



The Virtual European XFEL Accelerator

Development, test and integration of
high level software at the European XFEL

Raimund Kammering
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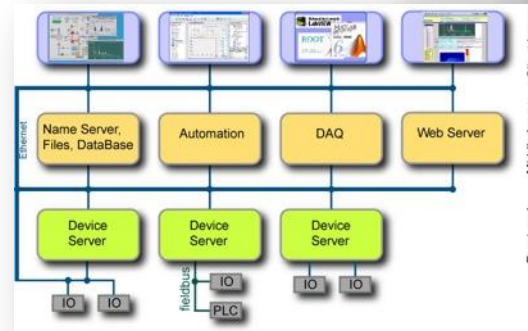
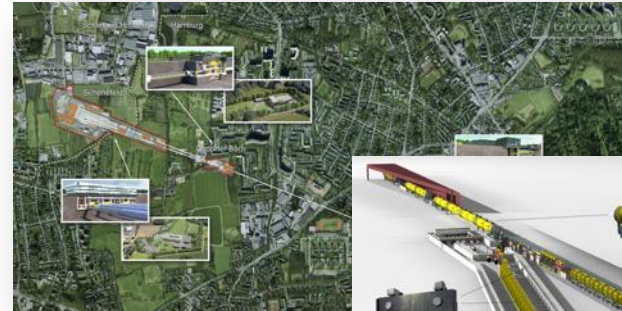


HELMHOLTZ
| **ASSOCIATION**



Can **not** talk about:

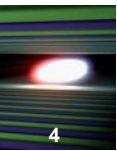
- the European XFEL
(see MOA3O02, MOPGF101, ...)
- the FLASH facility
(see MOC3O07, ICALEPCS2007 TOAA04, ...)
- the control system
(see ICALEPCS2009 MOD004, ...)





Outline

- **The Idea - Motivation**
- **Where we've grown up - From FLASH to XFEL**
- **The core of the Control System Architecture - The DAQ (Data Acquisition System)**
- **The Virtual XFEL - damned let's have a look**



- The European XFEL is a **large scale** machine
- **Tight time schedule** for commissioning and time up to first lasing
- **Lessons learned** at other facilities:

Need to have **all** software **ready** for the **commissioning**

Set up **interdisciplinary team** from multiple DESY groups to
provide high level software

Test and thereby **approve** foreseen **control system architecture works**

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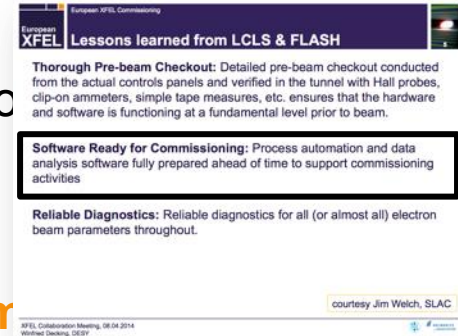
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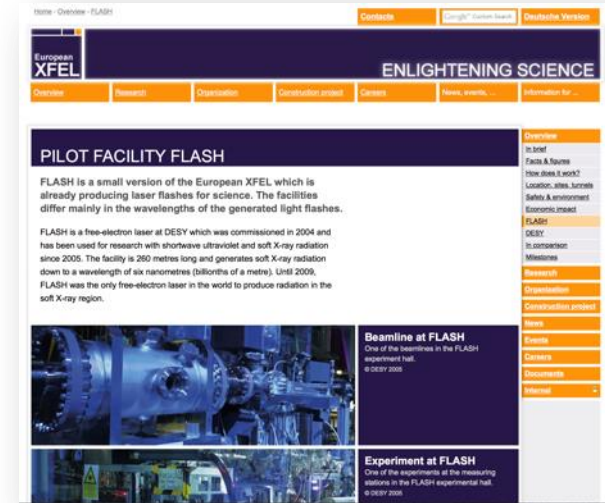


■ FLASH is the *little brother* of XFEL

- Control System: DOOCS/TINE
- Front-end Hardware: VME, μ TCA
- Timing System
- Machine Protection System
- Multi-Beam-Line Operation
- ...

