setup (laser coupled in via ion pump port)
- Detector uses a temporarily free 0° front-end

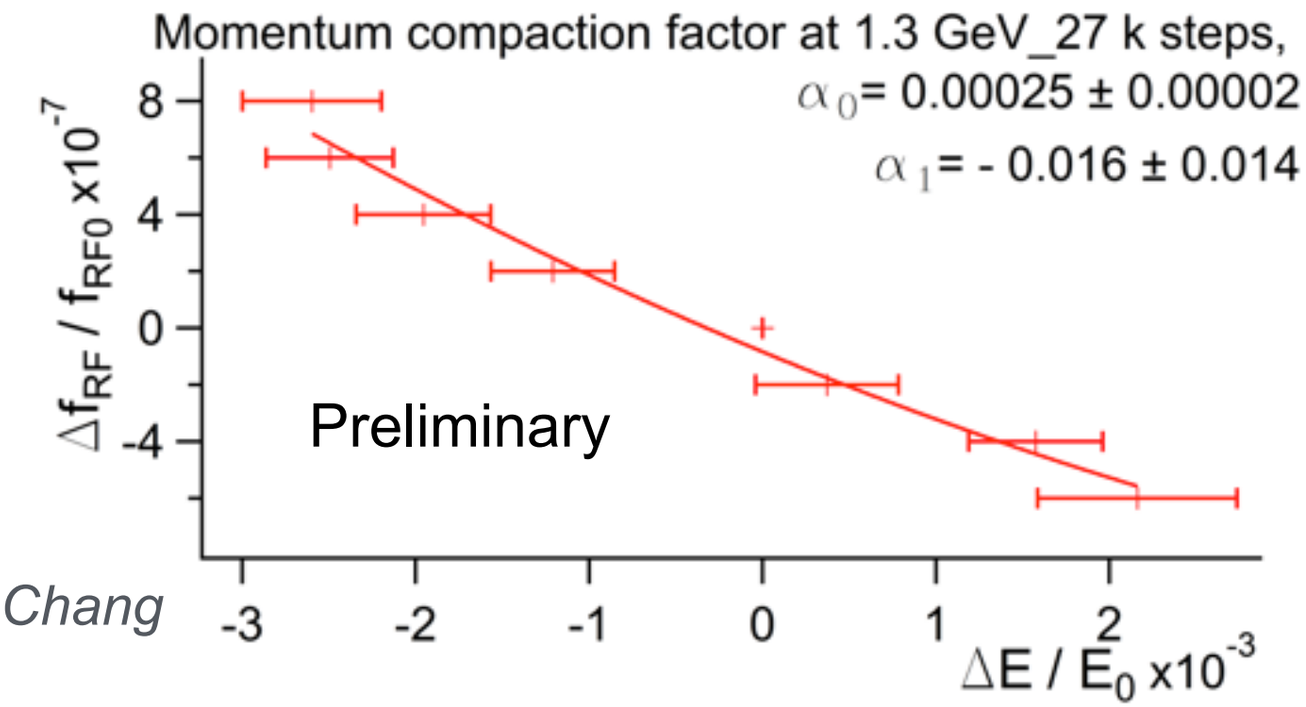
Preliminary results:

0.5 GeV: 495.64 ± 0.06 MeV
1.3 GeV: 1287.0 ± 0.2 MeV
1.6 GeV: 1582.1 ± 0.2 MeV
2.5 GeV: 2476.4 ± 0.3 MeV

C. Chang et al. IPAC2015 MOPHA040

Alpha measurements

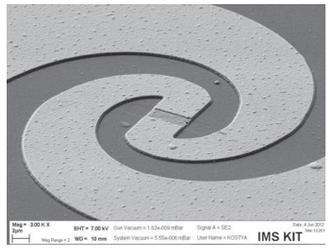
- Measure energy with CBS for different RF frequencies to obtain alpha

