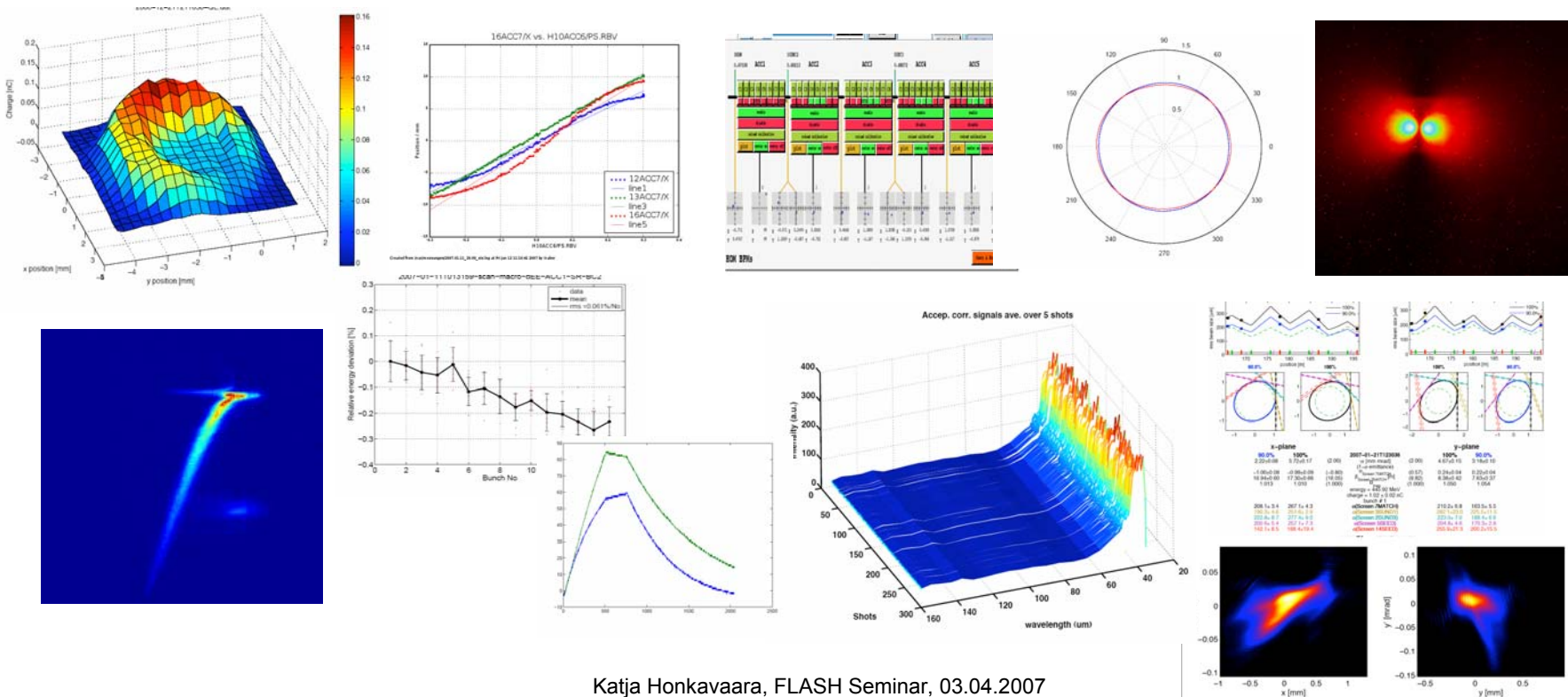


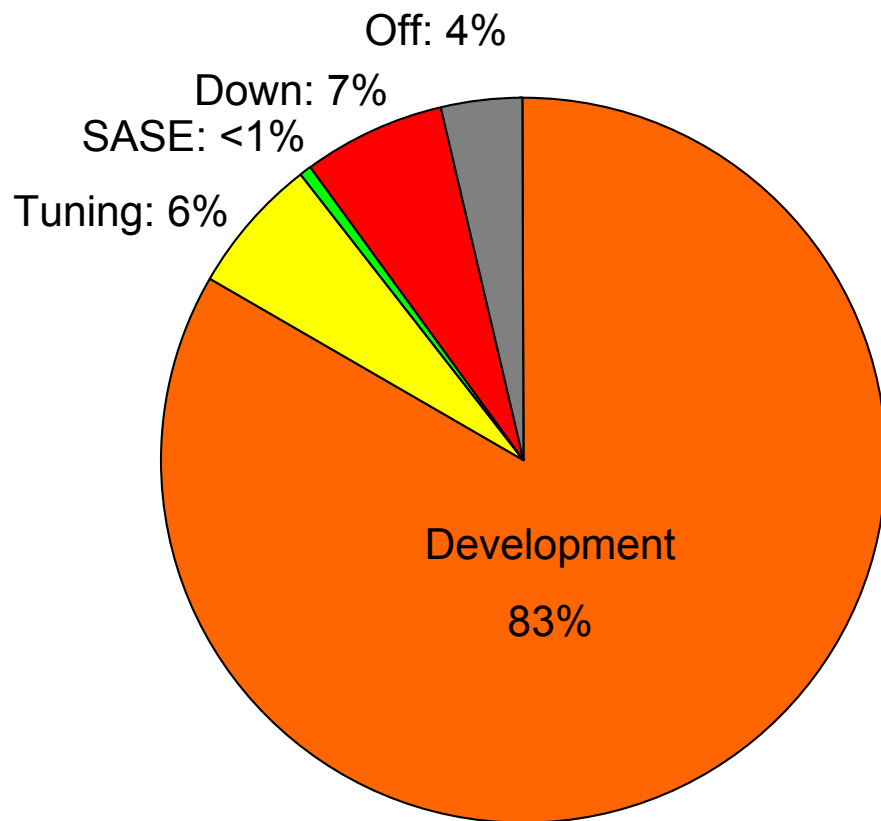
# Accelerator studies at FLASH

## 11.-22.12.2006 and 08.-21.01.2007

Katja Honkavaara

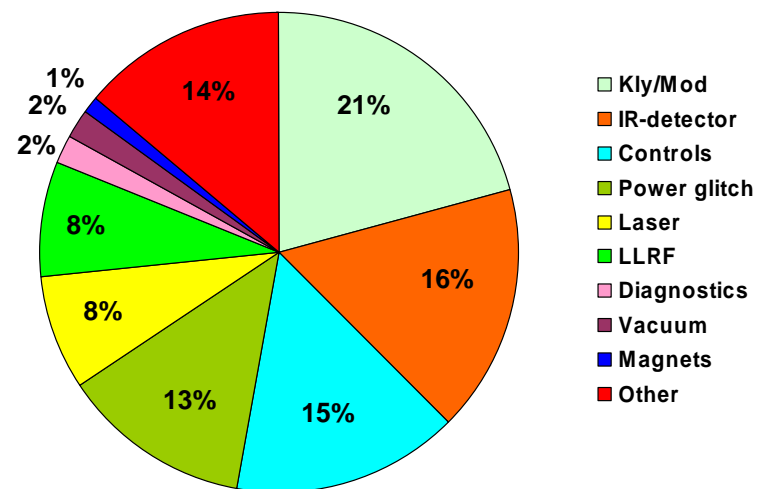


- Requests collected well in advance, beam-time allocated according to available beam time and possibilities, supervised by the BAC
- Requests for ~ 90 shifts (~70 shifts available)
  - Between the two study blocks were Christmas and maintenance period (KW 52 and 1) → shut-down and start-up of the machine needed to be included to accelerator study time
  - Recover SASE during second block of accelerator studies required: only one week reserved for FEL studies before user experiments started
- Collaborators from different laboratories (INFN, SLAC, FNAL, CEA-Saclay, Institutes from Poland)

