FLASHFORWARD ▶▶ Laser Lab update

Facility development and experiments

Kristjan Põder, S. Bohlen, J. Dale, R. D'Arcy, M. Dinter, L. Goldberg, J.-N. Gruse, G. Indorf, S. Karstensen, O. Kononenko, K. Ludwig, F. Marutzky, P. Niknejadi, C. Palmer, P. Pourmoussavi, M. Quast, A. Rahali, J.-H. Roeckemann, V. Rybnikov, L. Schaper, A. Schleiermacher, J.-P. Schwinkendorf, B. Sheeran, M. Streeter, G. Tauscher, J. Thesinga, S. Weichert, P. Winkler, J. Viswanathan and J. Osterhoff

Elba, 24th September 2017

HELMHOLTZ ASSOCIATION

DESY

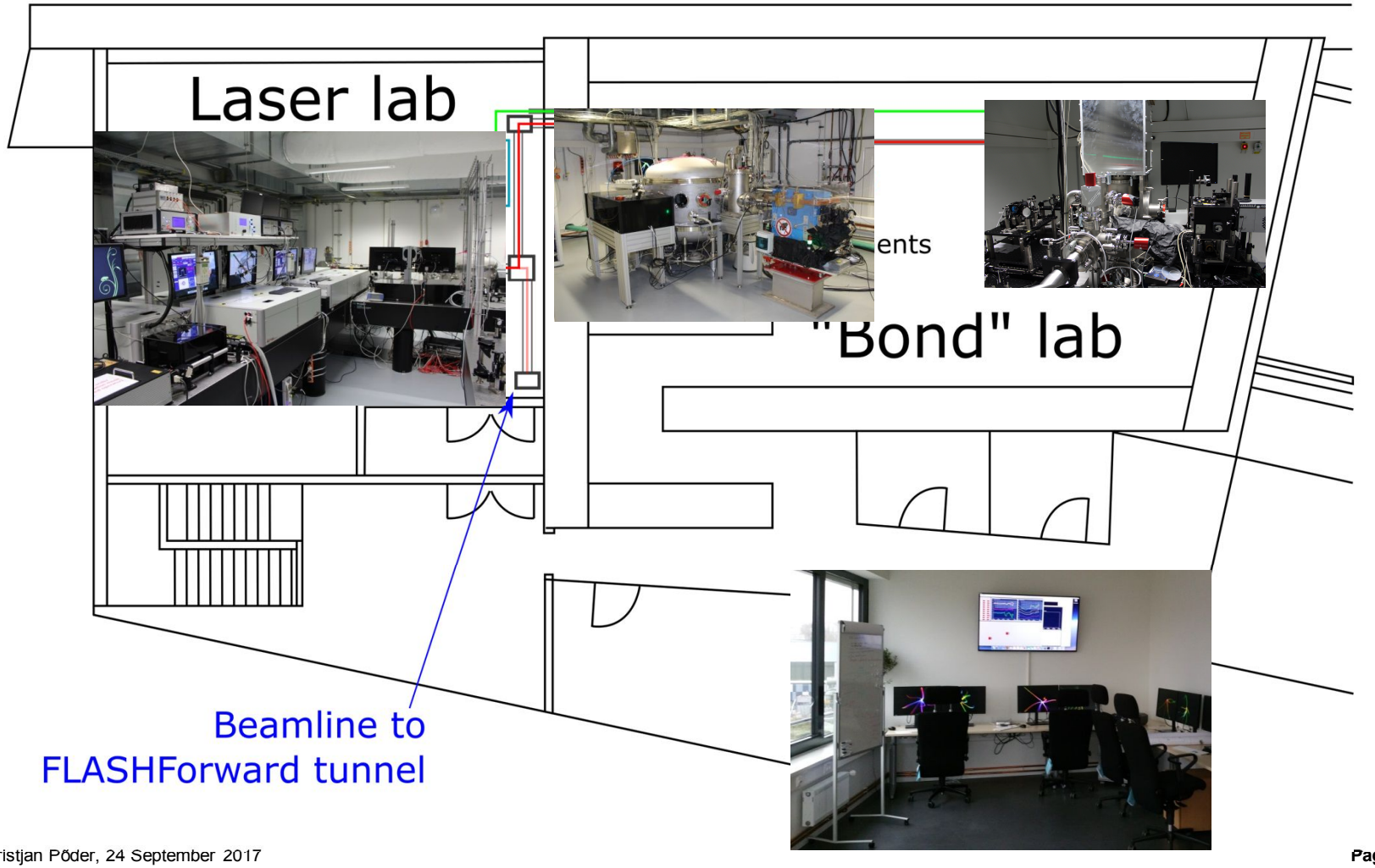
Laser and test lab

Fully operational since 2016

Laser and test lab

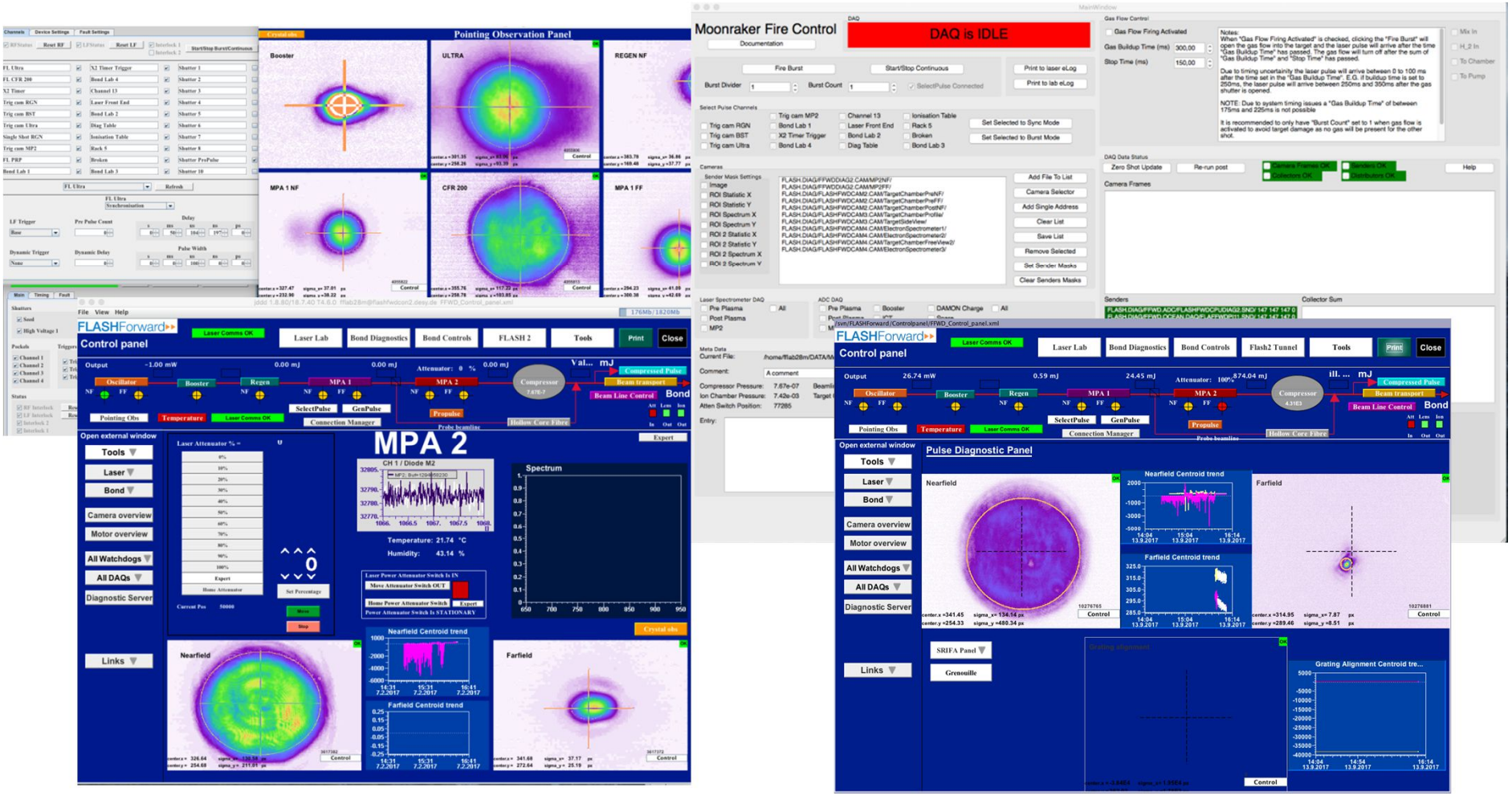
Fully operational since 2016

- Ti:Sa Laser System from Amplitude
  - 25 TW Laser
  - 25 fs
  - 10 Hz
- Second Compressor for additional laser arm (3 mJ compressed)