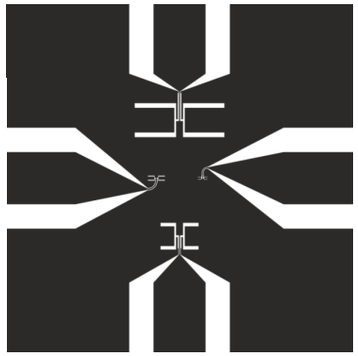


C. Chang

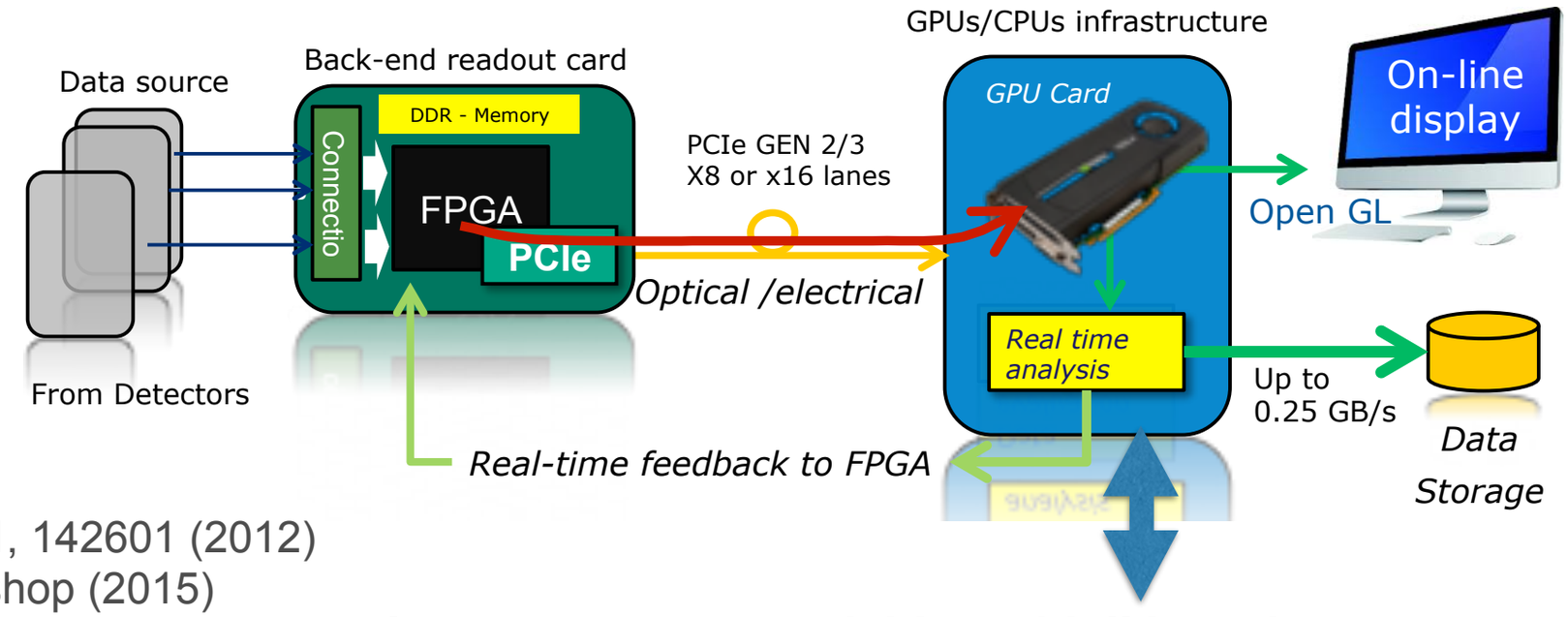
- Use measured alpha as input for prediction of CSR bursting threshold and compare it with measurement