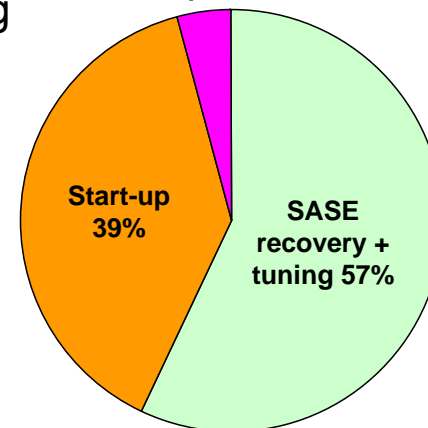


Total up-time: 90%

Down-time



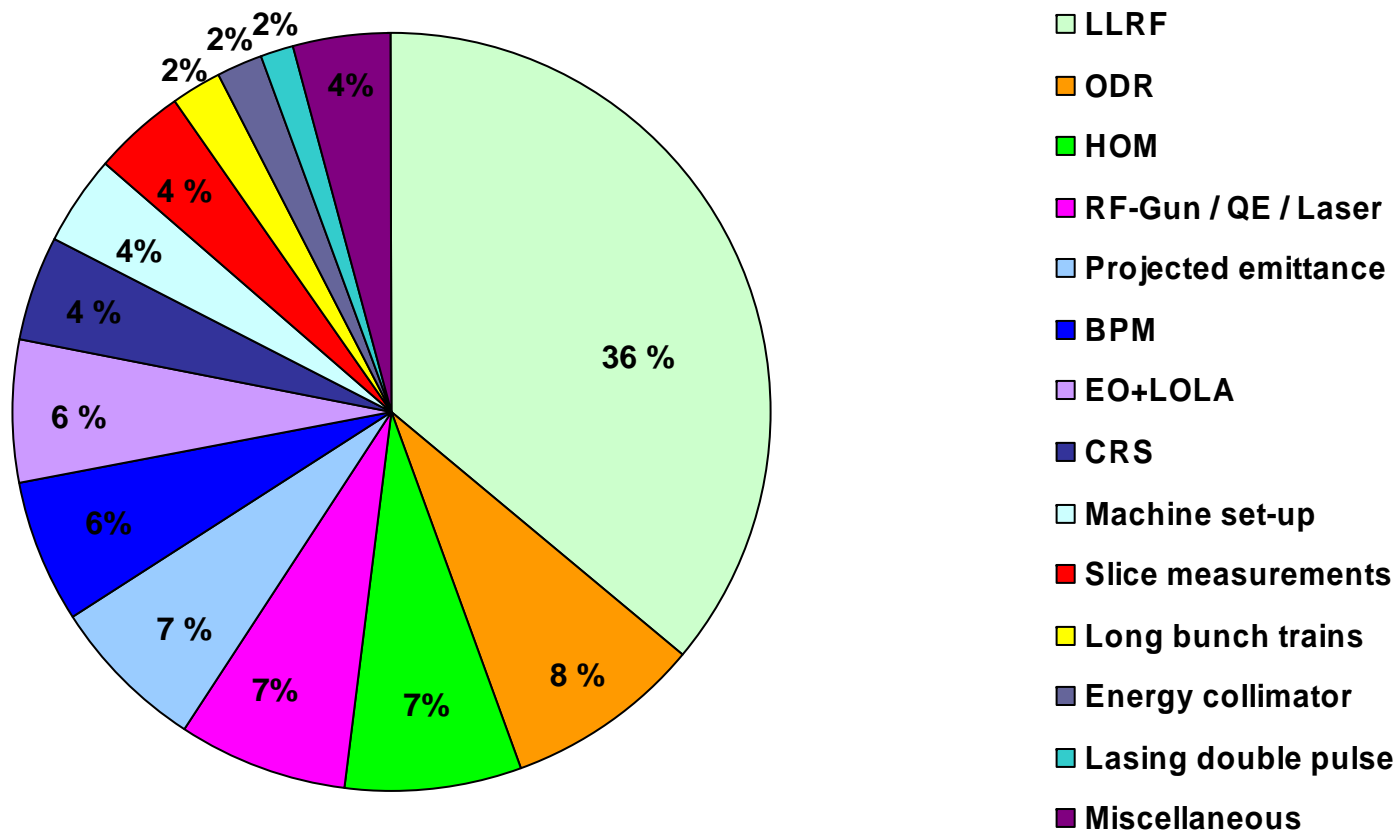
Tuning  
Machine set-up 4%



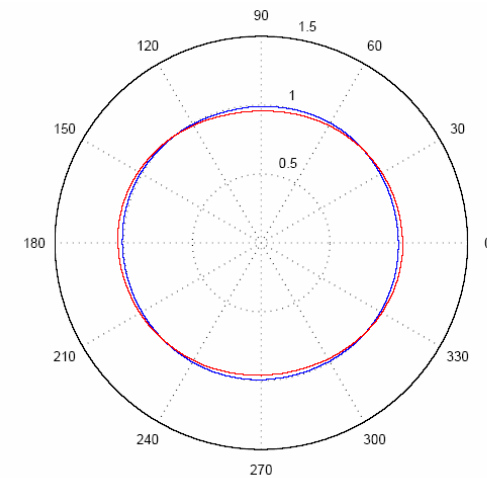
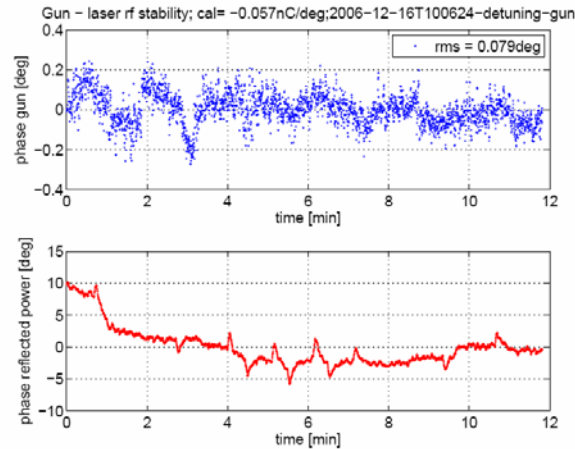
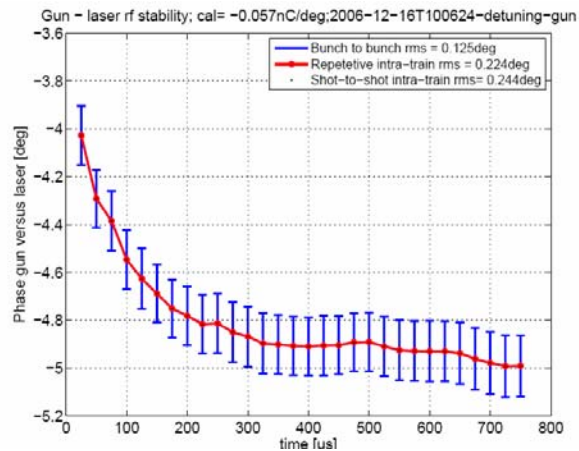
# Main study subjects