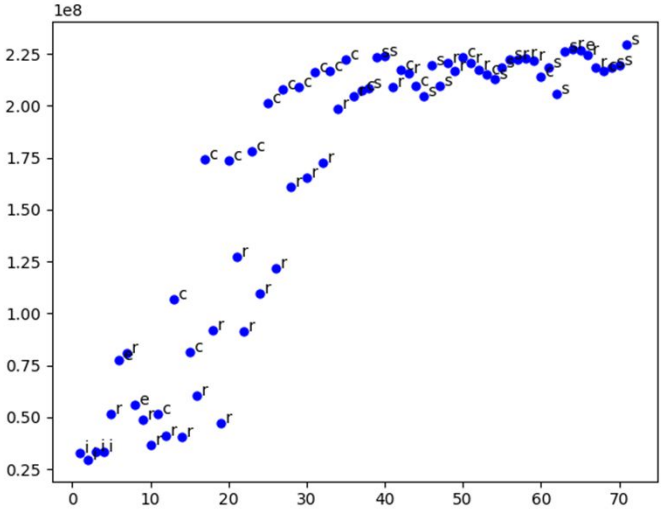
Control system

Laser control and diagnostics integrated into DESY-wide DOOCS control system

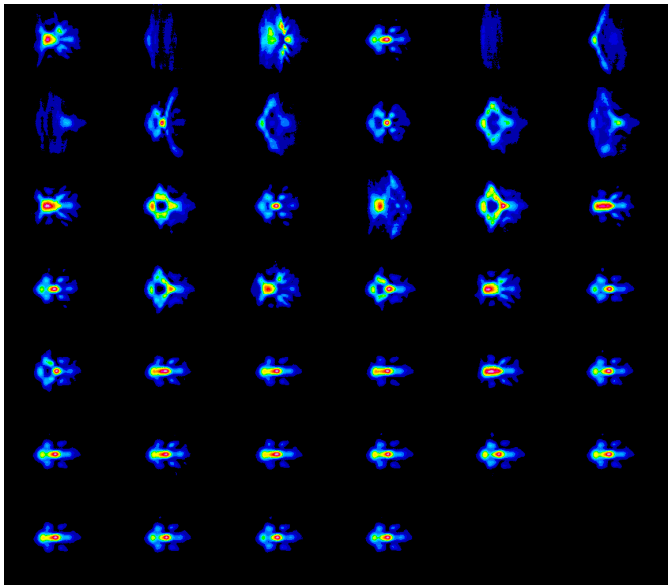


Laser stability and improvements

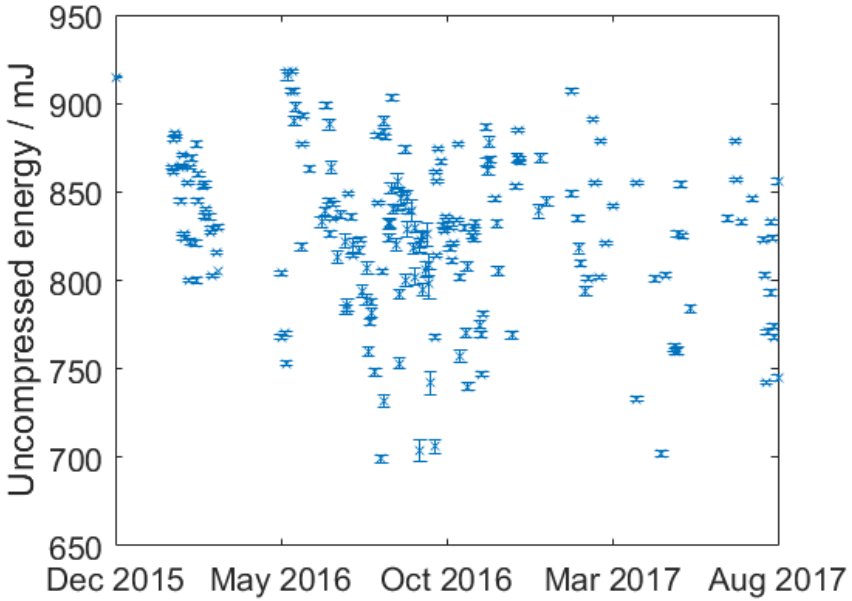
- Implemented feedback routines to optimise short pulse temporal shape using the Dazzler



P. Pourmoussavi



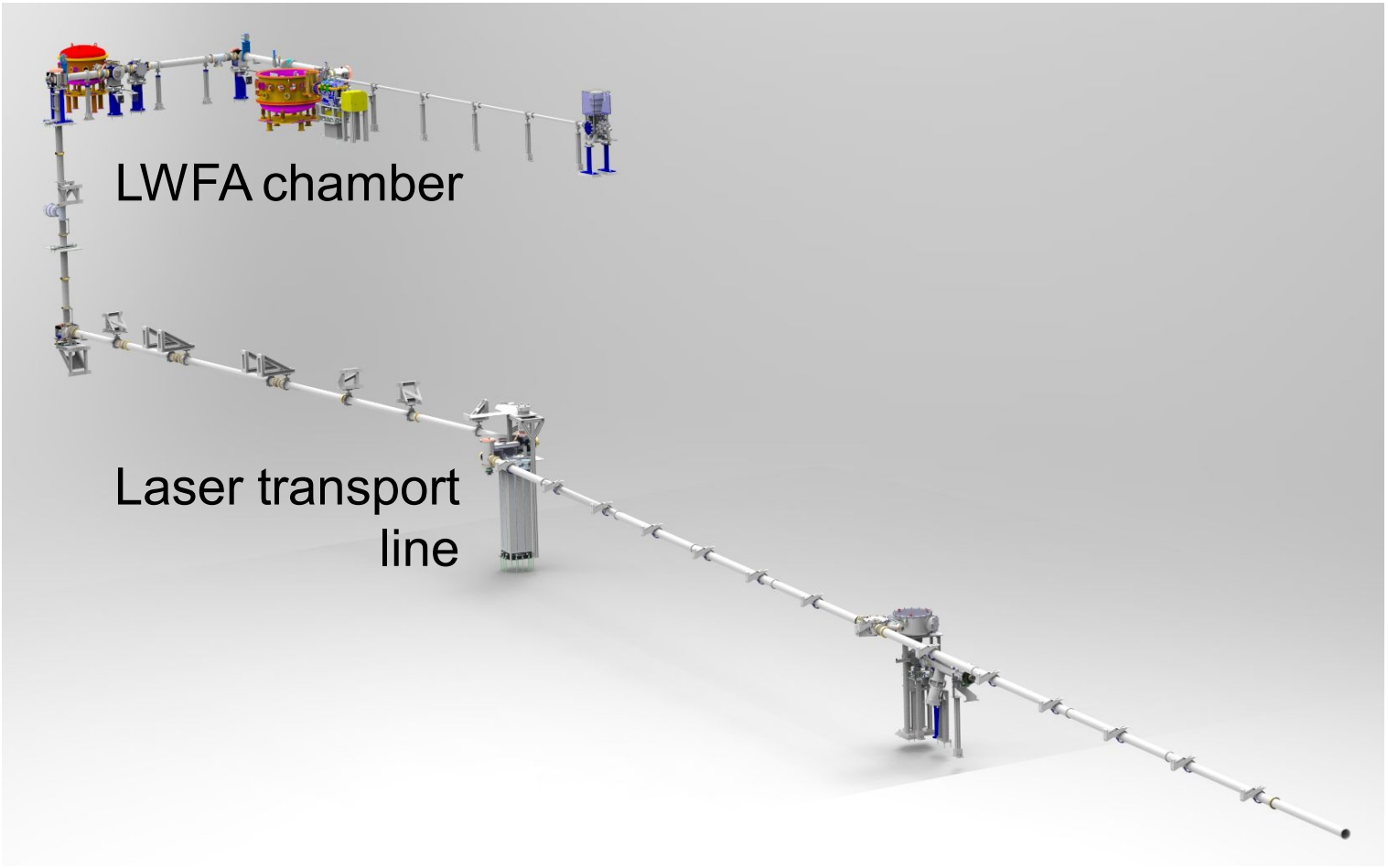
- Laser energy monitored day to day to ensure reproducible laser