THz signal dynamics - development of detectors, readout & (online) analysis



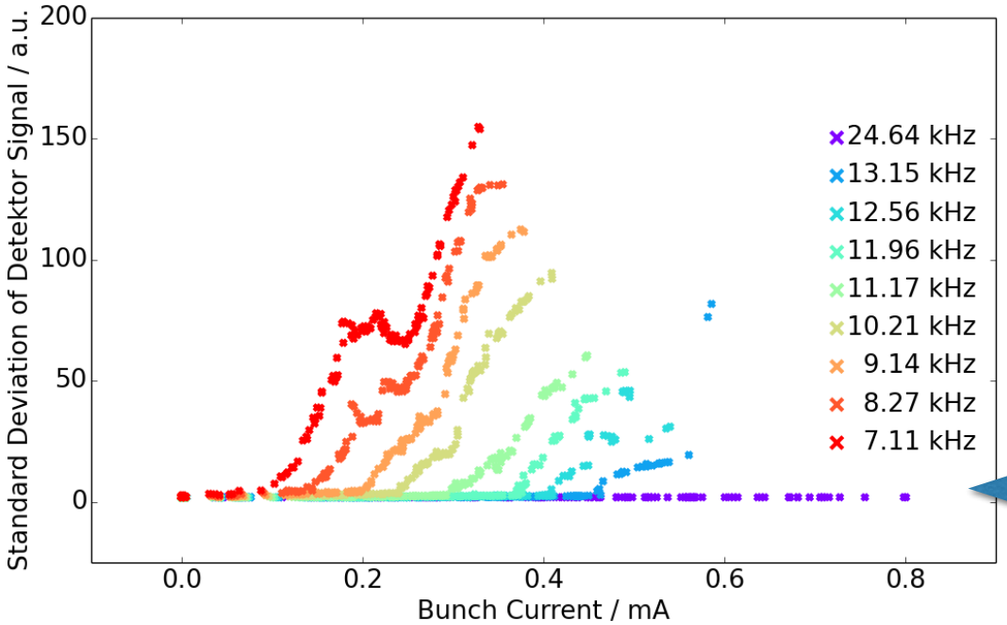


M. Caselle, et al., Journal of Instrumentation, 9(01):C01024 (2014)

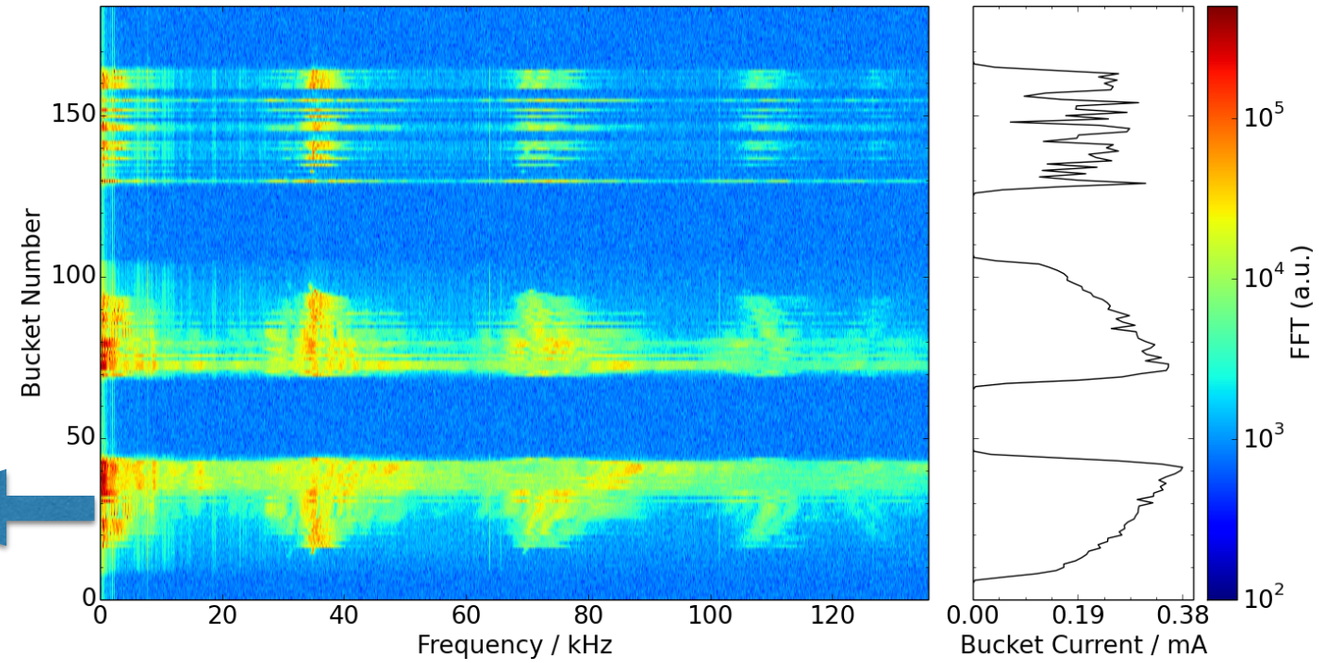


P. Thoma, et al., Appl. Phys. Lett. 101, 142601 (2012)
A. Schmid et al., 3rd ARD ST3 Workshop (2015)

Instantaneous threshold determination



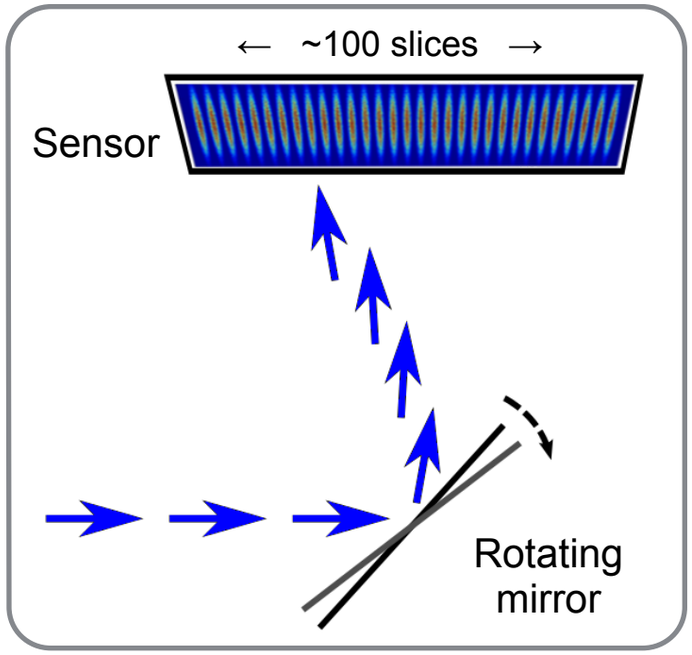
Instantaneous acquisition of full bursting spectrogram

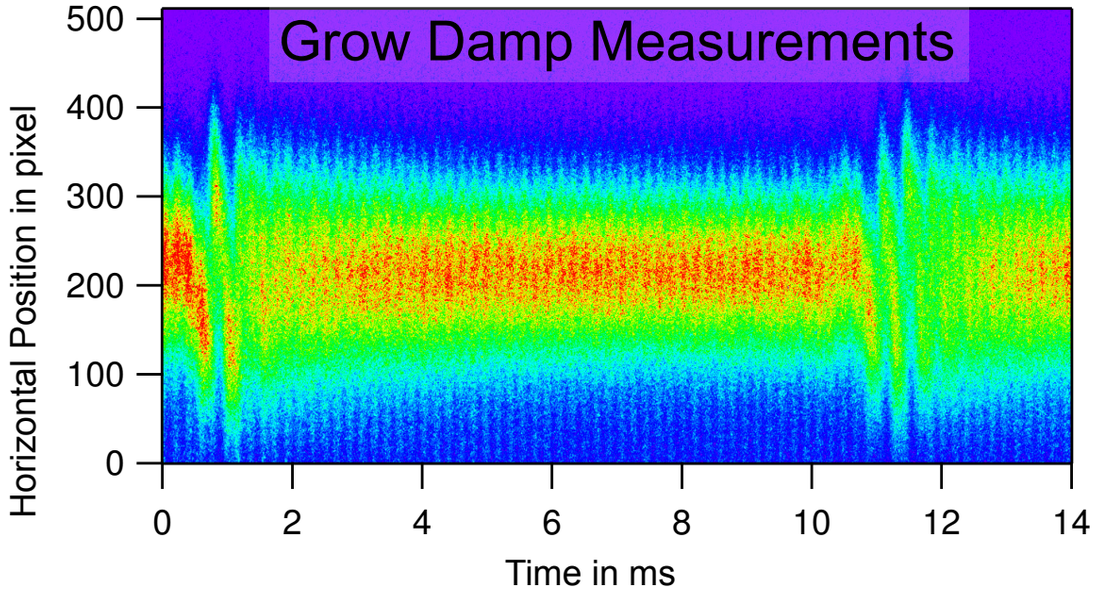


M. Brosi, et al., IPAC 2015, MOPHA042

Fast gated intensified camera

- **Task: Monitor size and position of a single bunch over consecutive revolutions in a multi-bunch environment.**
- Fast gated intensified camera:
  - Optical gate width < 2 ns
  - Maximum gate repetition rate of 500 kHz: Imaging of every 6th turn
- A rotating mirror deflects consecutive pulses to different positions on the sensor
- Acquire up to 100 slices
- Focusing optics optimized for horizontal plane





