Data Acquisition at FLASH

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Summer Student Program

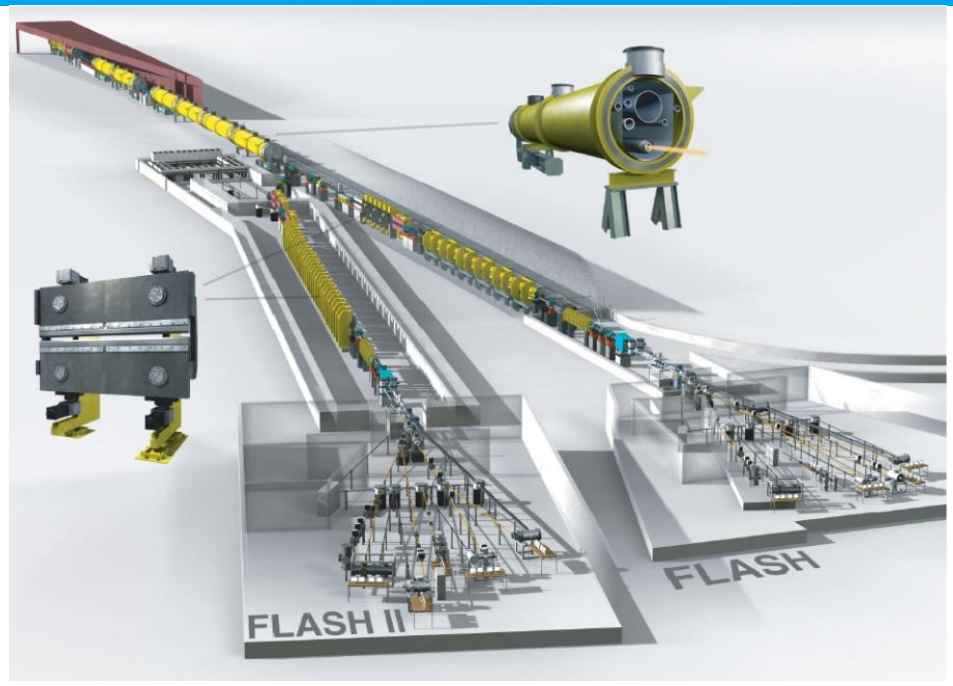
September, 2016

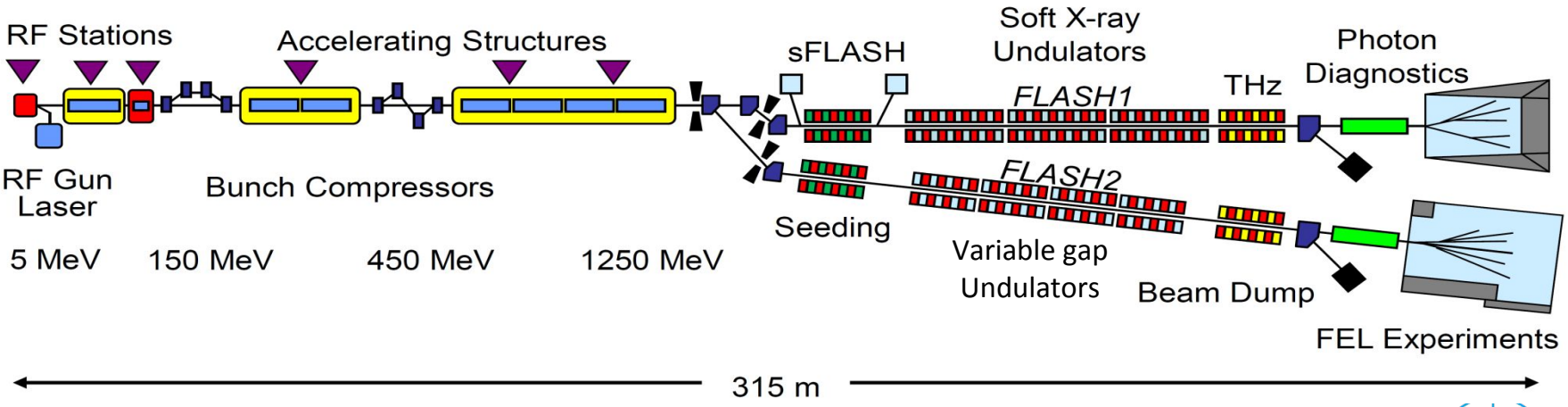
HELMHOLTZ ASSOCIATION

DESY

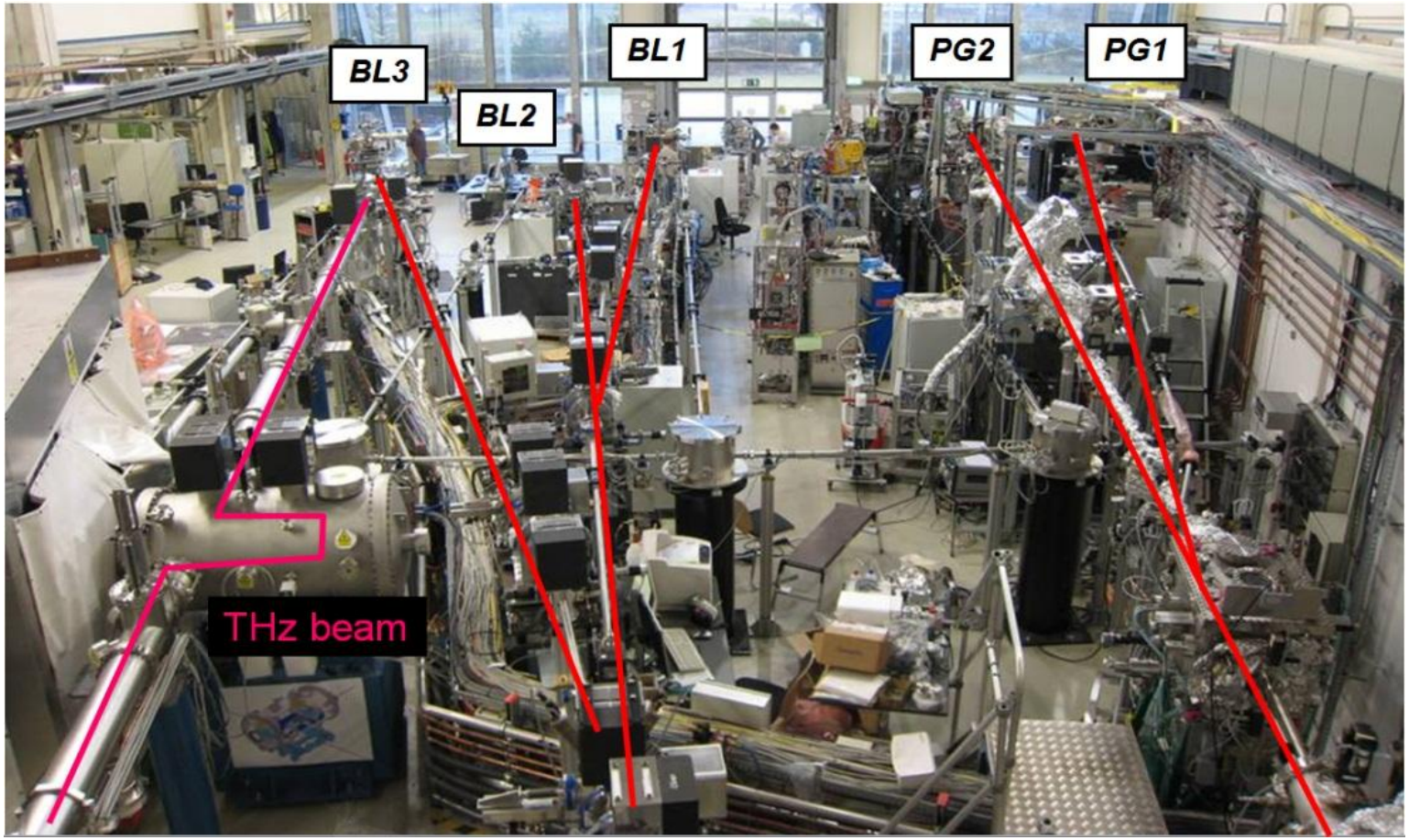
FLASH @ DESY


FLASH
PETRA III


FLASH II
FLASH


RF Stations
Accelerating Structures
sFLASH
Soft X-ray Undulators
Photon Diagnostics
FLASH1
THz
RF Gun Laser
Bunch Compressors
FLASH2
Seeding
Variable gap Undulators
Beam Dump
FEL Experiments
5 MeV
150 MeV
450 MeV
1250 MeV
315 m