- FLASH is **the test bed** for software to be used at XFEL
but ...

XFEL is 10 times as big!



From FLASH to XFEL

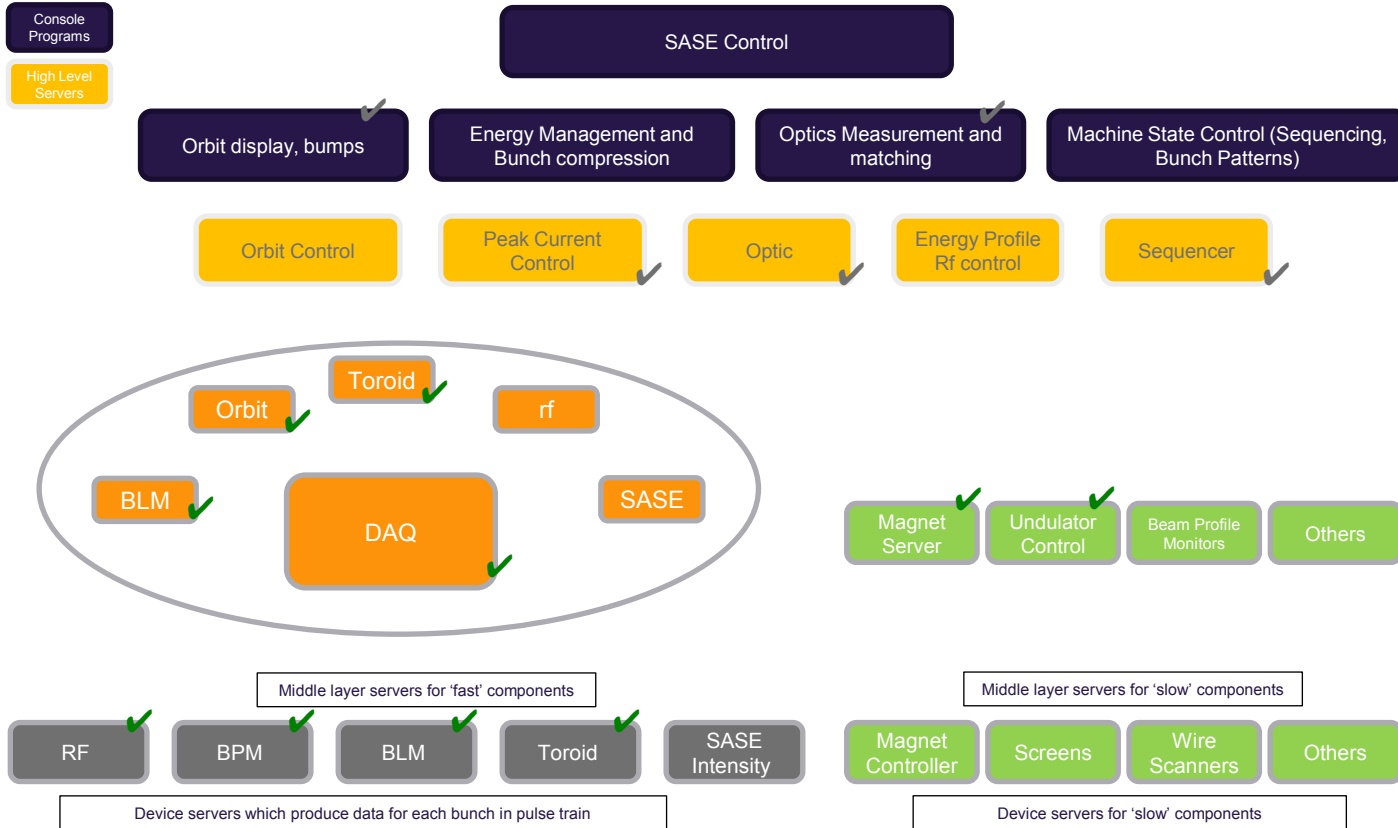


FLASH ~ 30 crates producing < 100 Mbyte/s
XFEL ~ 200 crates producing >> 100 Mbyte/s