P. Schütze, B. Kehrer

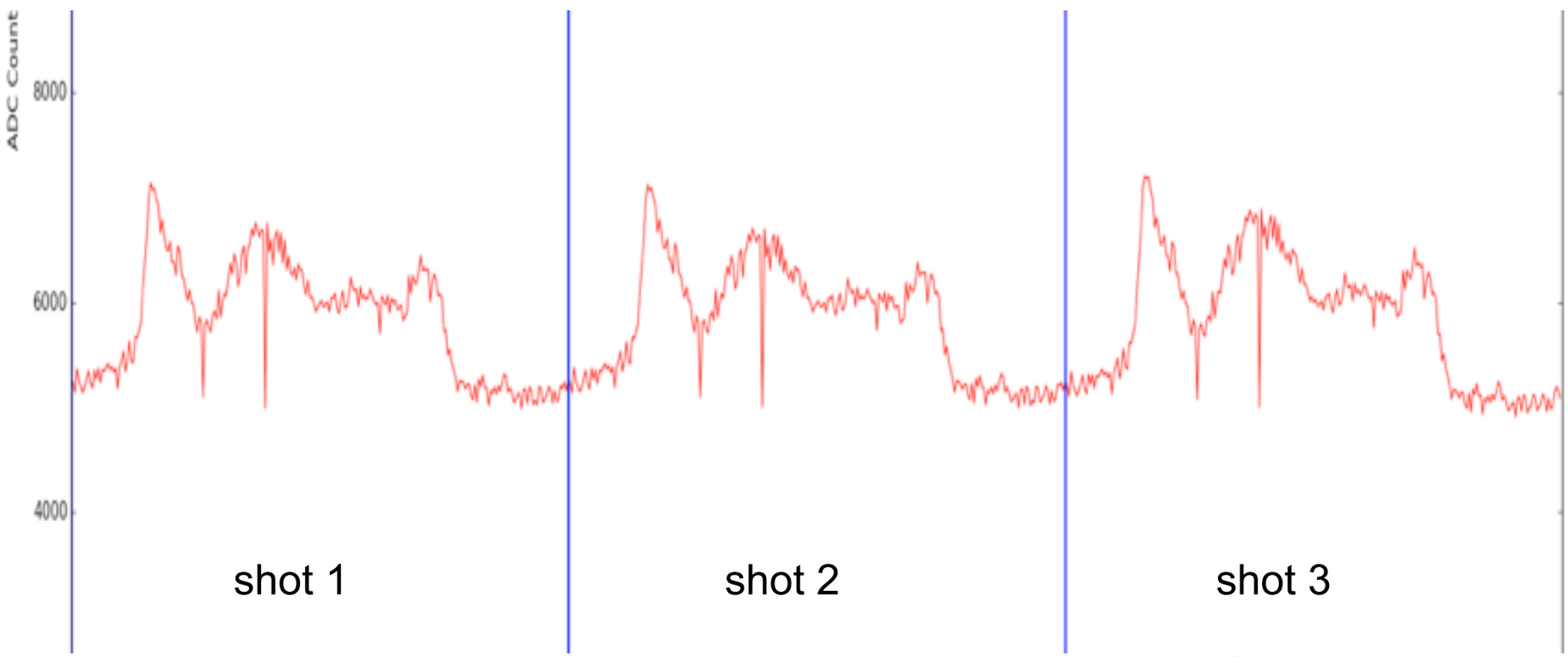
An ultra-fast line array detector system - KALYPSO

KIT Accelerator Technology Platform

SPONSORED BY THE Federal Ministry of Education and Research

Karlsruhe Institute of Technology

- KArlsruhe Linear arraY detector for MHz-rePetition rate SpectrOscopy
- First measurements at ANKA with 900kfps



L. Rota, N. Hiller et al.

Collaboration

Karlsruhe Institute of Technology

DESY

PAUL SCHERRER INSTITUT PSI

Lodz University of Technology

HZDR

GSI

N. Hiller, M. J. Nasse, G. Niehues, P. Schönfeldt, S. Walther, L. Rota, M. Caselle

Summary and outlook

- New operation/usage strategy for ANKA:
  Photon science facility and technology platform
- New LLRF and 3D feedback system enables more controlled beam manipulations
- New diagnostics devices available
  - 3D BBB feedback
  - FGC
  - CBS
  - KALYPSO
- Upcoming tasks
  - New projects, e.g., EuroCirCol
  - Refurbishment continues
  - FLUTE commissioning

Thank you for your attention!