Study	FLASH	XFEL	ILC
LLRF	x	x	x
Optical diffraction radiation (ODR)		x	x
HOM	x	x	x
RF-gun / QE	x	x	
Projected emittance	x	x	(x)
BPM	x	x	x
EO-TD + LOLA	x	x	(x)
Coherent radiation spectroscopy (CRS)	x	x	(x)
Slice parameters	x	x	

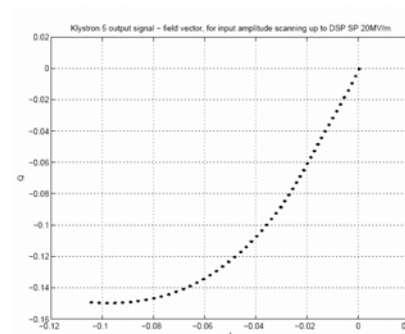
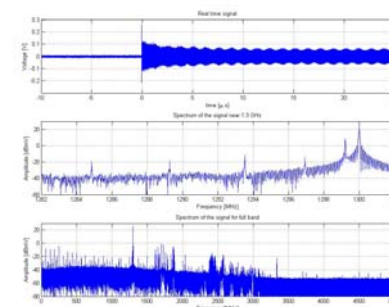
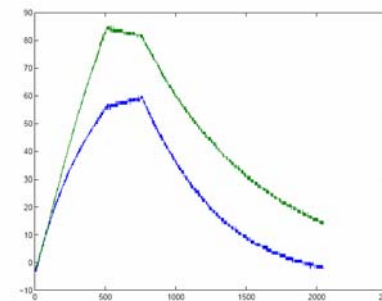
# Distribution of beam time



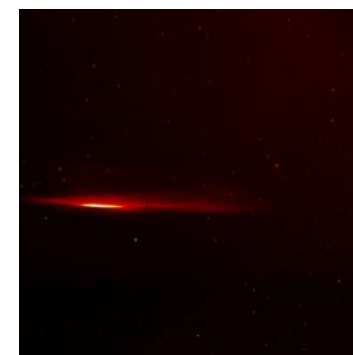
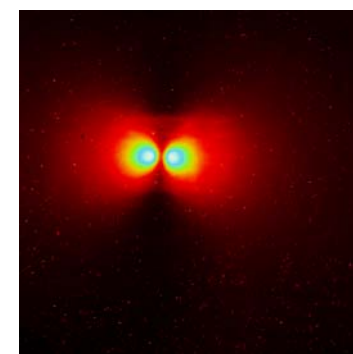
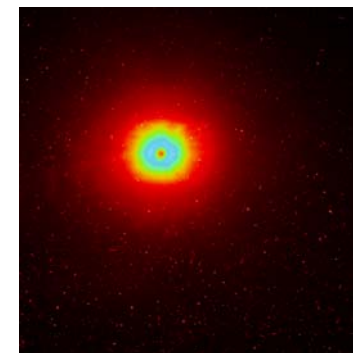
- RF-gun operated with 800 us flat top (typically 400 us)
- Investigation of phase stability along long macro-pulses (up to 30 bunches, different bunch frequencies)
- Development of mechanism to compensate non-linearities in forward power; Linearization of forward and reflected power
- Test of new IQ detector



- Beam load compensation and exception handling
- Beam stability at BC2: Examination of effects of different RF control methods
- Test of influence of temperature in injector racks on LLRF parameters and SASE
- Many tests with ACC1 (SIMCON):
  - Fast adaptive feed forward
  - Transient measurements with different methods
  - MIMO controller optimization
  - Multi-channel complex controller based system parameters identification
  - Test to drive with 9 MHz IF (new IQ detector and digital down converter)
- Test of new vector modulator (ACC1)
- Test of SIMCON at ACC2/3 (16 cavities)
- Klystron linearization (Kly5) and automation of klystron operation