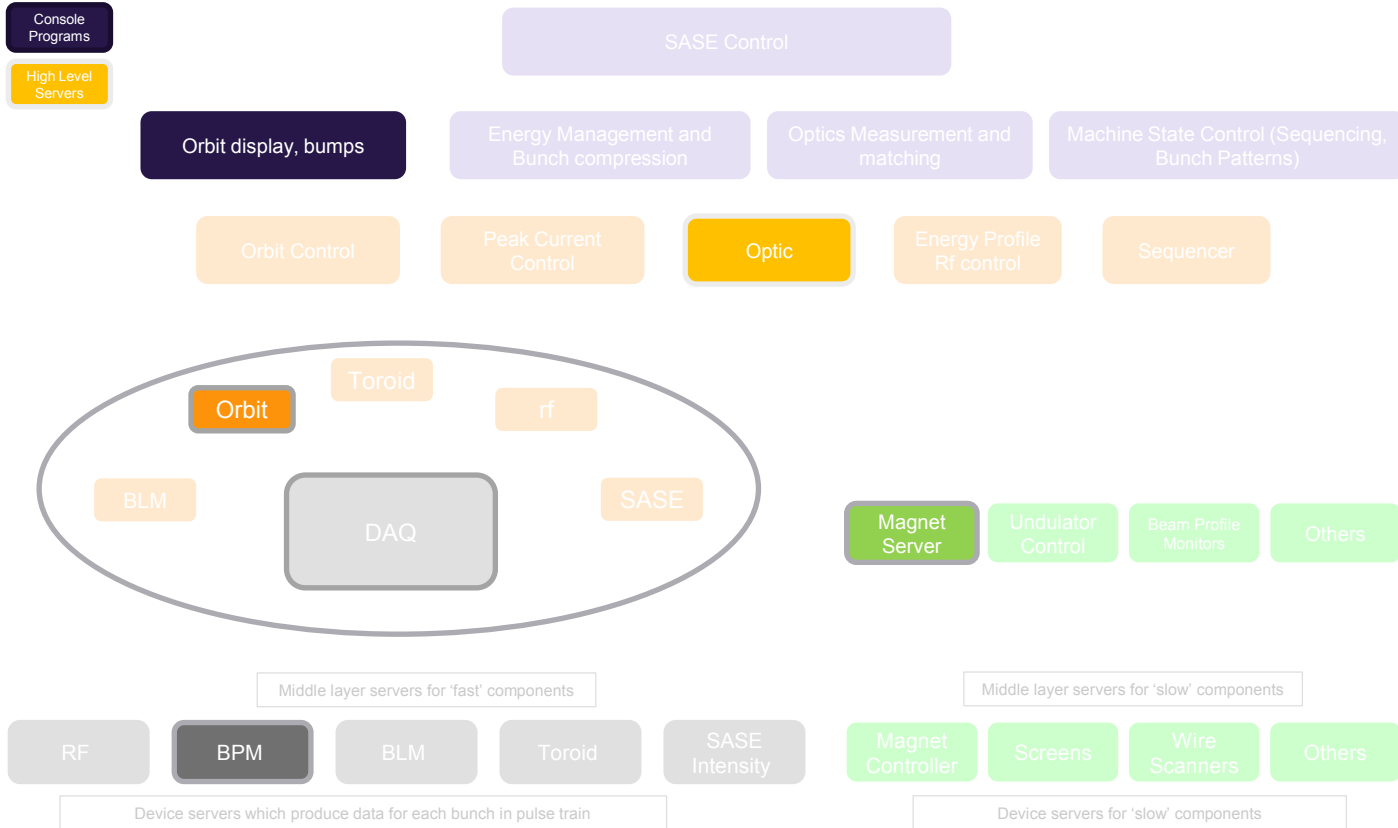
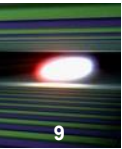
- High data rates **require data reduction**
- **Synchronize data** from various sources
- Have to think more in **physics entities**