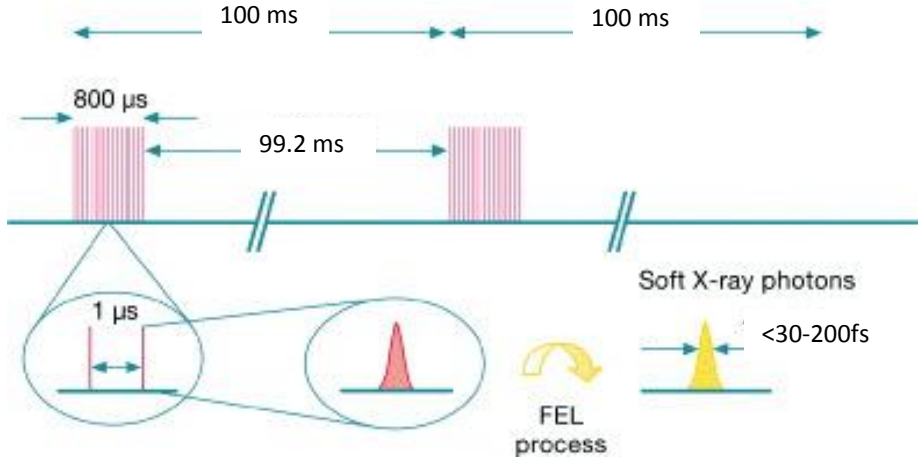
FLASH experimental hall

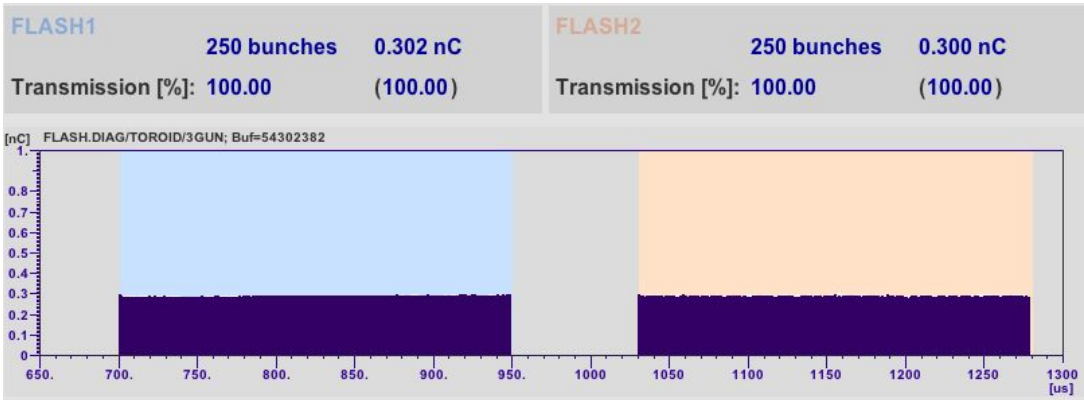


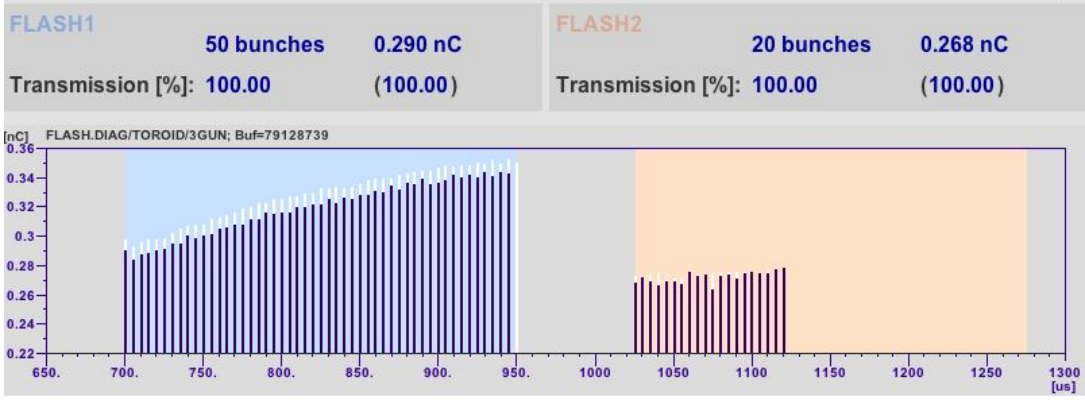
FLASH Parameters, SASE Burst mode

SASE (Self-Amplified Stimulated Emission)
Each shot -different pulse profile & pulse duration
-different arrival time (>pulse duration)

Photon beam (SASE)	FLASH 1	FLASH 2
Wavelength	4.2-52nm	4-90nm
Pulse Energy	1-500μJ	1-1000μJ
Pulse Duration (FWHM)	<30-200fs	(<30-200fs)
Pulses per second	10-5800	10-5800
Spectral Width (FWHM)	0.5-2%	0.3-2%
Photons per Pulse	10^{11}-10^{13}	10^{11}-10^{14}
Peak Brilliance	10^{28}-10^{31}	10^{28}-10^{32}
Brilliance= photons/(sec · mrad^2 · mm^2 · 0.1%bw)		