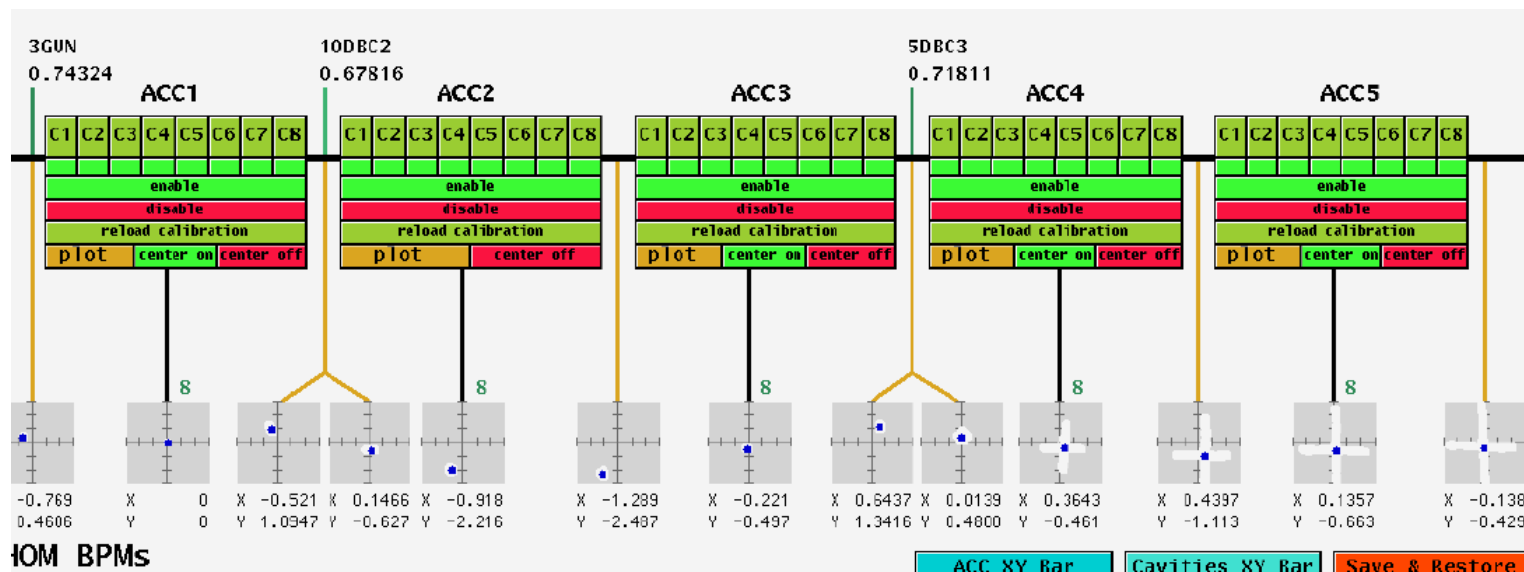
- Goal: development of non-destructive beam size monitor based on measurement of ODR angular distribution (→ XFEL, ILC)
- Recent results:
  - OTR angular distribution with and without polarizer
  - After optimization beam narrow enough for 1 mm and even for 0.5 mm slit. Series of images of ODR angular distribution collected. Promising results, off-line analysis on-going.
- Measurements at FLASH complicated
  - Beam optics not well-known in by-pass, position of experiment not optimal for a vertical waist → much time spent to optimize beam through the slit
  - Electron beam energy (670 MeV) still too low (sensitivity) → Measurements will continue in autumn with highest possible electron beam energy



