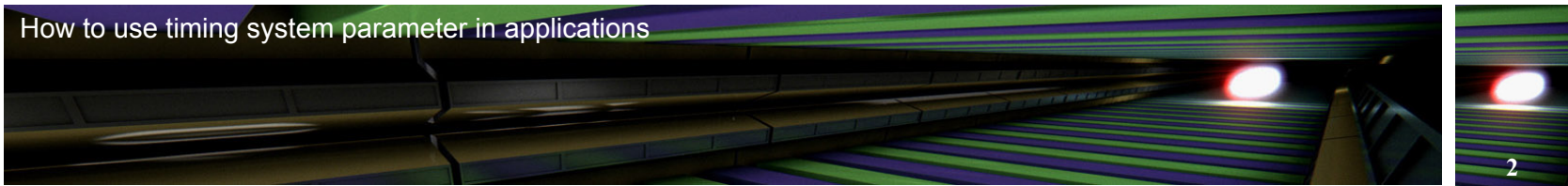# How to use timing system parameter in applications

3rd Collaboration Meeting of the European XFEL, Hamburg, 7-9 April 2014

Olaf Hensler DESY – MCS
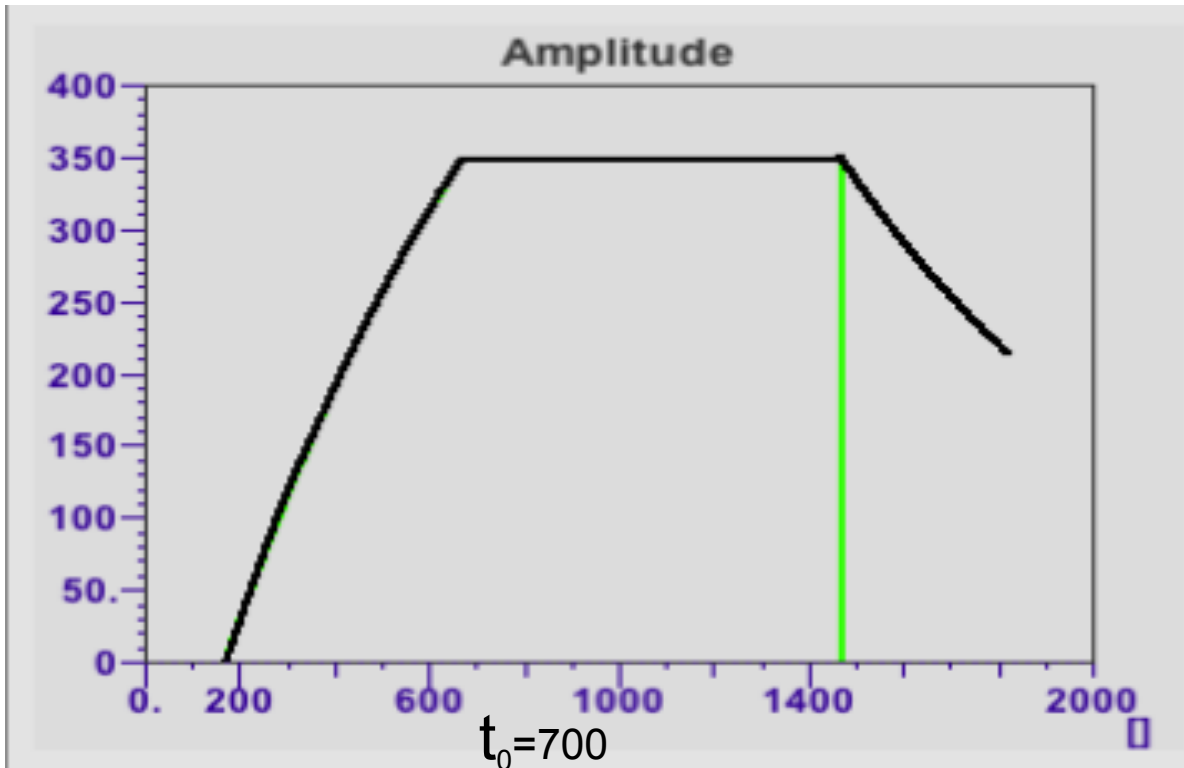
WP28

European XFEL

- **Outline**
  - Old times
  - Many sampling frequencies and bigger buffer
  - More then one accelerator (beamline)

Good old TTF times ..