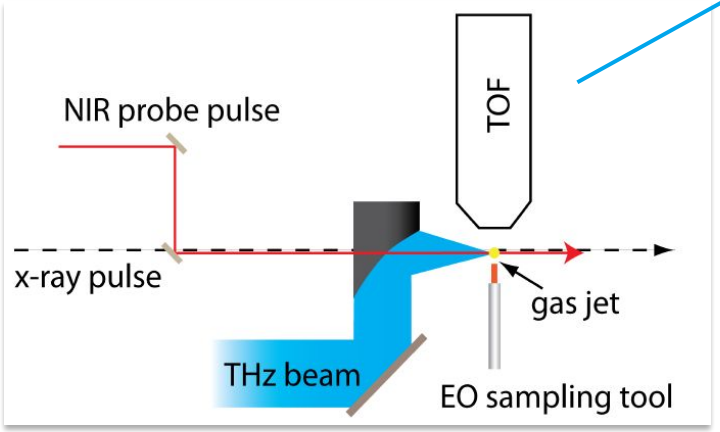




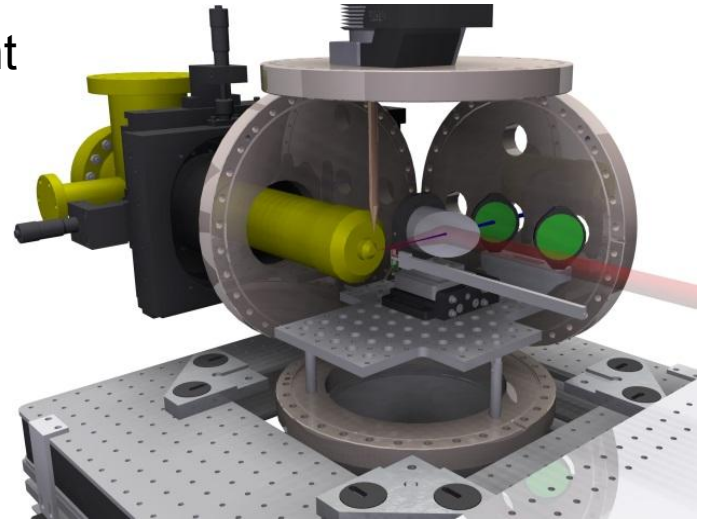


Typical experiment@FLASH

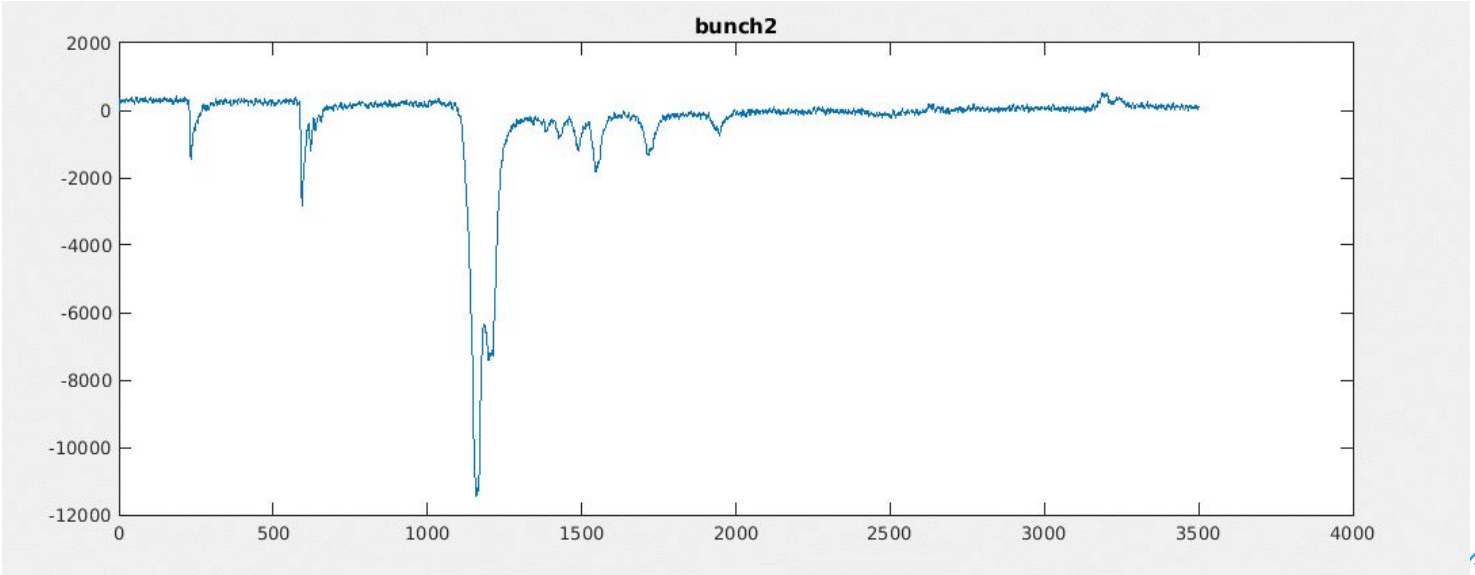
THz streaking



Time Of Flight



Sample spectrum