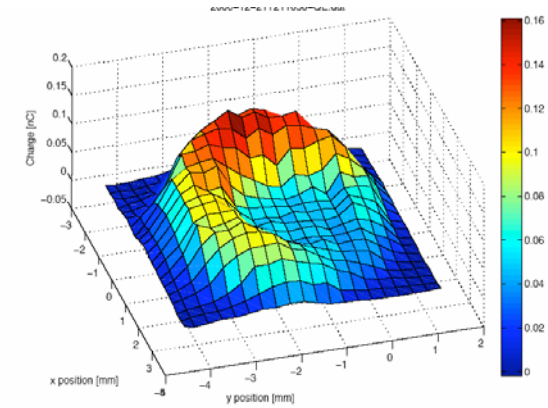
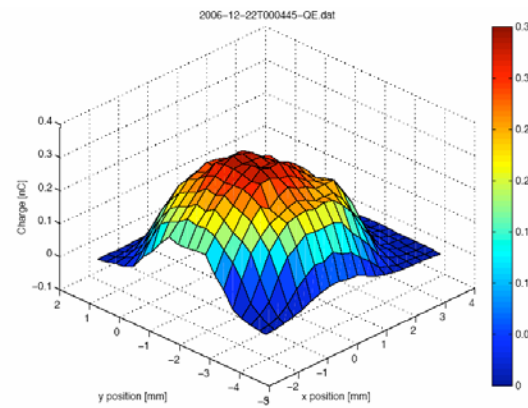
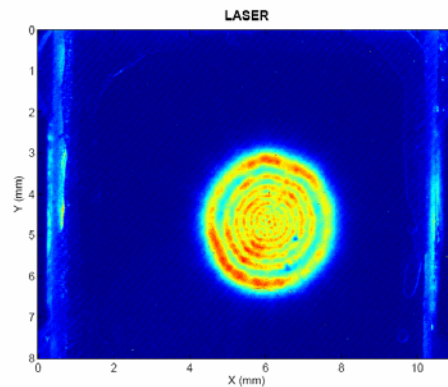
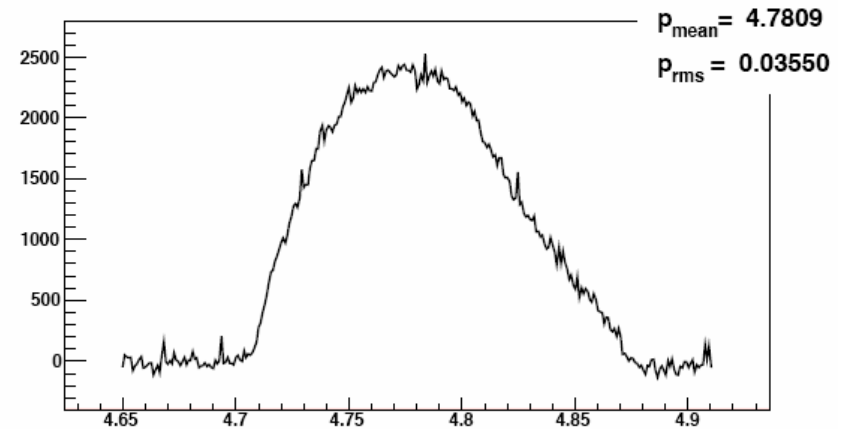
Experiment carried out by collaborators from INFN-LNF / Tor Vergata



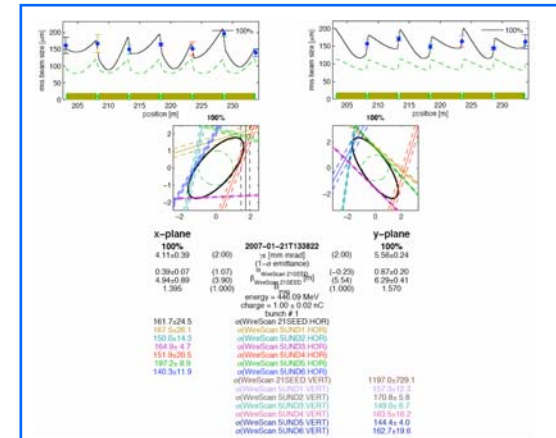
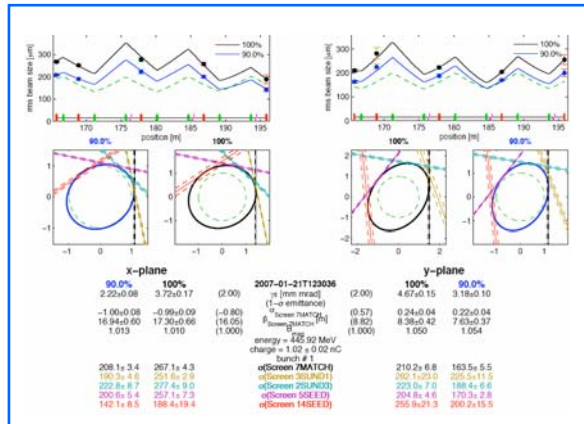
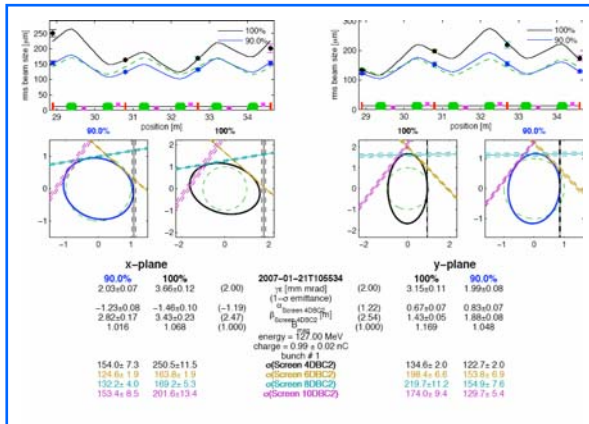
- Goal: Development and commissioning of a HOM based beam position monitor system at FLASH
- Resolution and calibration measurements of HOM BPMs
  - Single / multibunch
  - On / off-crest
  - Comparison with “normal” BPMs
- HOM BPMs now available in DOOCS