Amplitude

t_0=700
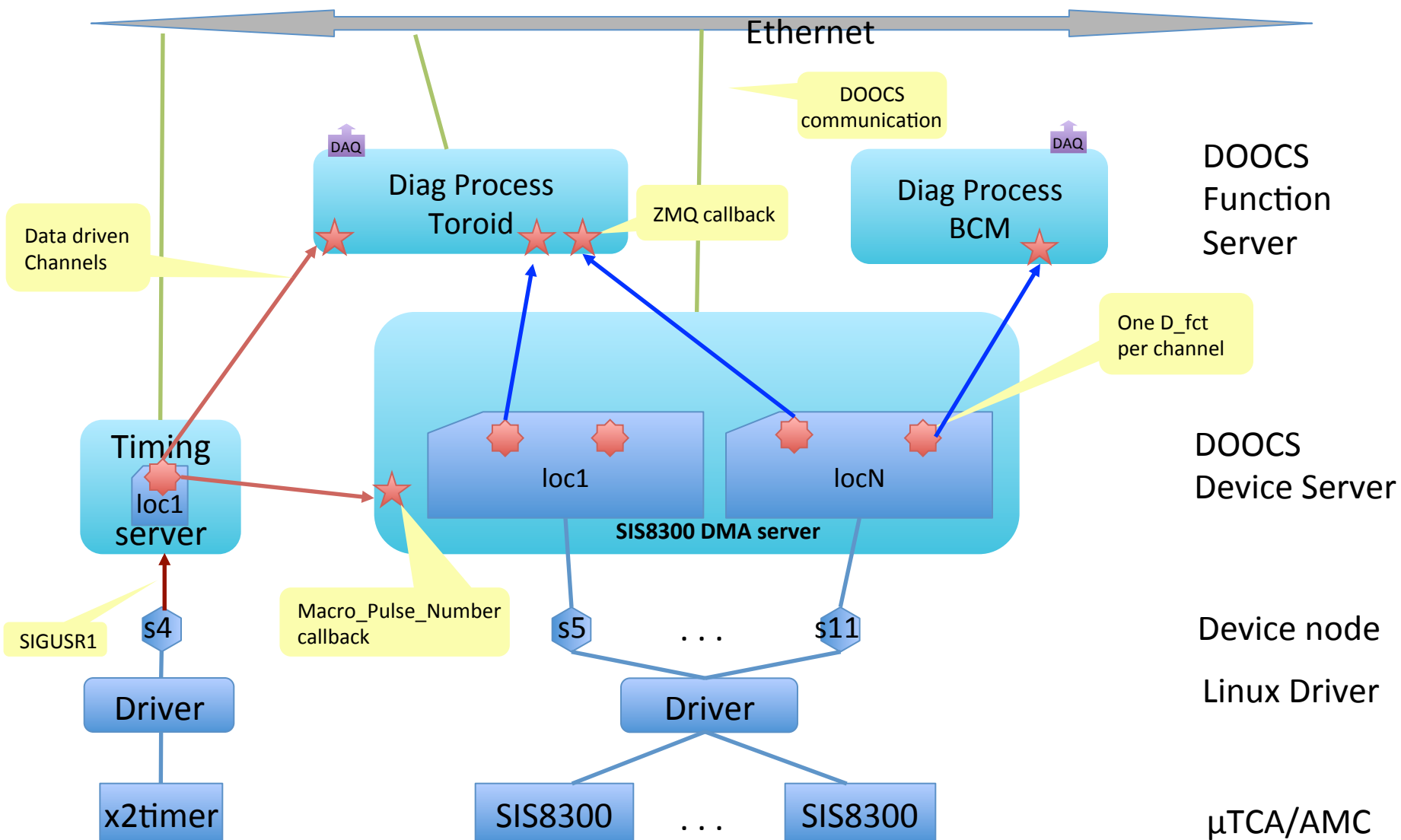
- 1 MHz sampling (1.00308 MHz)
- t_0 at 700 after A6 trigger => 1.Bunch at 700
- 1 MHz max. bunch rate
- Index of 1.Bunch at 700
- Increment of 1
- One flattop of 800
- Data block length always 2048 samples