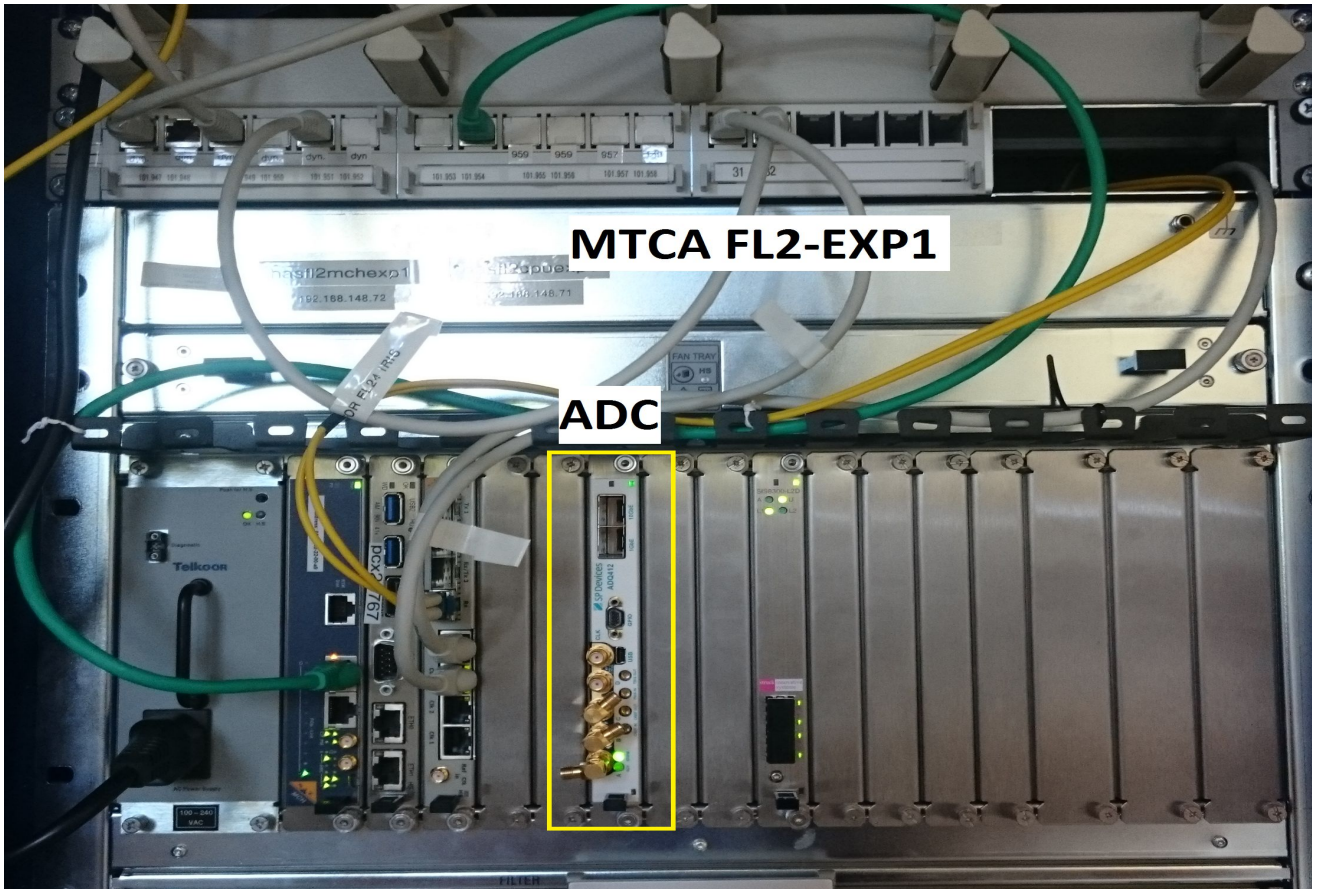


Arrival time at the detector in samples (0.2ns)

DAQ at FLASH

- Collect beam relevant data in real time.
- Monitoring tools
- Store data for offline analysis