Laser beamline in FLASH2 tunnel

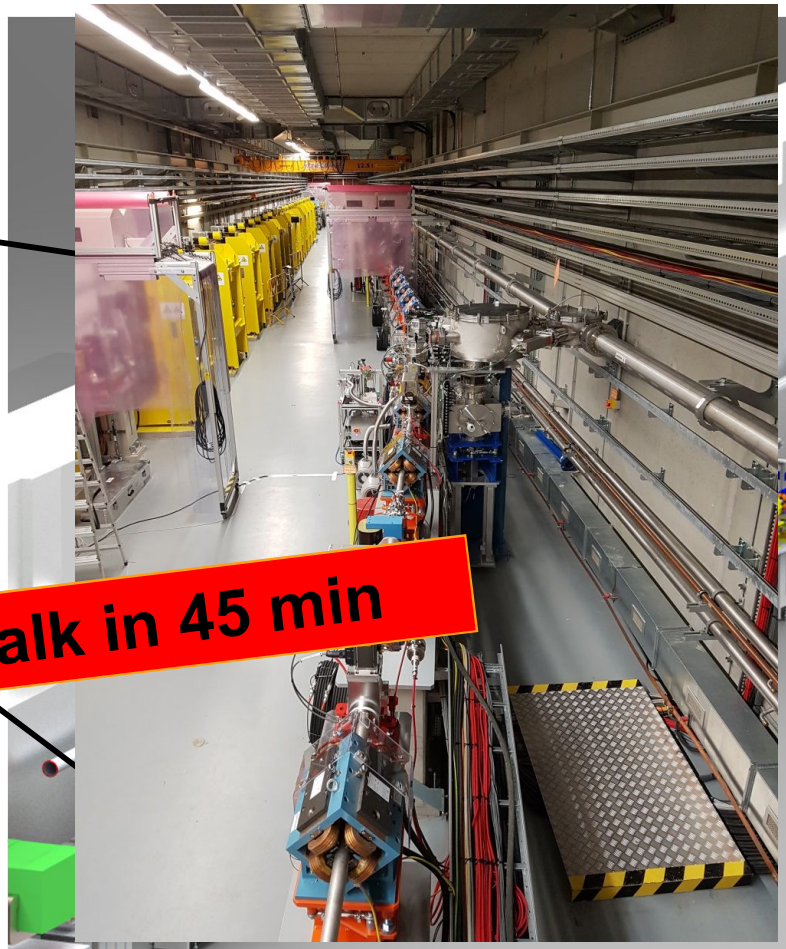
Transport beamline for ionisation laser of FLASHForward plasma channel completed