Front-end Architecture: Example Toroid

Ethernet

DOOCS communication

DAQ

Diag Process Toroid

ZMQ callback

DAQ

Diag Process BCM

DOOCS Function Server

Data driven Channels

One D_fct per channel

DOOCS Device Server

Timing loc1 server

loc1

locN

SIS8300 DMA server

SIGUSR1

s4

Macro_Pulse_Number callback

s5

. . .

s11

Device node

Driver

Driver

Linux Driver

x2timer

SIS8300

. . .

SIS8300

µTCA/AMC

Olaf Hensler   DESY – MCS, Hamburg, Germany
3rd Collaboration Meeting of the European XFEL

Many frequencies

- Many different sampling frequencies
  - LLRF : 81.25 MHz internal and 9.027 MHz for displays
  - Diagnostics : 108.3333 MHz raw data
  - BLMs : 36,1111 MHz
  - XGM : 3.6 GS (12 bit)
- Much higher data rates
  - LLRF : 18432 samples (float) for ~2ms
  - Diagnostics : 90000 samples (16 bit) for ~800µs
- Higher bunch frequencies possible
  - 3 MHz at FLASH
  - 4.5 MHz at XFEL

Definitions

- Base frequency is 9.027777 MHz

- t_0 is at 700µs

- No bunches before t_0

- Time Domain (.TD) plots are now in µs

- Bunch pattern in 9 MHz steps
  integer type to be used as indexes

- BUNCH_FIRST_INDEX.*   Structure (4 integer)
  I_1 : first bunch   0 = 700µs
  I_2 : Duration
  I_3 : Increment
  I_4 : Number of Bunches

- PRE_BUNCH_TIME in µs before t_0

- 9MHZ_DIV from 9 MHz base frequency, could be 1,2,3,9
  => to configure the display frequency

- SAMPLE.FLASH* structure for reduced data + PRE_SAMPLES offset

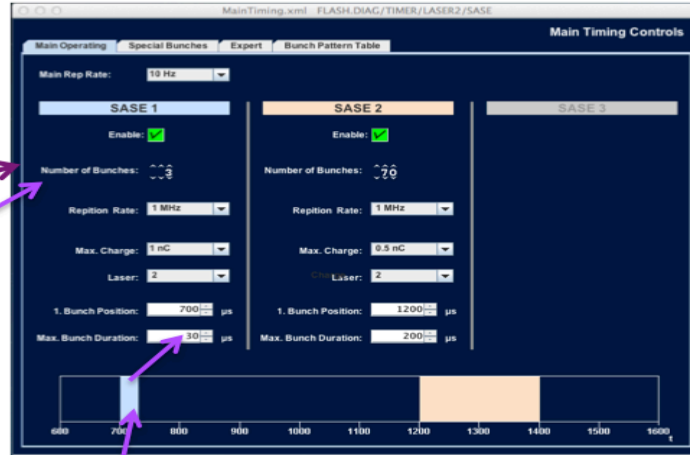# BUNCH_FIRST_INDEX.1 Definition
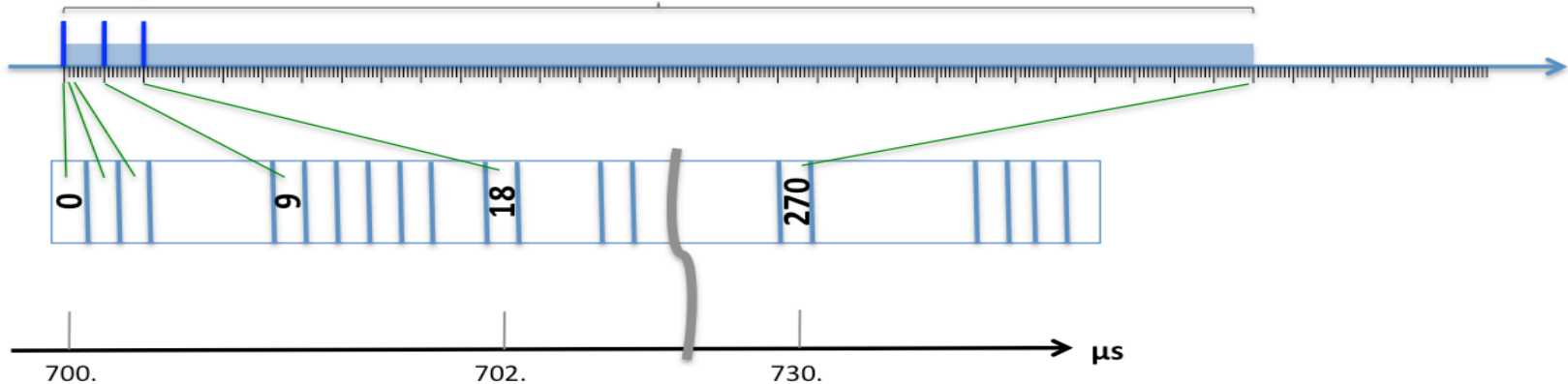
Example:
1. Bunch
Max duration
Increment
Number of bunches