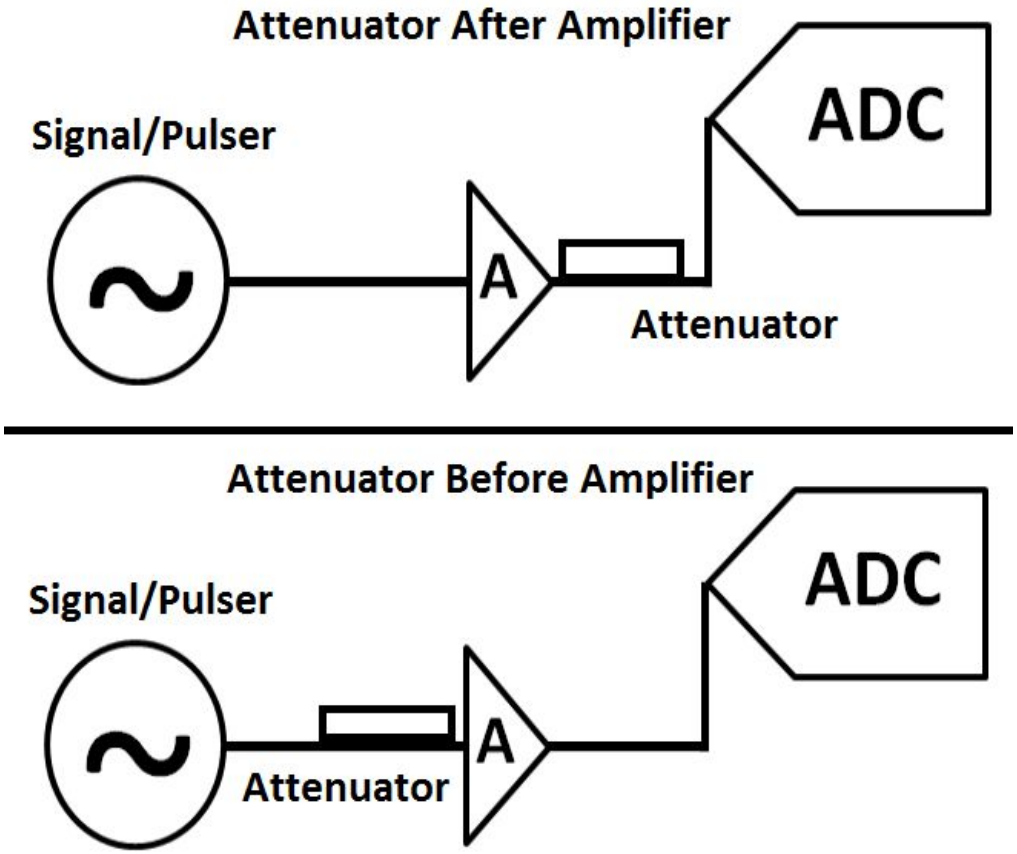
MTCA-ADC @FLASH 2 hall



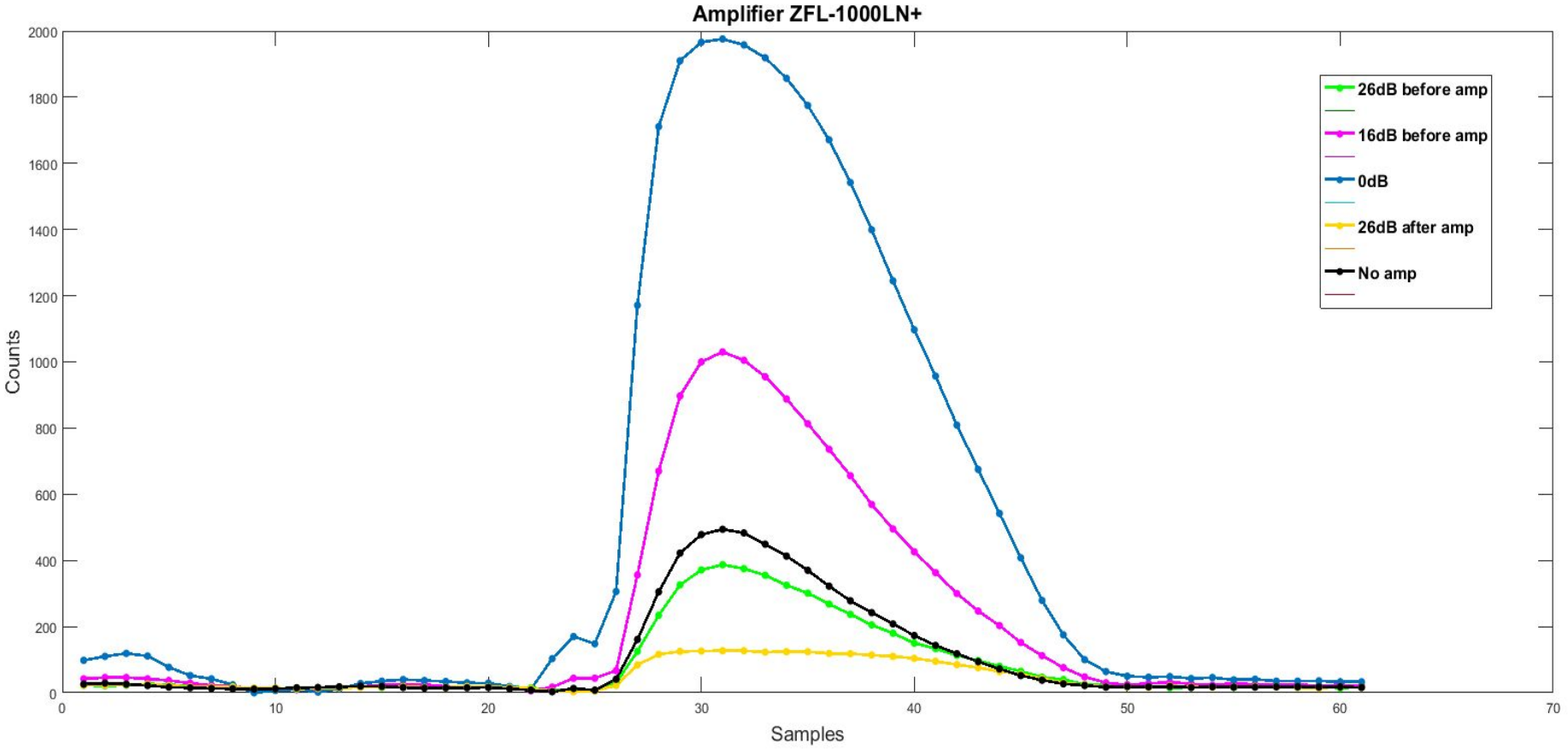
- ADQ412AC-4G-MTCA from SPdevices
- 2 Gsamples (0.5 ns per sample).
