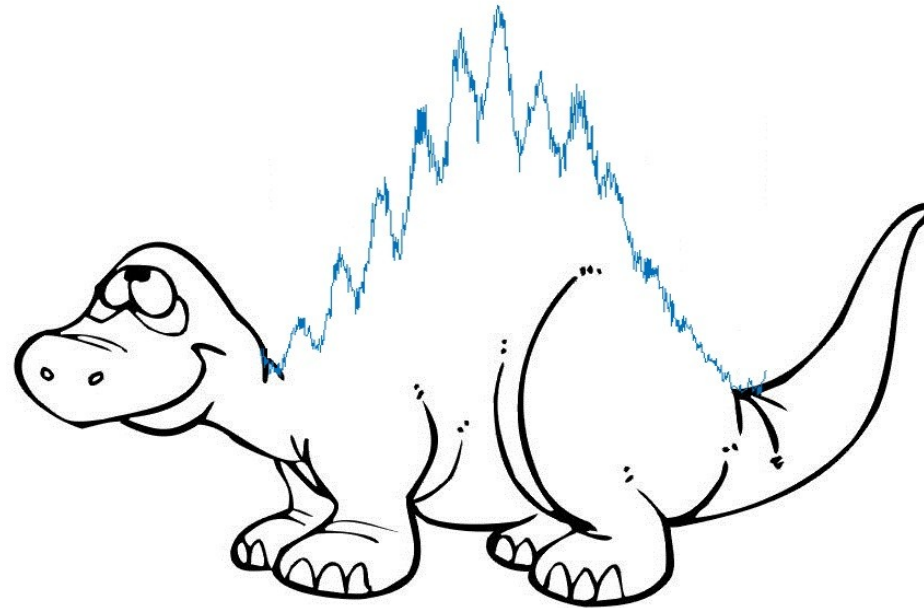


Intra-train bunch charge leveling at FLASH

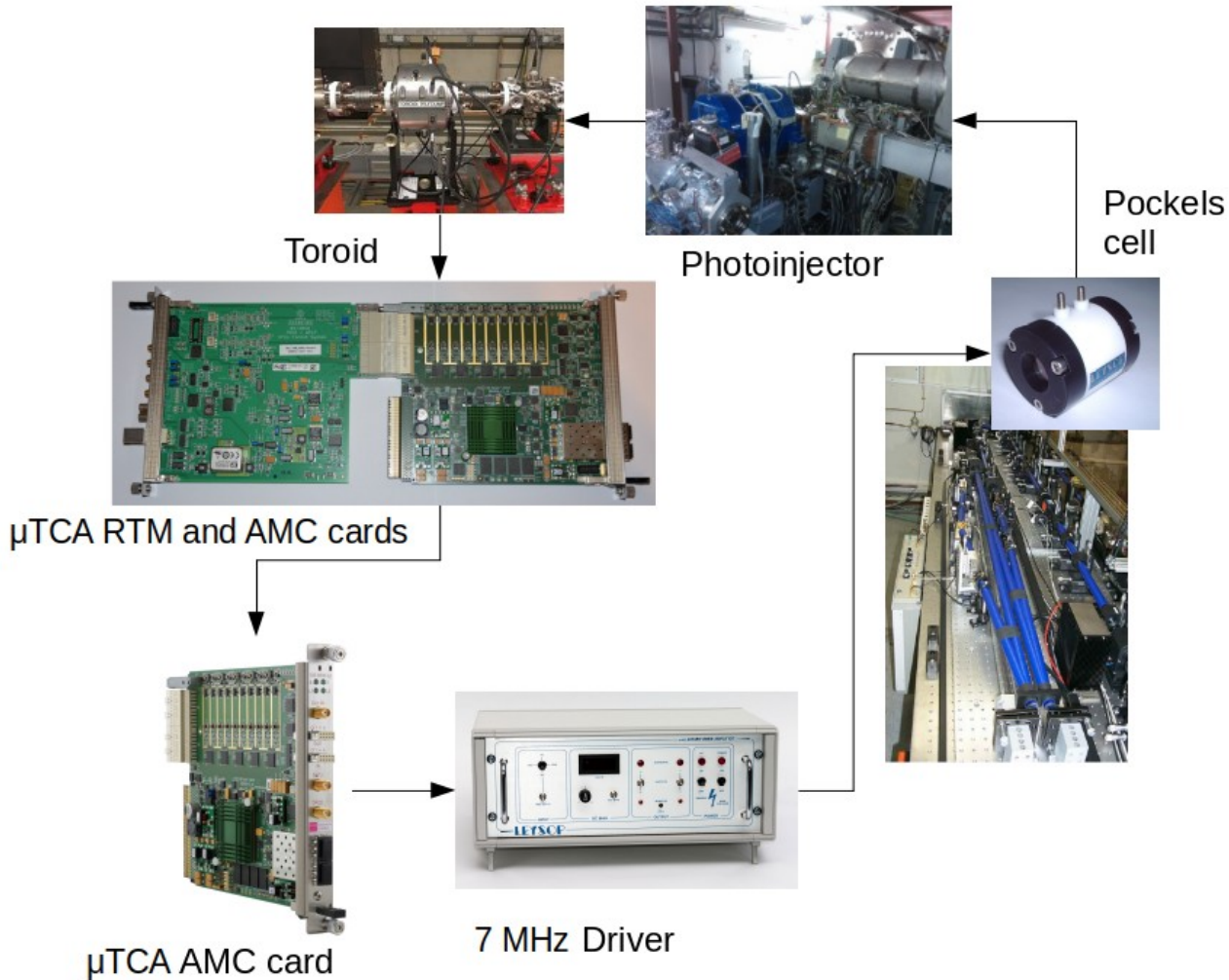
MT ARD ST3 Meeting 2021

Jiri Kral, Bernd Steffen
DESY, MSK
Hamburg, 30/09/2021



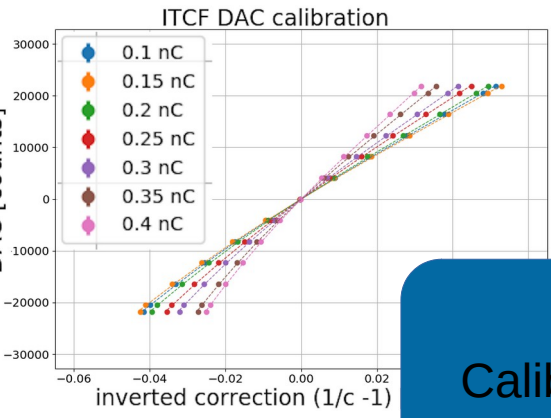
System architecture

Toroid sensor, μ TCA electronics, Pockels cell actuator



Correction
(the cell effect)
deconvolution

Feed-forward
Per-macropulse
History of 10
Decaying weight



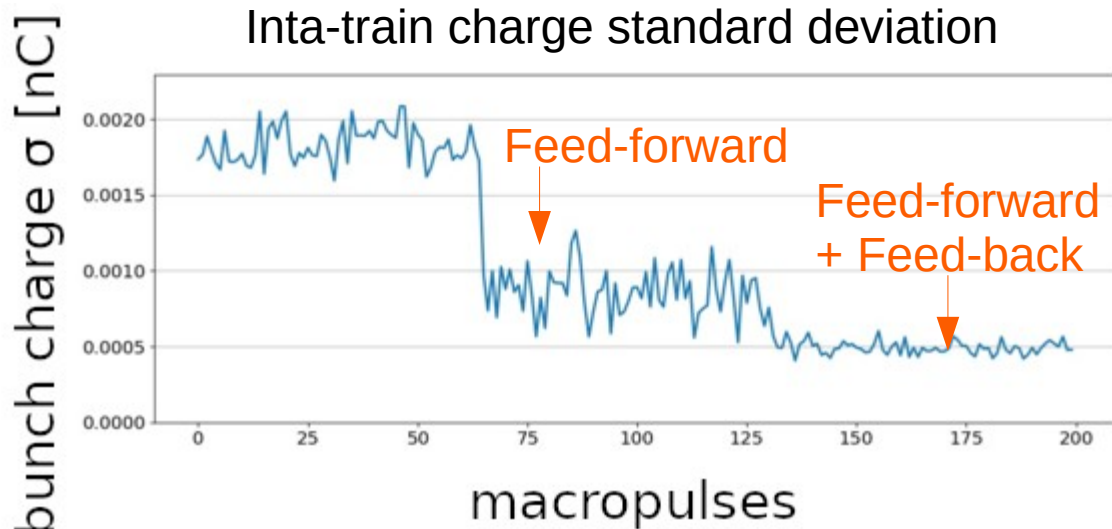
Calibration