0 270 9 3

3 bunches

30μs bunches max allowed = 270 indexes
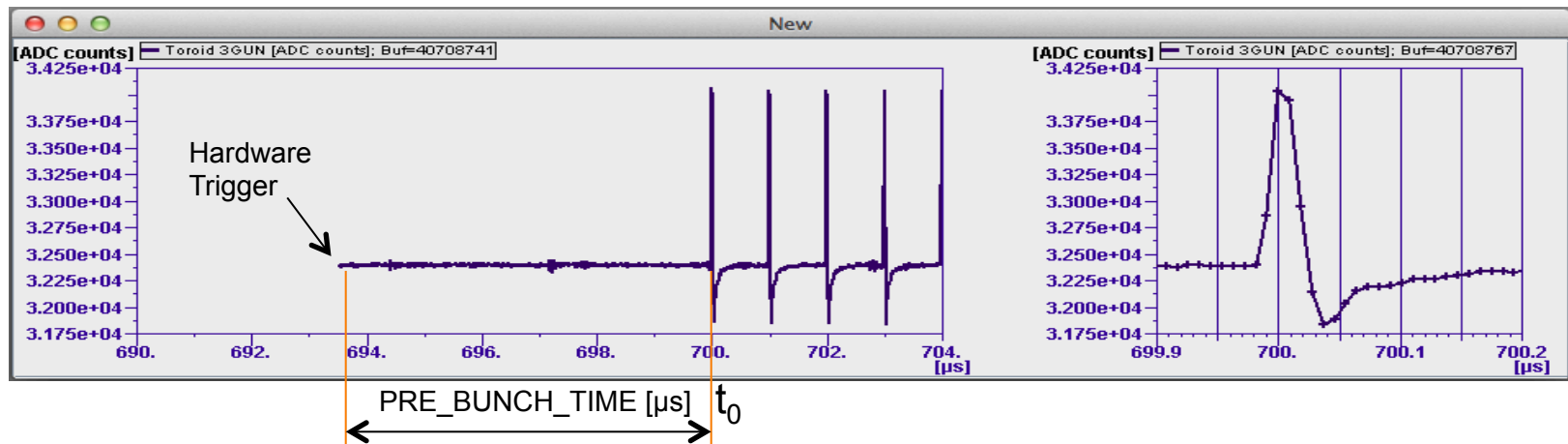
0   9   18   270

700.   702.   730.   μs

Olaf Hensler   DESY – MCS, Hamburg, Germany
3rd Collaboration Meeting of the European XFEL

Get 1. bunch to 700µs (t_0)

Steps to do :