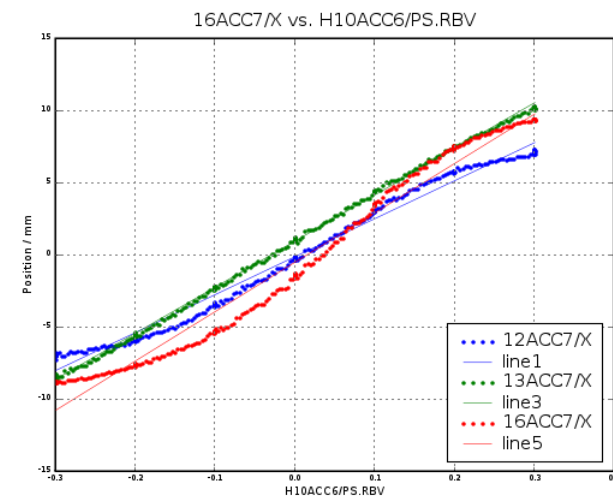
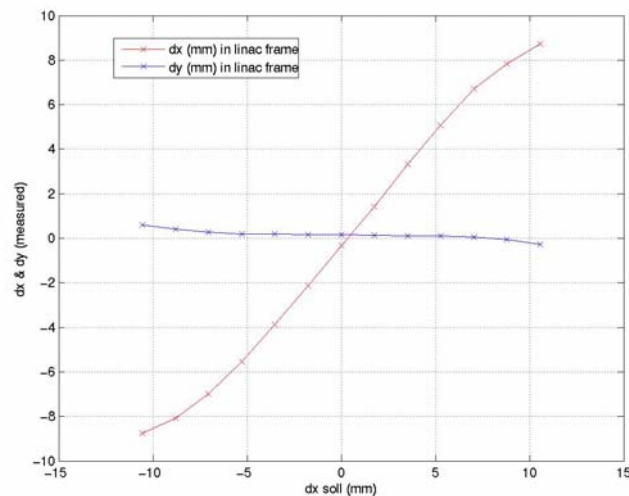
- Measurements of
  - Dark current
  - Beam images with different solenoid settings
  - Beam momentum
- Quantum efficiency and QE map
  - Different RF-gun phases
  - Different cathodes
- Laser set-up for SASE runs



- Commissioning of emittance measurement system in SEED section
- Emittance measured at injector (OTR), SEED (OTR) and undulator (WS)
  - Injector and SEED: similar results; matching works
  - Results in undulator inconsistent; problems with matching, different wires and PM voltages gave different results
- Measurements continued during following FEL studies. Problems with WS extensively studied and (partly) solved
- Summary and results will be given in a FLASH seminar by E.Pratt

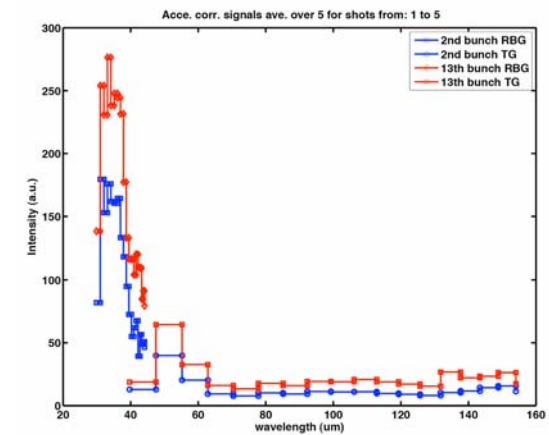
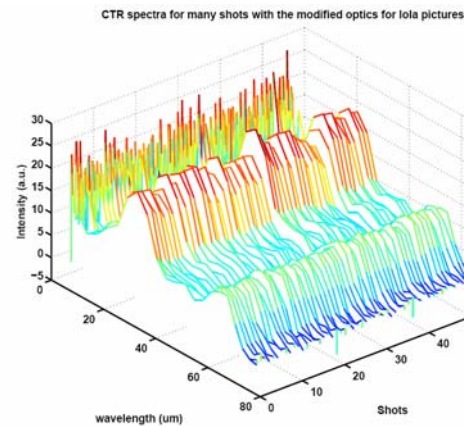
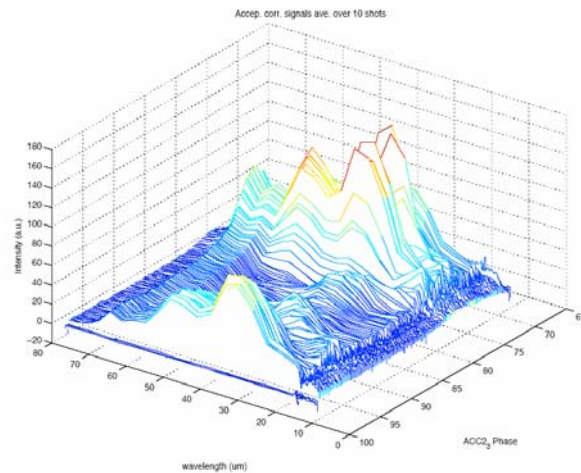
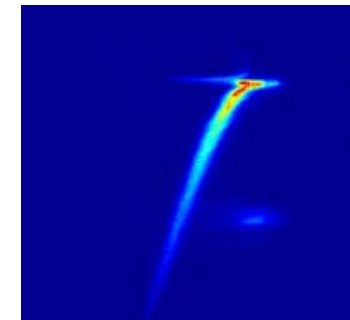
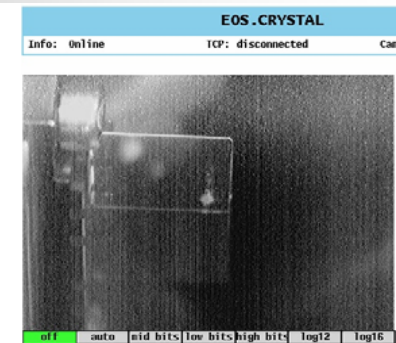