→ **The Data Acquisition System (DAQ)**

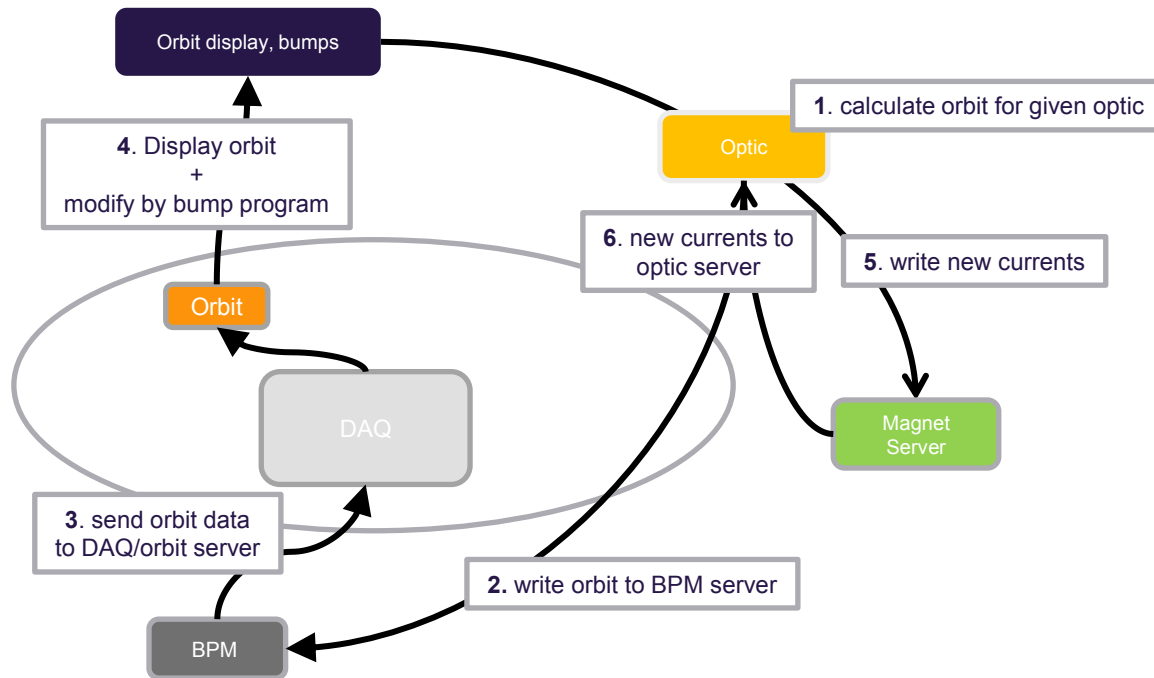
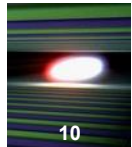
The Data Acquisition System