- 12 bit resolution

Define signal

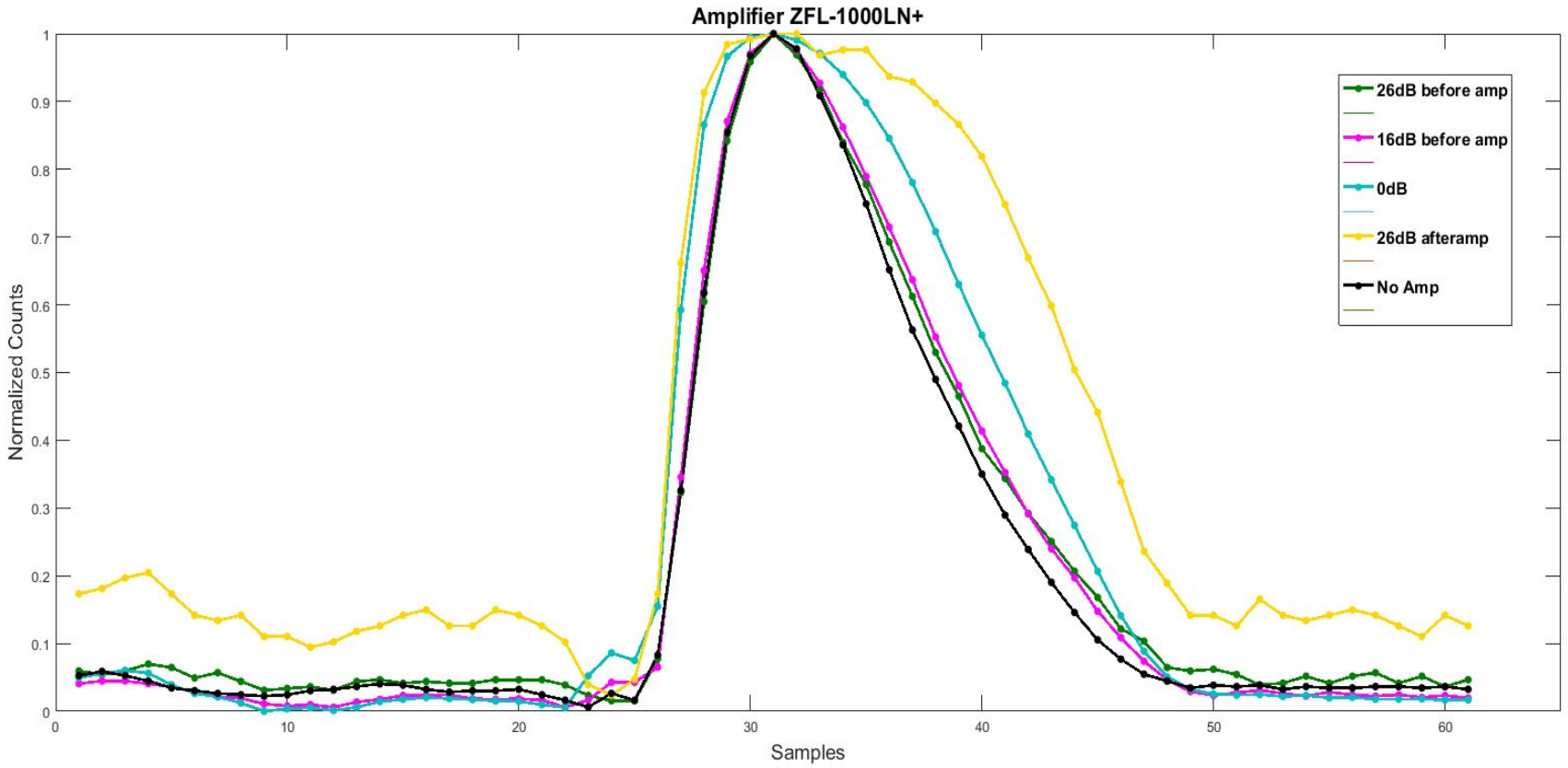
- No amplifier.
- 26dB, 16dB before.
- Only Amplifier (no attenuator).
- 26dB after.