1. Define PRE_BUNCH_TIME
2. Set SAMPLE_FREQ
3. View Raw Data Signal
4. Adjust trigger delay at the timing card

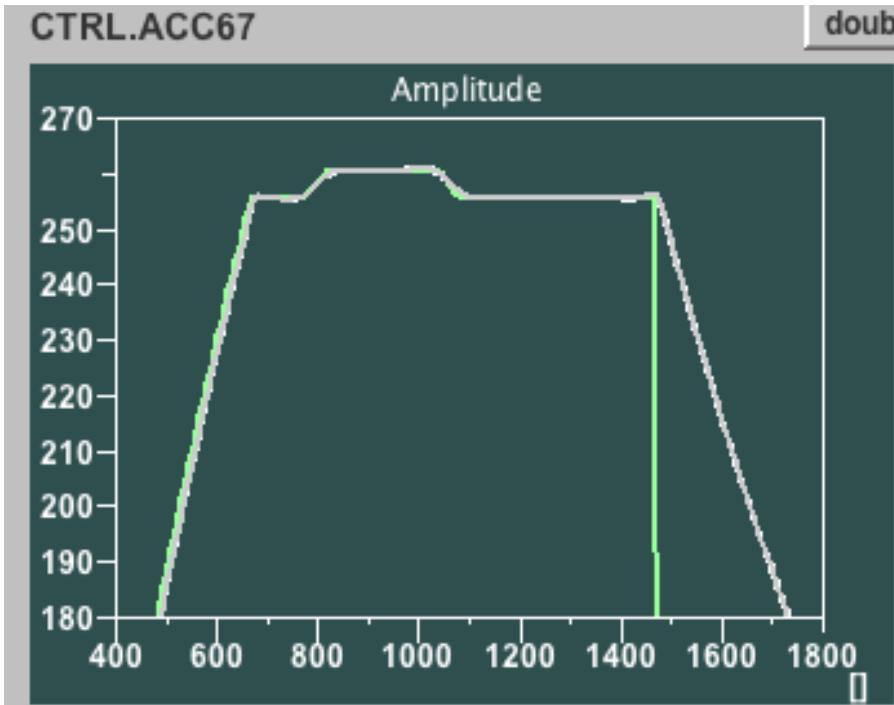5. Adjust SAMPLE.SHIFT (for different cable length)

Software needed to do it ?

PRE_SAMPLES = PRE_BUNCH_TIME * SAMPLE_FREQ
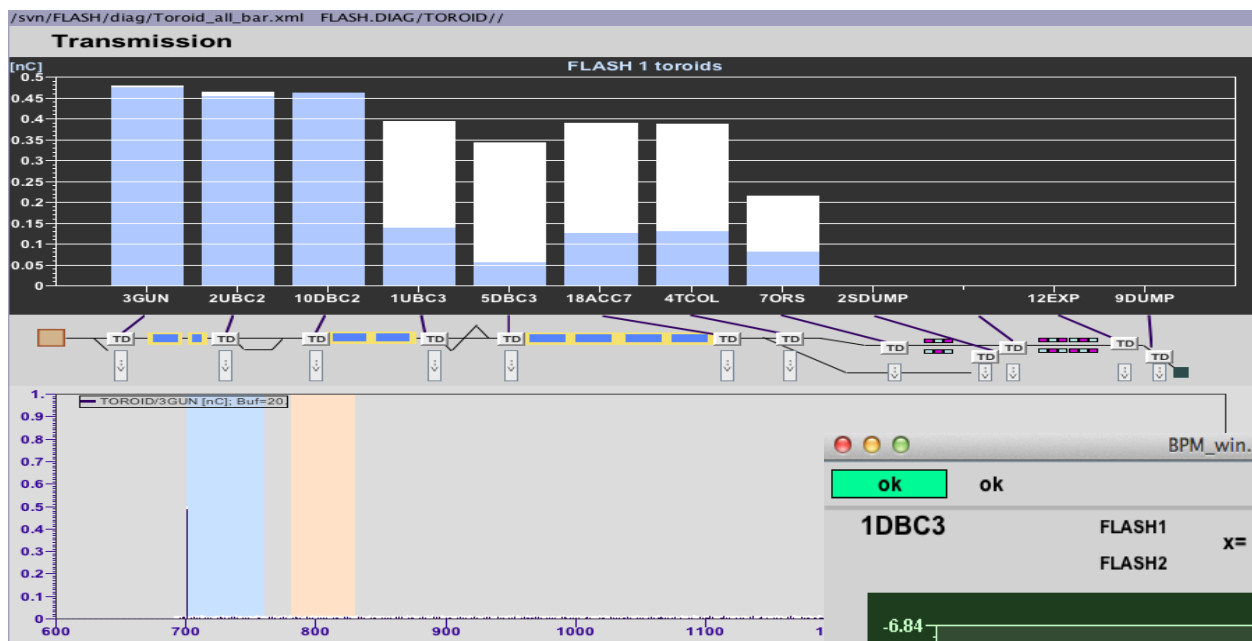
More then one beamline