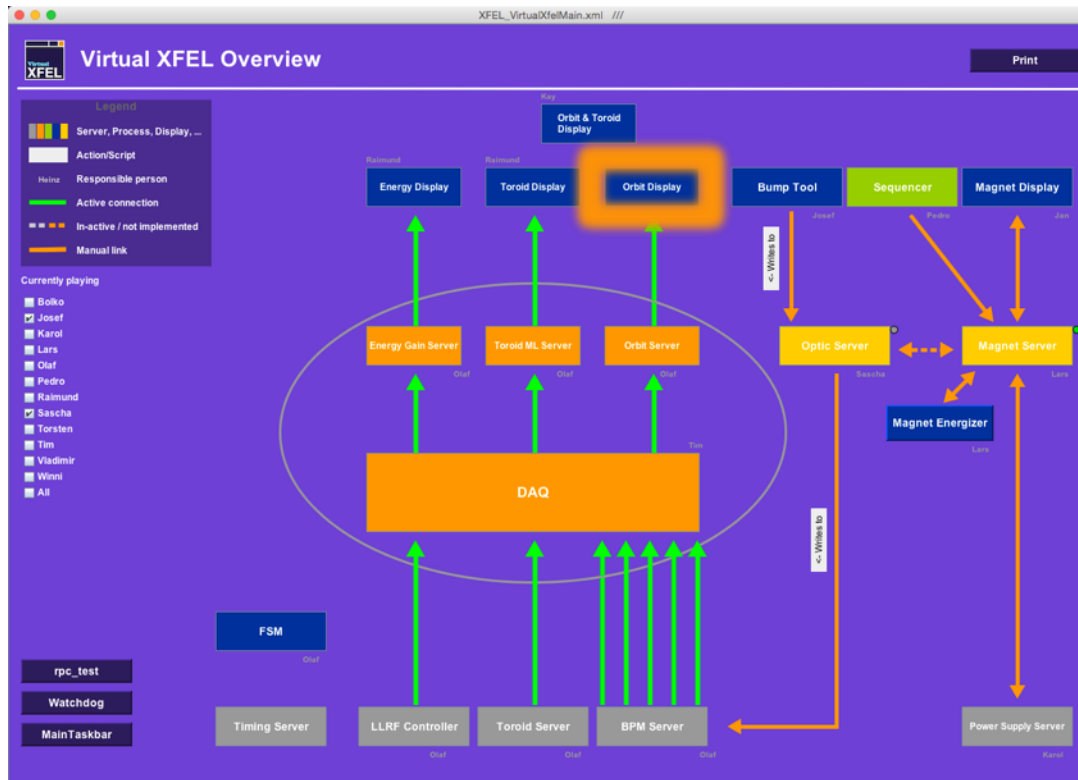
The Data Acquisition System



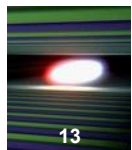
The Data Acquisition System



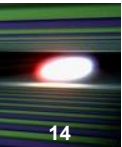
The virtual XFEL – Orbit



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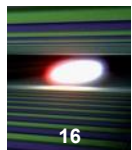
The virtual XFEL – Orbit