- Re-entrant cavity BPM prototype (XFEL)
  - CEA-Saclay
  - Electronics re-adjusted, calibration and resolution measured
- Studies on BPM calibration procedure
- Studies on stripline BPM with improved electronics
- Studies on XFEL button BPM prototype

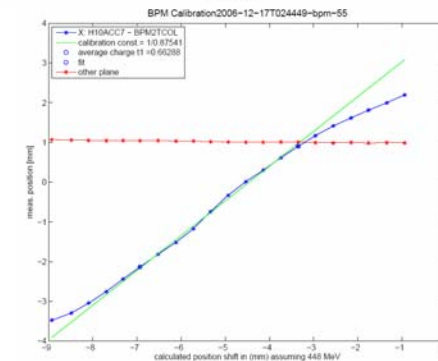
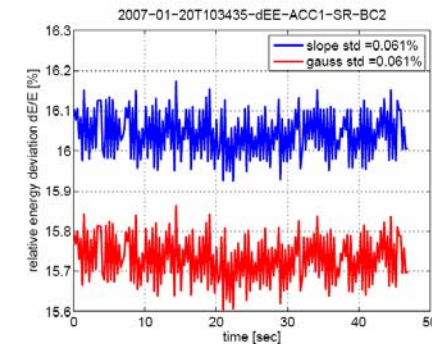
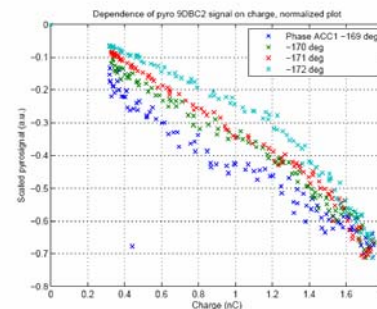
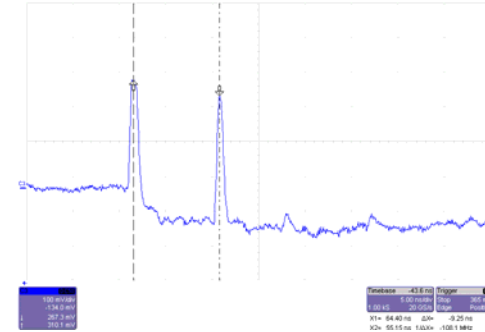


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- EO (Electro-optical) – TD (Temporal detection) measurements parallel to LOLA measurements
- Measurements of slice emittance and slice energy spread + studies of bunch tilt
- Coherent radiation spectroscopy (CRS)
  - Spectra taken for different bunches in the bunch train, with different detectors, and different phases of RF-gun and accelerator modules



- Long bunch train operation
  - Commissioning of toroid protection system
- Test of double pulse lasing
  - New set-up of photo-cathode laser pulse doubler; second pulse delayed by 9.23 ns
- Test to drive ACC2/3 by klystron 6 instead of klystron 5
- Tilt studies at BC2
- Test of SR cameras at BC2
- Energy stability measurements
- Collimator studies (ECOL)
- Test of LOLA kicker
- CSR studies at different charges
- Pyro phase scans
- ....





- Many different studies and developments especially in LLRF, beam dynamics, and electron beam diagnostics
- Collaborators out-side DESY; Students preparing Theses
- Many of studies continued in the following FEL study blocks
- Next Accelerator / FEL study periods after the FLASH shutdown (Aug/Sep 2007)
  - Requests of beam time will be asked soon (April)
  - Procedure to request beam time changed: a common form for both accelerator and FEL study periods in FLASH e-logbook
  - More details in FLASH seminar 17.4.2007