- Several flattops possible
- Start and duration of every flattop needed
- Properties for every beamline needed, CHARGE.FLASH1 and CHARGE.FLASH2
- Histories for every beamline needed, e.g. CHARGE.FLASH1.HIST or CHARGE.FLASH2.HIST
- Laser order may swap
- 1. Bunch maybe later then t_0 (700µs)
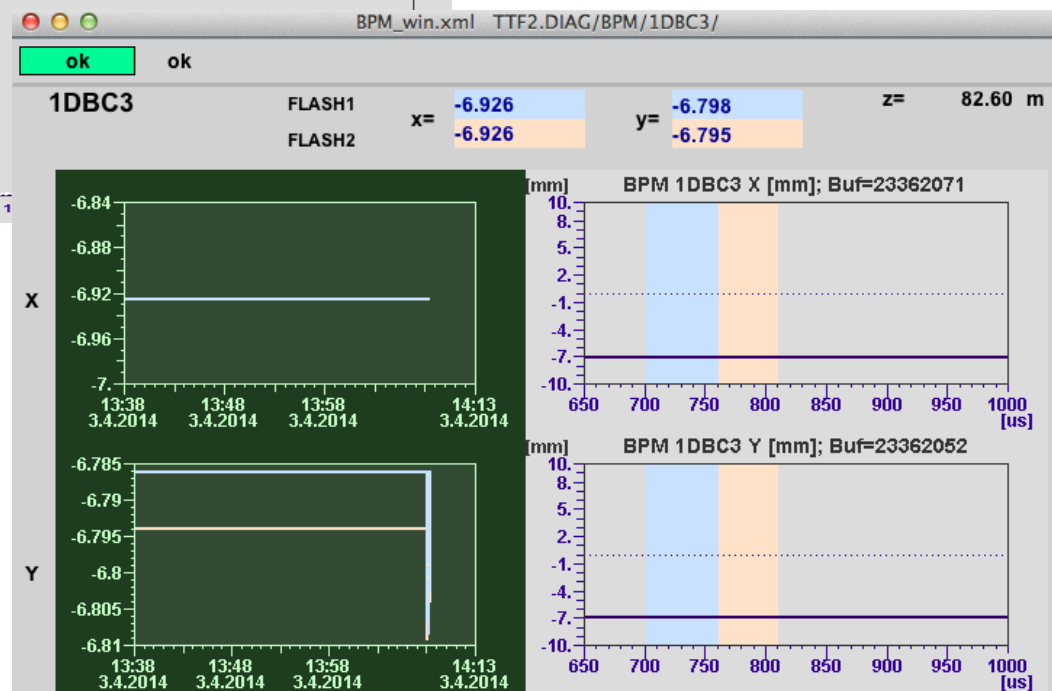- Different bunch pattern possible
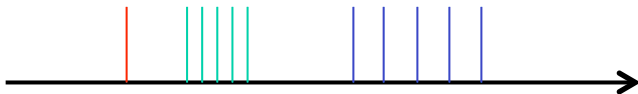
Colour code with jDDD

- Provide colour code per beamline
- Indicate the Time Domain of every beamline
- Properties and Histories per beamline

Inside DAQ

Toroid Middle-layer Server provides :

- Desired Bunch Pattern
- Actual PulsePattern at every toroid location
- NUMBER_OF_BUNCHES.* for every beamline
- CHARGE and CHARGE.HIST for every beamline at every toroid
- Feeds the Shared Memory of the DAQ
- FLASH.DIAG/TOROID.ML

Summary

- Front-end software is ready
- High complexity is handled by DOOCS C++ libraries
- Under test at FLASH now
- Timing Parameter available inside DAQ Shared Memory
  - But not used yet in all DAQ server