HLSW next steps

Discussion startup

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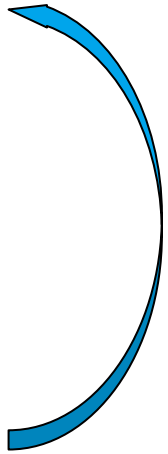
DESY

Applications to be integrated

- Frequency and QI control
  - Strategy clear, main development for AMTF tests → re-usage for machine operation
  - Integration of motor tuners (piezo relaxation), critical system (safety)
  - Gradient tilts and cw operation
- **Multi beam mode operation**
  - Coupling with timing integrated pre-pulse information
  - GUI interfaces (virtual machines), exception handling of different OP
  - Future pulse to pulse changes (foreseen in FW design)
- Combination of fast and slow BBF
- Diagnostic server , RF info server
  - Status display, performance measurement
- Automated SI and controller generation (MIMO, LFF)
- Klystron linearization, and ORC
- Automated notch filter adjustment, online FFT
- VS calibration, Forw and reflected signal calibration

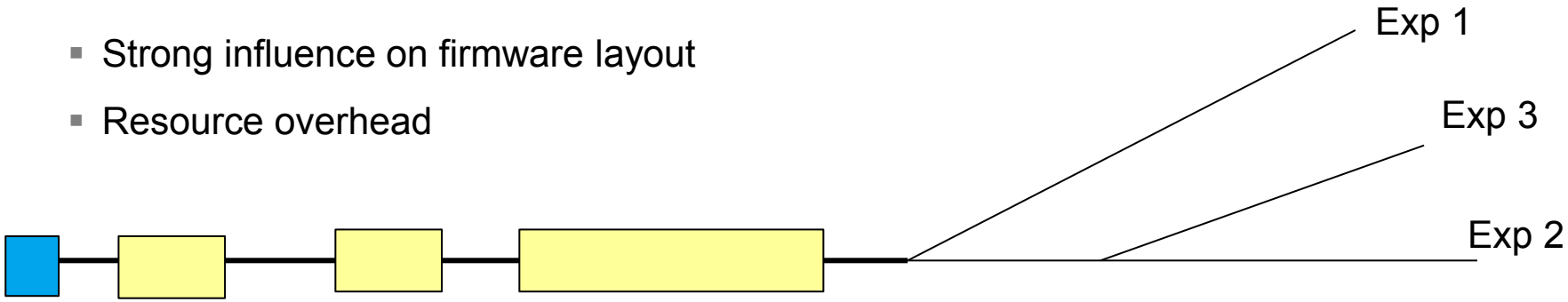


Further points

- Quench detection and prevent
  - QL computation inside FPGA
  - Energy management of consecutive RF stations
- Integration to DAQ
  - Which data is stored and with which frequency (9,1 MHz) ?
- DCM integration and control
- Performance measurement and display
  - Experiment related, bunch resolved ?
- Detuning computation on FW level
  - Integration with piezo module
- Panel design
  - Operator and expert level
  - Naming convention within server should allow generic design
- Adjustable attenuators
  - Automated setup (raw data fit)
  - Higher sensitivity for calibration with low charge