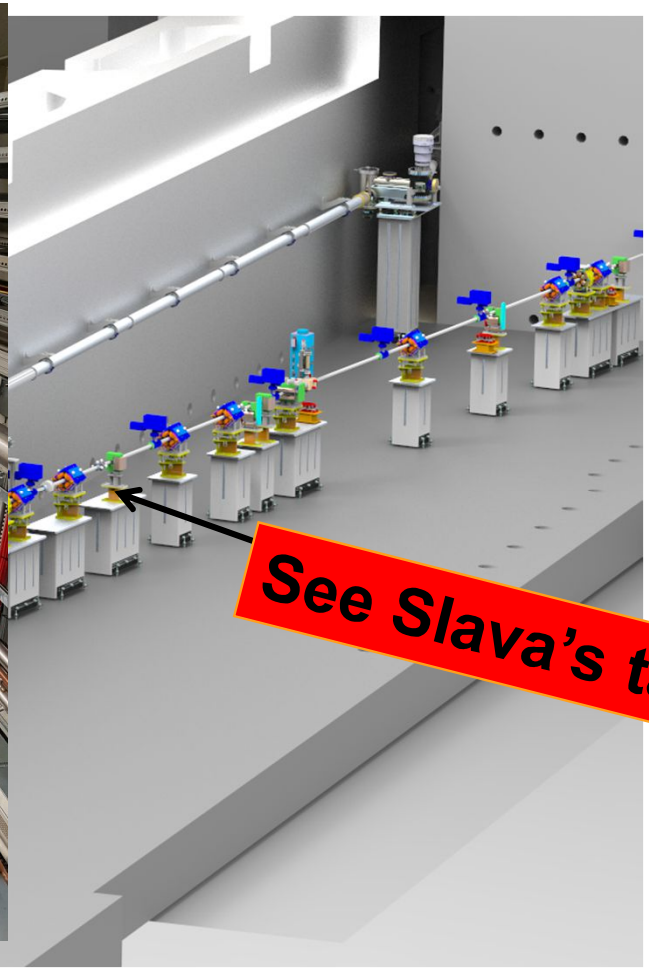
Compressor



Laser beamline completed

Laser beamline





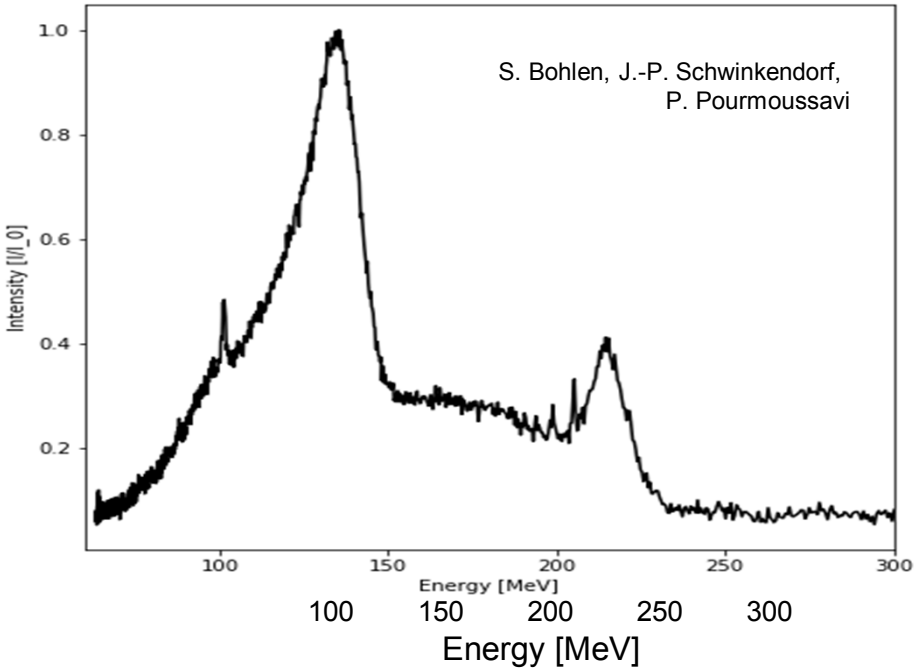
See Lucas' talk in 45 min

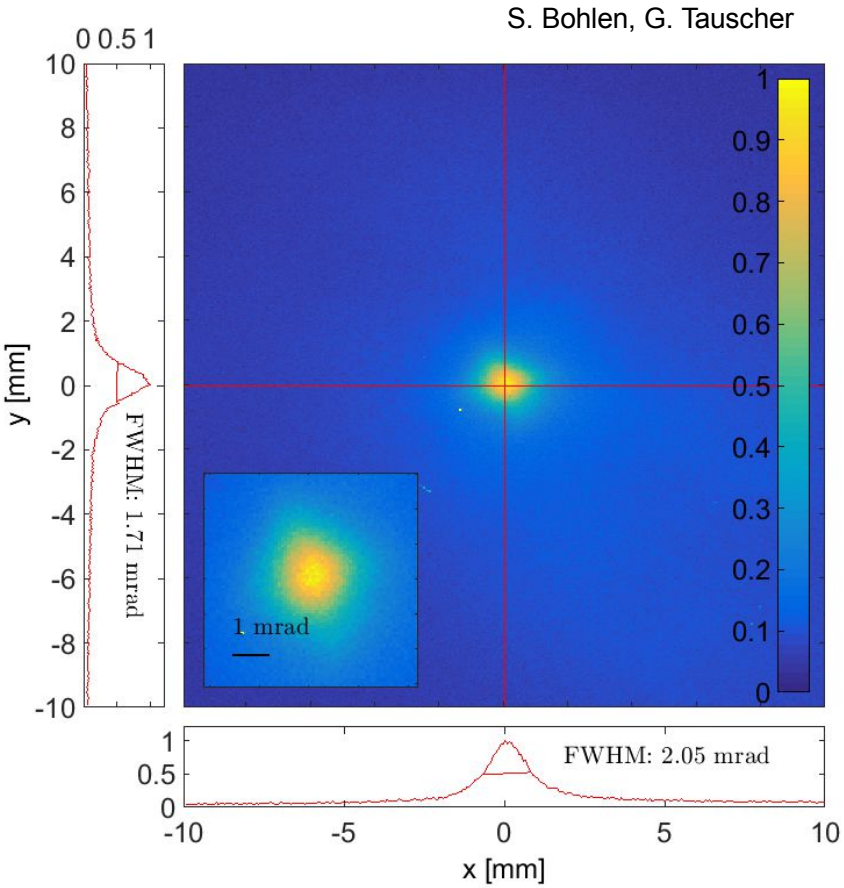
See Slava's talk in 30 min

Experiments in test lab

Laser wakefield acceleration

- 23rd of Dec 2016 - first beam!
- Self injection and ionisation injection in dielectric capillary target
- Measurements of dependence of betatron spectrum on injection dynamics