Feed-back
PID controller
1.5 μ s loop

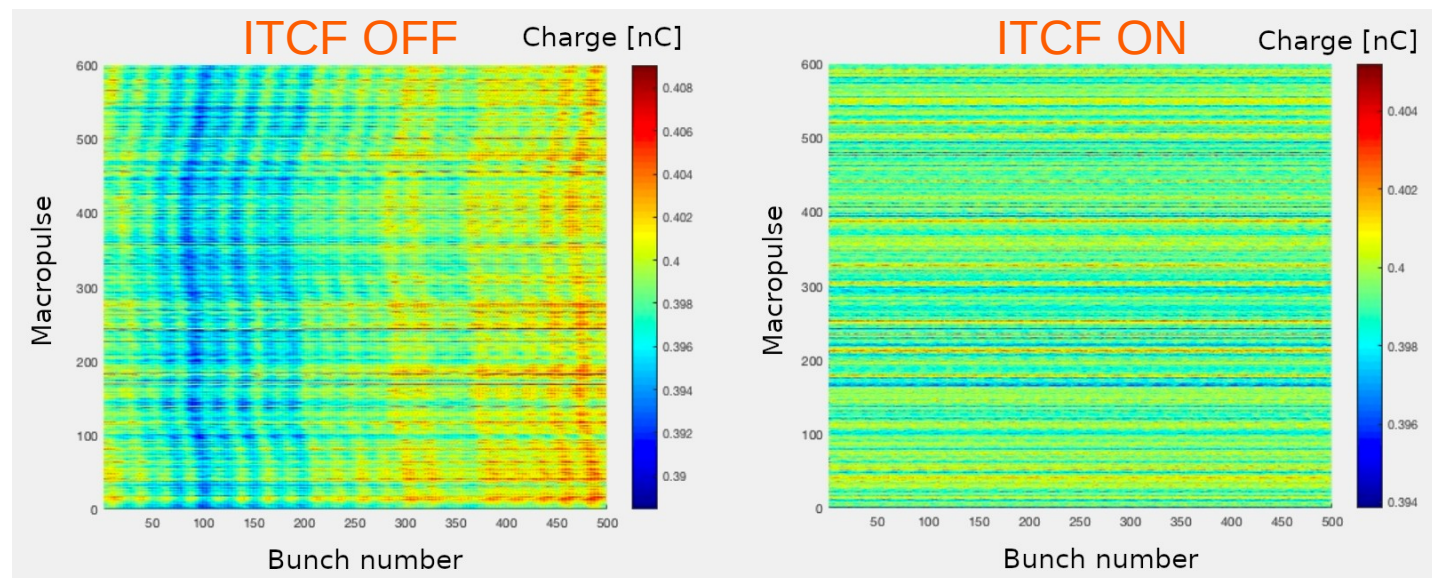
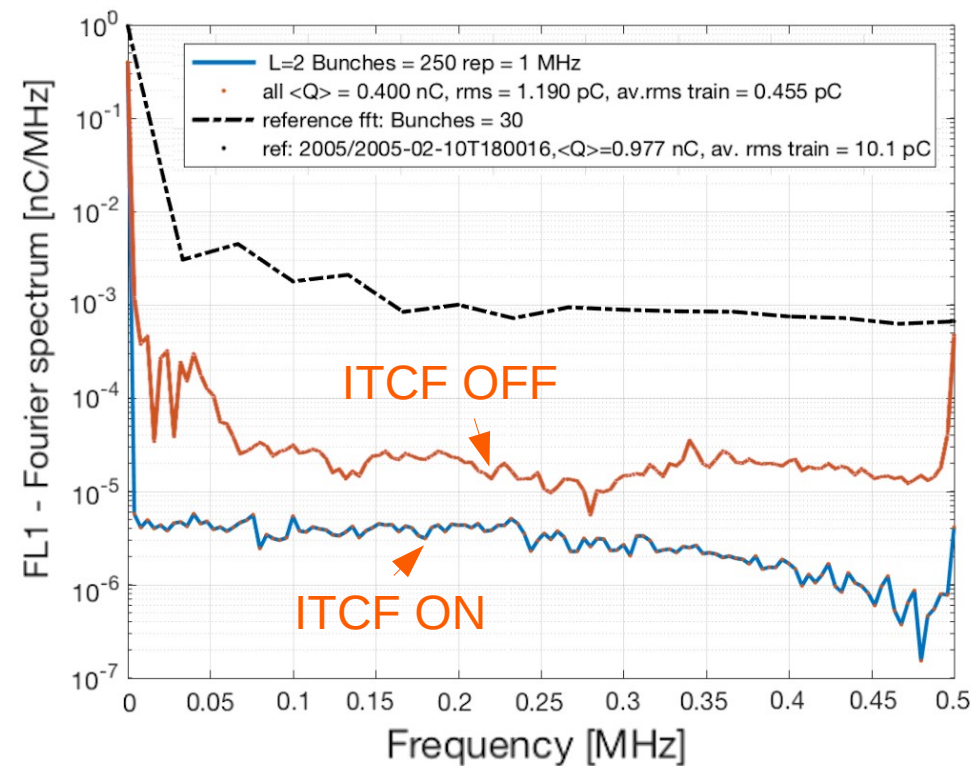
- Pockels cell in the UV laser path
- The control algorithms operate on “open loop” signal
- Pockels cell calibration is charge dependent
 - More charge \rightarrow less dynamic range

The performance

Consistent with simulation



- Intra-train RMS improvement
 - from 1.8 pC to 0.5 pC for 0.40 nC beam
 - from 1.2 pC to 0.3 pC for 0.25 nC beam
- Feed-forward levels macroscopic shape
- Feed-back removes higher freq. noise
- Inter-train baseline stability improved



Conclusion

- Intra-train bunch charge leveling for FLASH Laser 2 was implemented and is operational
 - Feed-forward + Feed-back
- The performance of the system is close to the level of the sensor noise (0.2 pC RMS)
 - Approx. 0.1 pC RMS degradation is an effect of 2-bunch loop latency (instead of 1-bunch)
- The Pockels cell is being actuated in the UV path for ~6 months