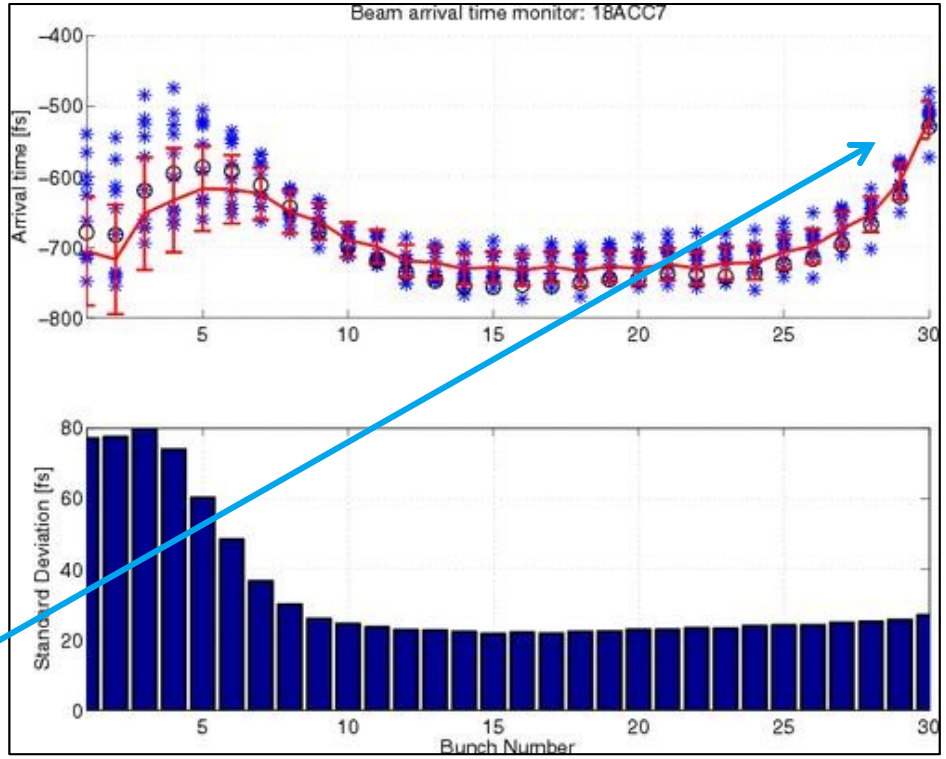
Operating with multiple beamlines

- Data display, operating with different set-points
  - Absolute values (virtual machine)
  - relative changes to be server handled (exception, transition)
- Influence with other subsystems in the controller
  - Learning FF, overshoot, oscillations have been observed – error removal
  - Intra train FB, handle different setpoints
  - Statistics server, readback beam, field bunch related
  - FSM, slow longitudinal feedback
- Pulse to pulse changes (currently only optional, but ..)
  - Strong influence on firmware layout
  - Resource overhead

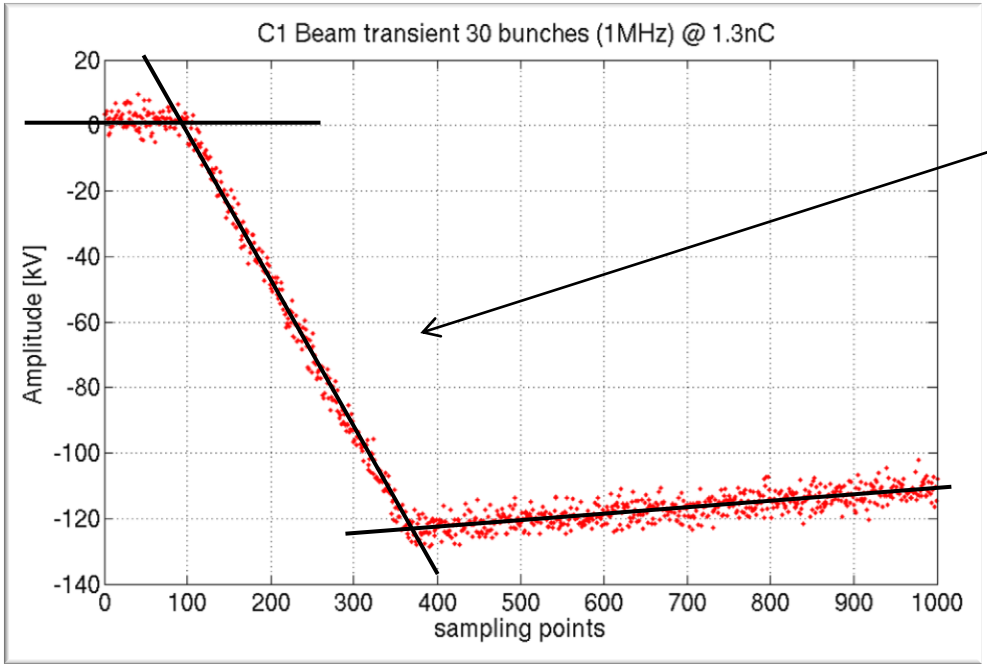


Combination of slow and fast BBF

- Equal setpoint given by user
  - Currently relative adjustment
  - manually, drift
  - Real arrival time vs. Arbitrary bits
- Regulation goal for slow FB
  - first bunch, **last bunch**, mean
- RF SP adjusted relative to fast FB
- Slow FB has no charge correction (BCM)
- Different response times (pulse to pulse not guaranteed)
- FSM integration, user interface and simplification