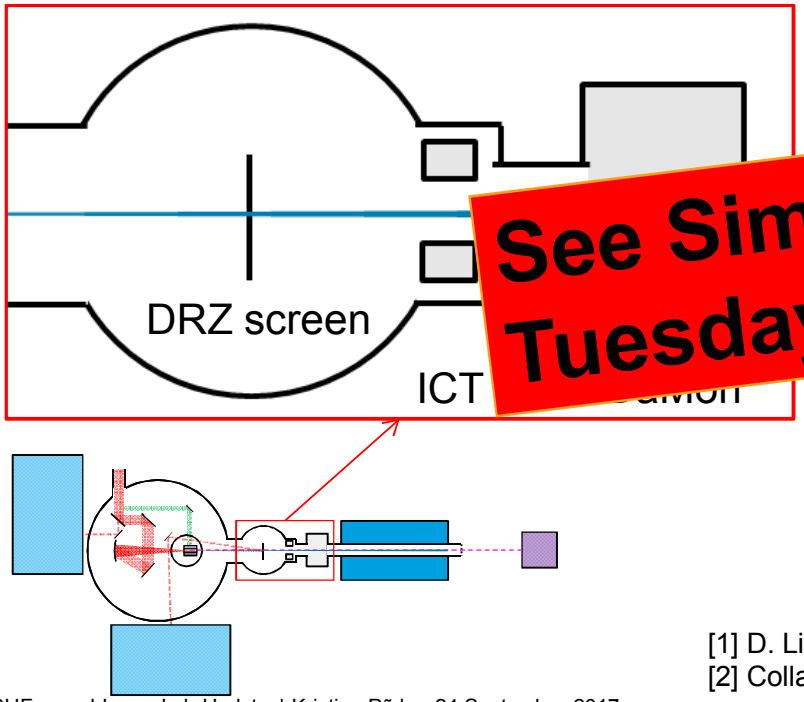




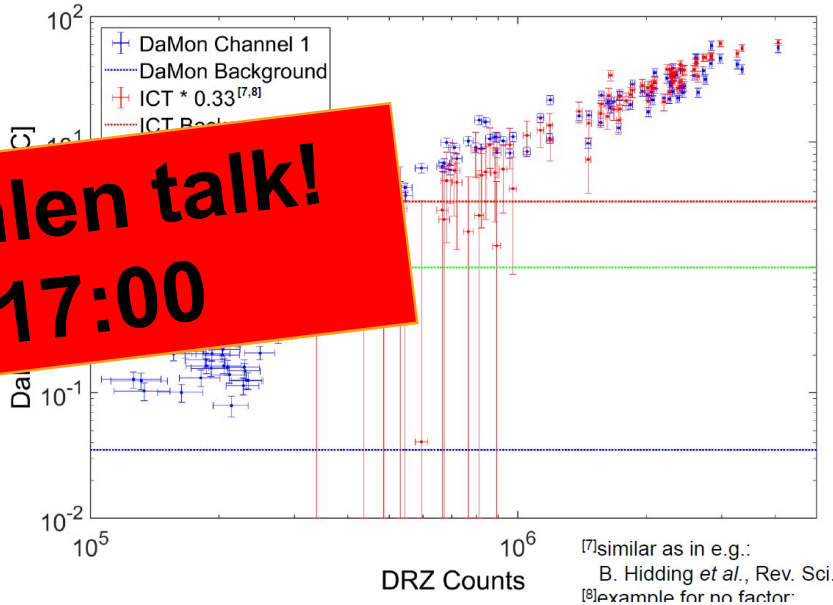
Charge measurement in test lab

Characterisation and cross-calibration of three different charge diagnostics

- Three types of charge measurement
  - Integrating Current Toroid and DRZ screen allow charge measurement
  - DaMon: Novel technique allows measurement of low charges (fC) [1]
  - Absolute calibration of DRZ screen for cross calibration performed [2]



See Simon Bohlen talk!
Tuesday, WG5 17:00

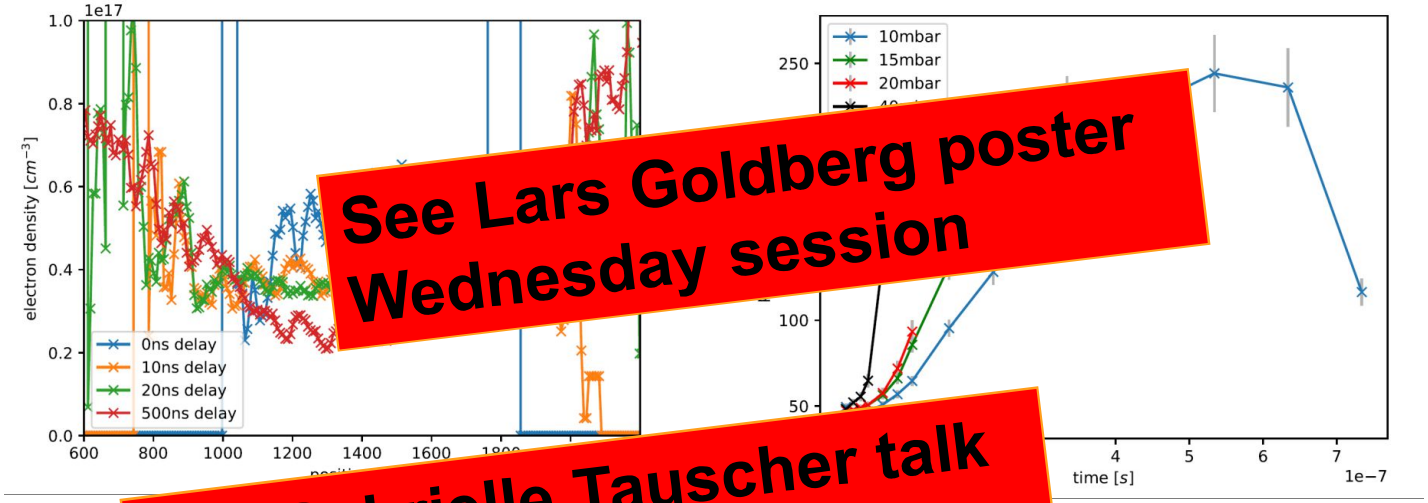


[1] D. Lipka, D. Nölle, K. Wittenburg, DESY technical note (2008)
[2] Collaboration of DESY, HZDR, Univ. München, MPI Garching, Univ. Jena