Results: Signal analysis

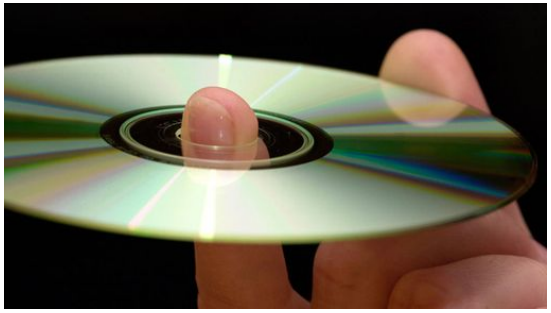


Results: Signal analysis



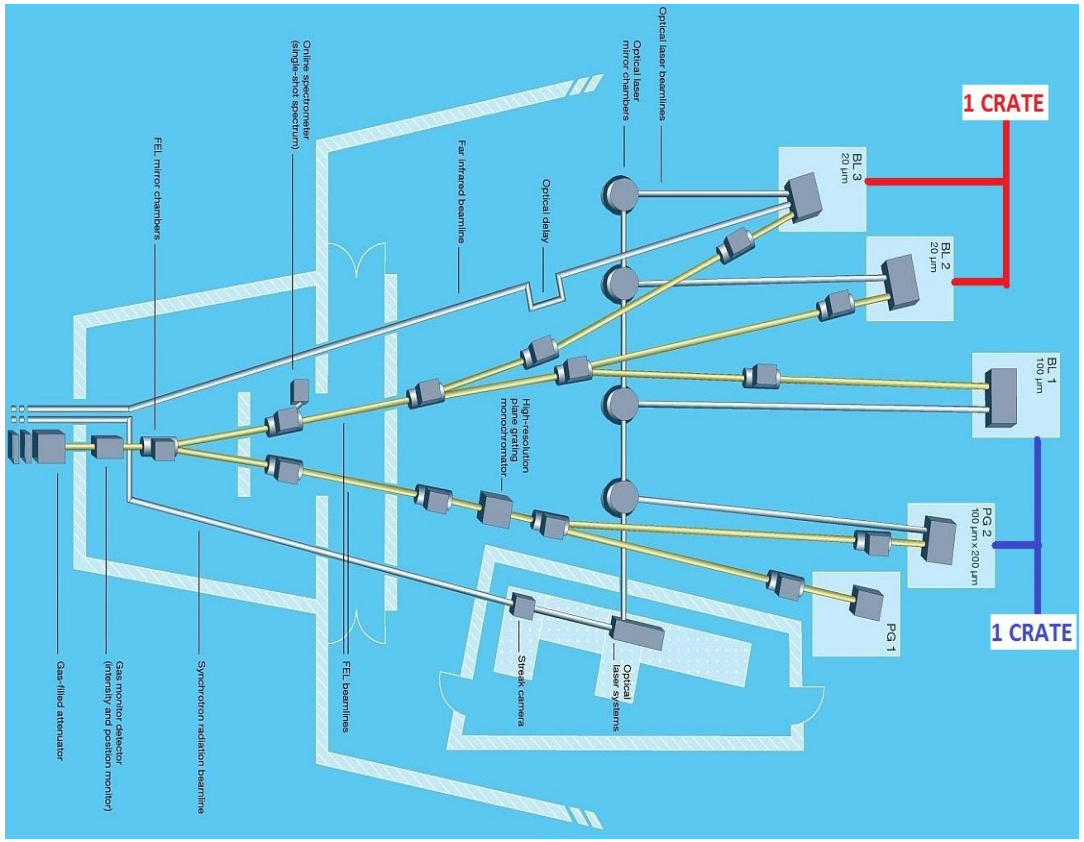
Challenge….