Beam based VS calibration

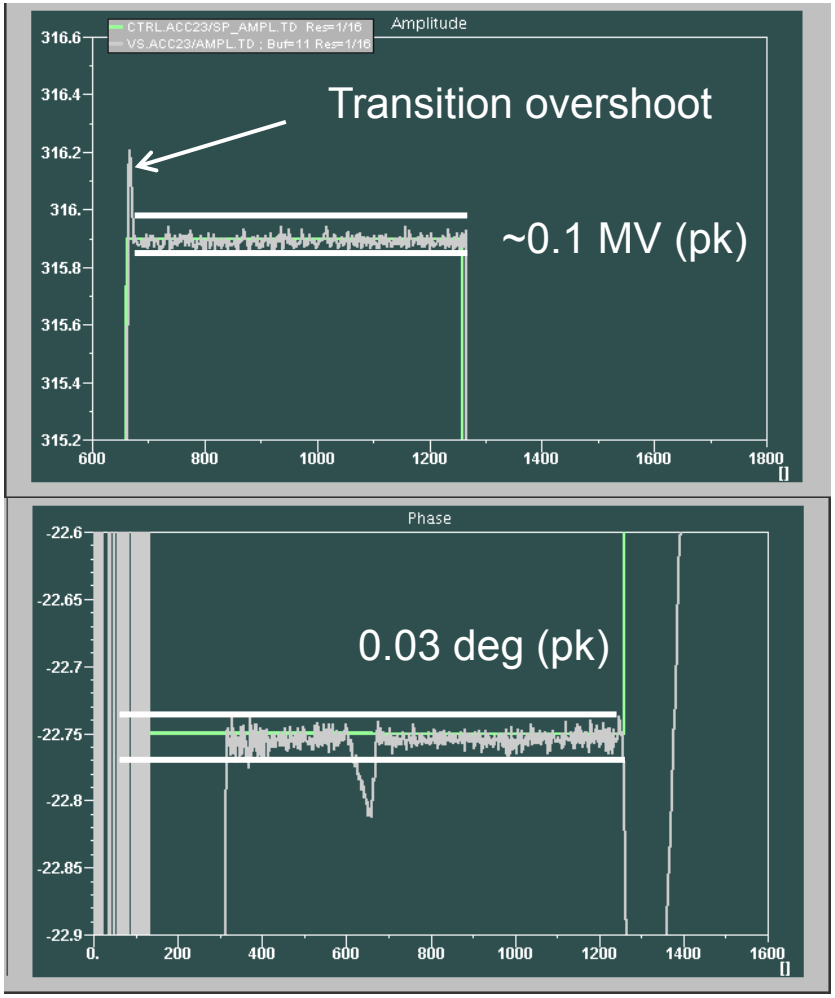


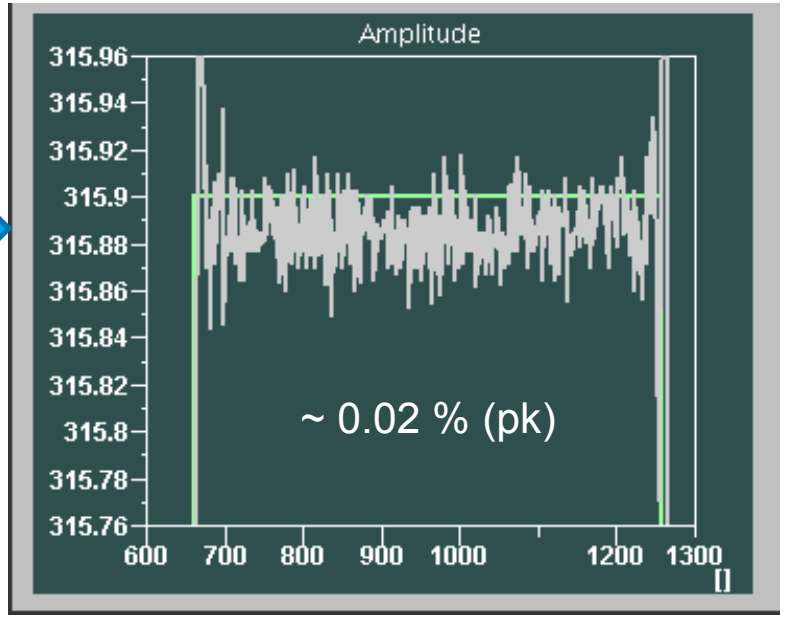
Beam induced transient
~ -125 kV

- Influenced by microphonics and LFD
- Low level sensitivity increase
- Using switchable attenuators
- Using data RBV from DAQ values

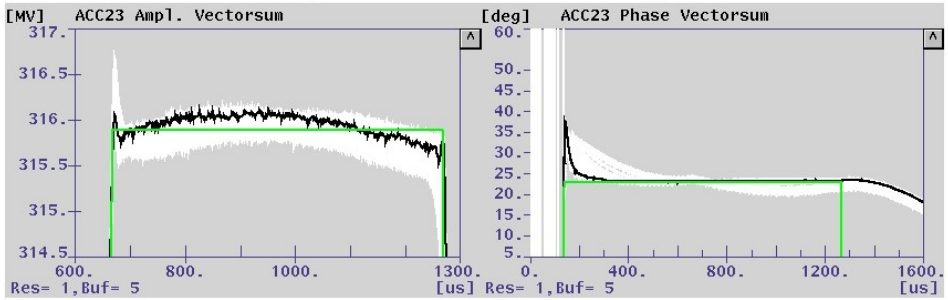
- Main drawback is special machine condition for calibration setup
  - High bunch charge, many bunches
  - Open loop mode of operation, beam transmission
- Procedure done by server based method, confirmation not automated
- Can this be done in close loop mode using VFORW and VREFL cavity signals ?
  - Online monitoring, change detection

In loop regulation with mTCA @ ACC23





Corresponding out of loop (VME) readout



> Both sytems calibrated the same way, different RBV visible

Discussion hints

- Possible risks for FLASH installation
  - Which boards are available, which FW development must/can be done
  - Allocation of personal for setup and maintenance
- Additional features to be developed
- Statistic server and Performance measurements
  - Bunch and experiment specific?
  - Do we need an specific LLRF ML server
- Treatment of multi beam operation
  - Discussion also together with MCS (strong coupling)
- Server performance and algorithm allocation
  - Development in future (CPU upgrades)
- Software development transfer for non DESY facilities
  - Maintenance, non DOOCS interfaces