Experiments in test lab

Plasma characterisation

- Diagnostics to characterise 1e17 cm^{-3} plasma

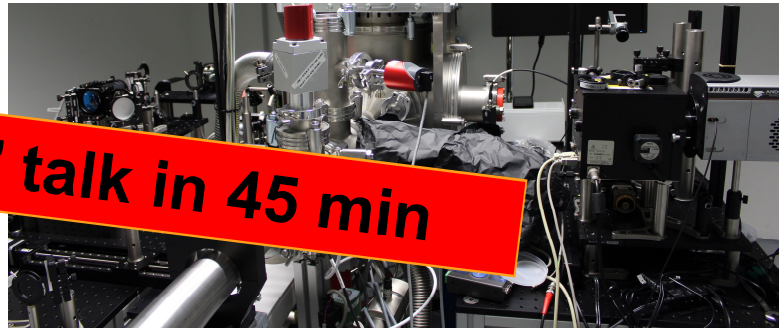


See Lars Goldberg poster Wednesday session

See Gabrielle Tauscher talk Monday, WG1 17:00

- Studies
  hydroger

- Experimental platform to measure the pla
  FLASHForward plasma

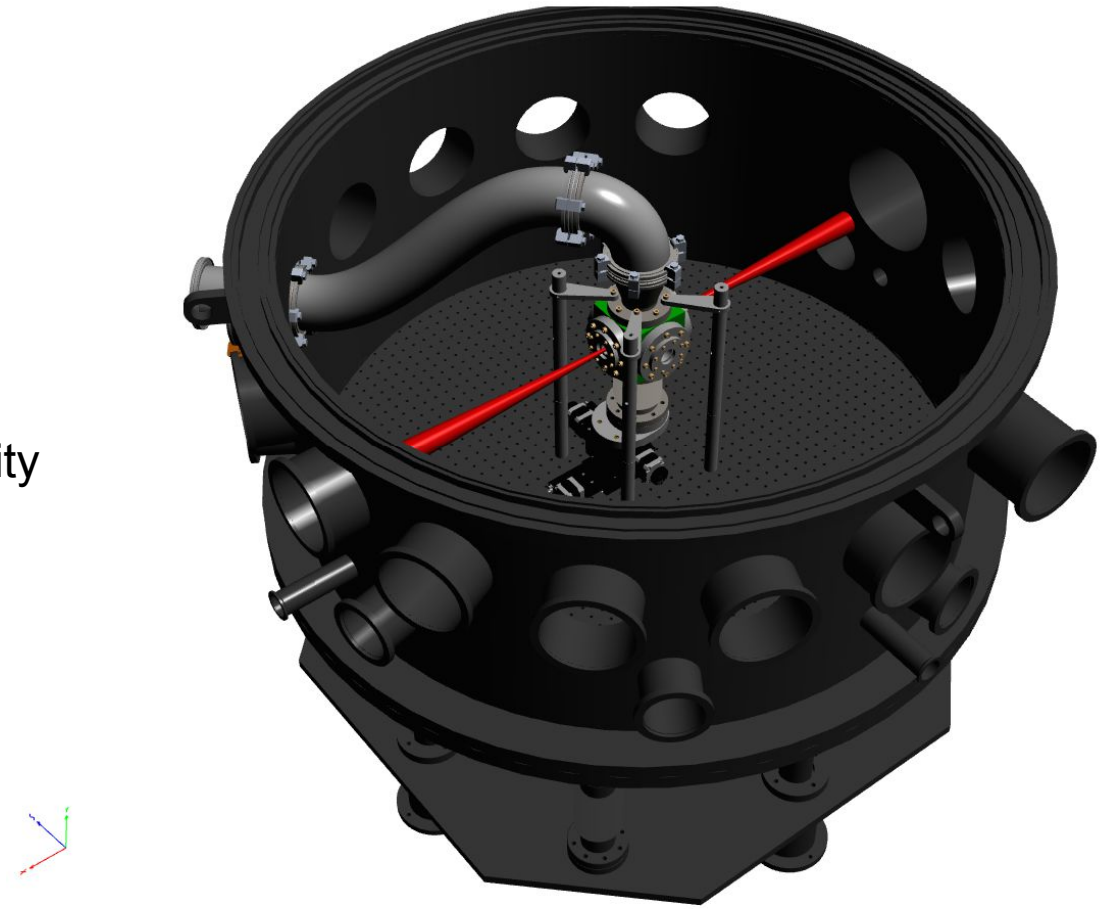


See Lucas' talk in 45 min

Future experiments in test lab

Differential pumping

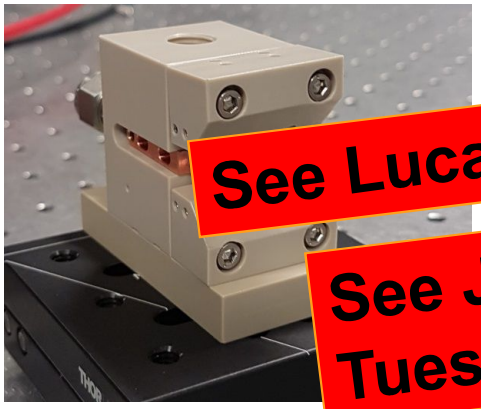
- Systematic studies of LWFA at **10Hz**
- Optimising charge, energy, beam profile, spectral shape etc
- Can shape pulse temporal profile
- Planning to include adaptive optic system to allow shaping of the intensity profile
- Forms a platform for 10Hz electron beams with excellent diagnostic access