Saving data..



How much data can we save????
Where are the limits??

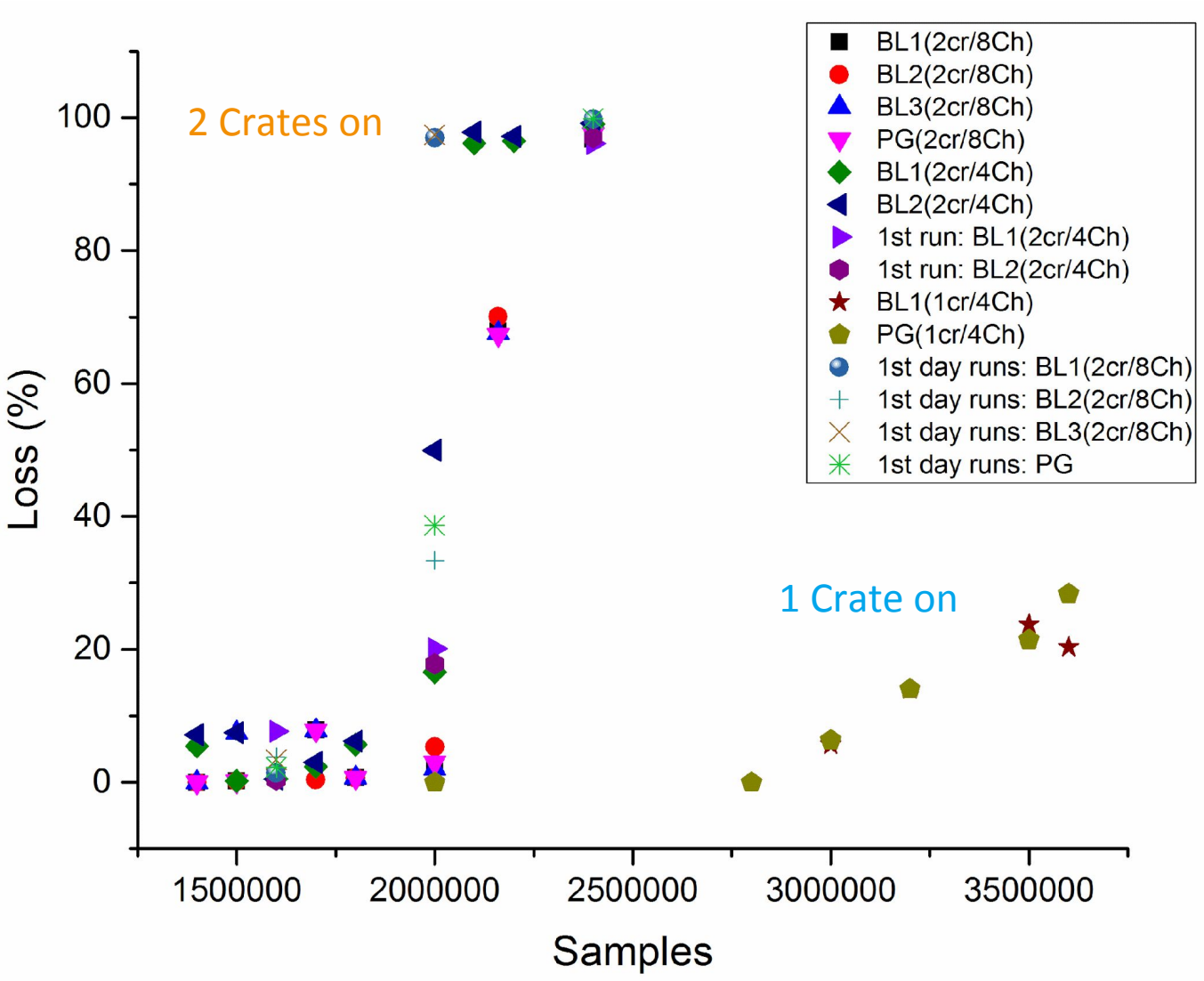
DAQ load test



Cases studied:

- 2 Crates and 8 Channels on
- 2 Crates and 4 Channels on
- 1 Crate and 4 Channels on

Results


2 Crates on
1 Crate on
Loss (%)
Samples
100
80
60
40
20
0
1500000
2000000
2500000
3000000
3500000
BL1(2cr/8Ch)
BL2(2cr/8Ch)
BL3(2cr/8Ch)
PG(2cr/8Ch)
BL1(2cr/4Ch)
BL2(2cr/4Ch)
1st run: BL1(2cr/4Ch)
1st run: BL2(2cr/4Ch)
BL1(1cr/4Ch)
PG(1cr/4Ch)
1st day runs: BL1(2cr/8Ch)
1st day runs: BL2(2cr/8Ch)
1st day runs: BL3(2cr/8Ch)
1st day runs: PG

SUMMARY + CONLUSIONS

- The low noise amplifier preserves the shape of the signal.
- We have to be careful not saturating nor attenuating the signal.
- The load test results showed interesting and new results for the group:
- “Linear” behavior at more than 2500000 samples for 1 Crate on.
- The maximum number of samples appears to be 2000000 before it starts to have large amounts of loss for the case of 2 Crates on.
- Still have to work on how to solve the load problems in the adc.

Thanks for your attention. :)