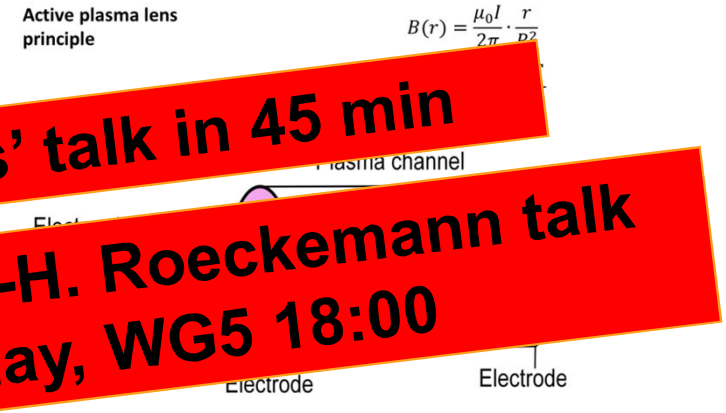


Future experiments in test lab

Other LWFA related experiment

Active plasma lens studies

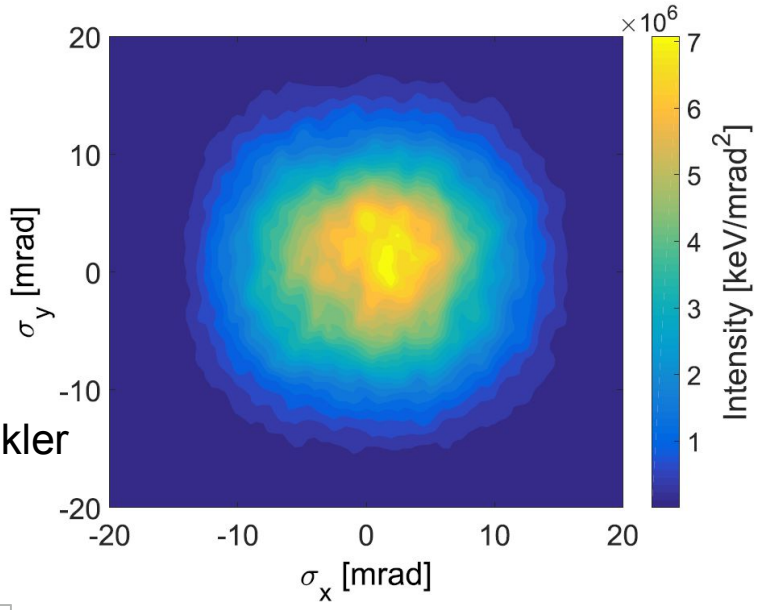




See Lucas' talk in 45 min

See J.-H. Roeckemann talk Tuesday, WG5 18:00

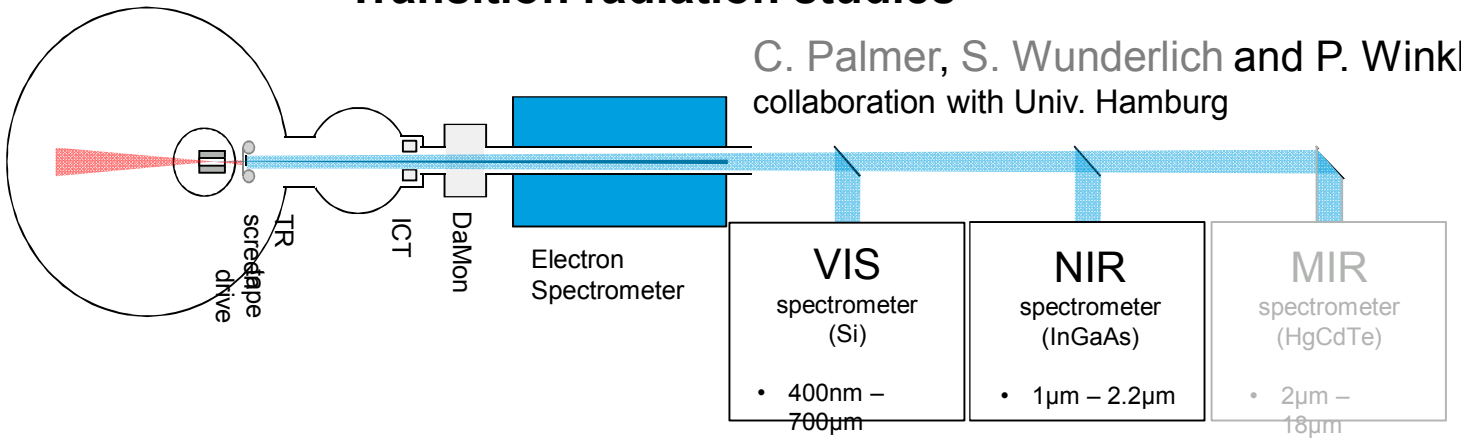
Inverse Compton scattering studies



S. Bohlen

Transition radiation studies

C. Palmer, S. Wunderlich and P. Winkler
collaboration with Univ. Hamburg



Overview and outlook

Highlights of past year

- 25 TW laser performing reliably
- GA for Dazzler: optimise pulse shape for arbitrary process
- Successful LWFA experiments
- Betatron data camera running at 10Hz
- Plasma characterisation at 1e17 cm^{-3} densities
- Defragmentation studies
- Tunnel beamline installation finished
- IR beam in FLASH2 tunnel

Plans for next year

- **Detailed characterisation of IR laser stability in FLASH2 tunnel**
- **FLASHForward plasma target characterisation**
- **Studies of hollow plasma channel creation**
- **Differential pumping + LWFA at 10Hz**
- **Plasma lens studies with LWFA**
- **TR studies of LWFA beams**
- **Compton scattering experiments to characterise the electron beam**
- **Dazzler + GA for HCF (<5 fs pulses)**