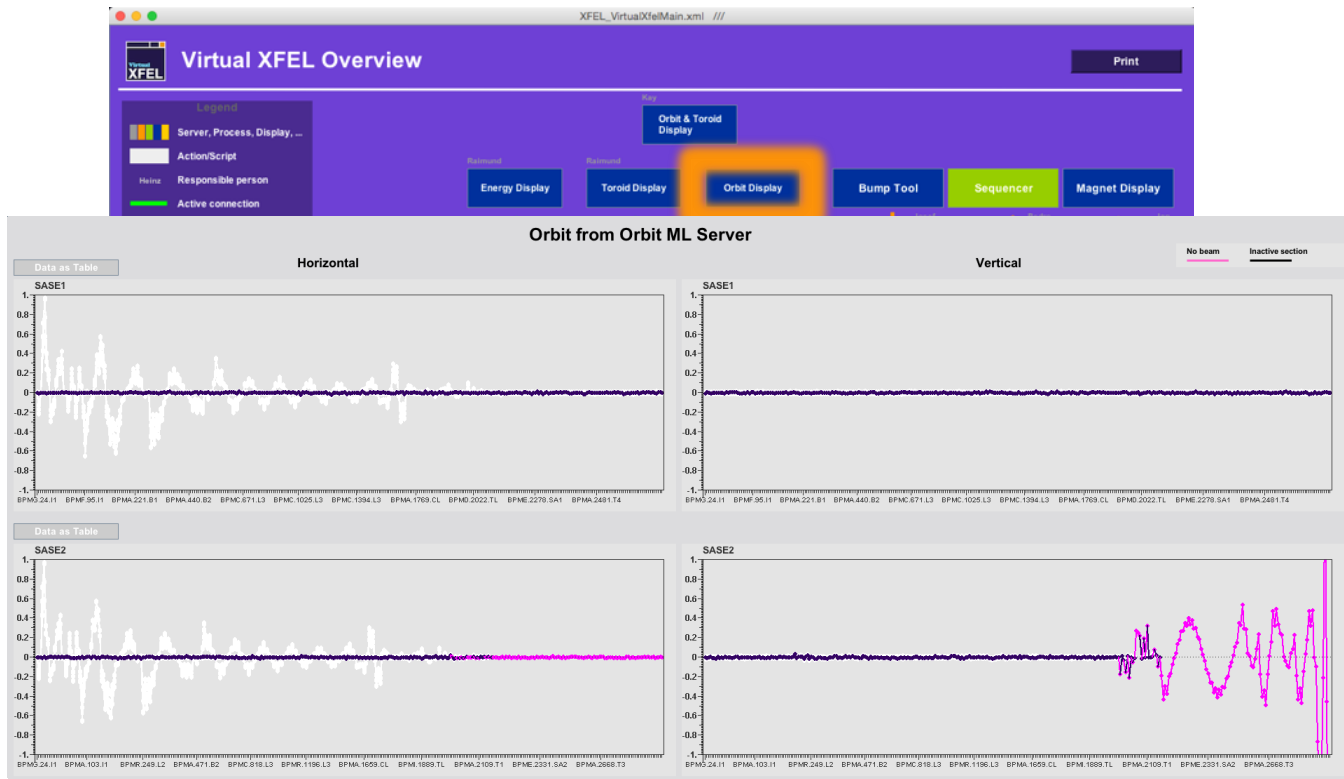
The virtual XFEL – Orbit



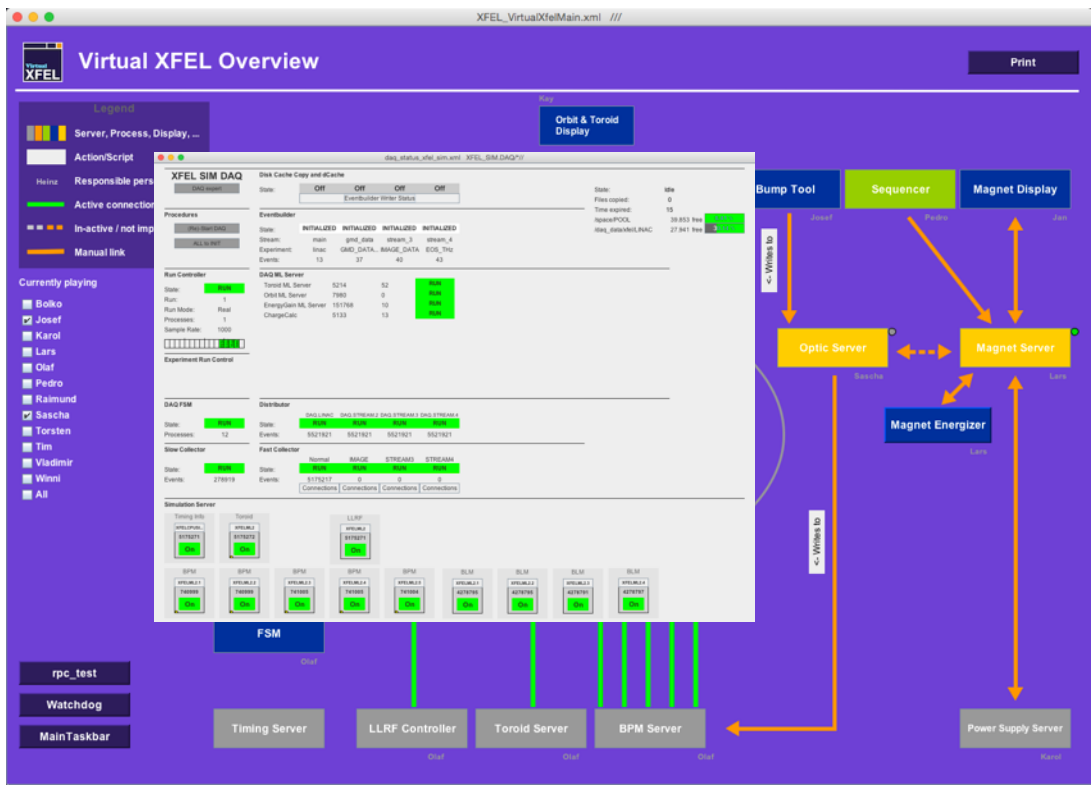
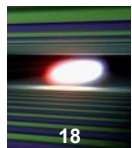
The virtual XFEL – Orbit



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The virtual XFEL – Data throughput



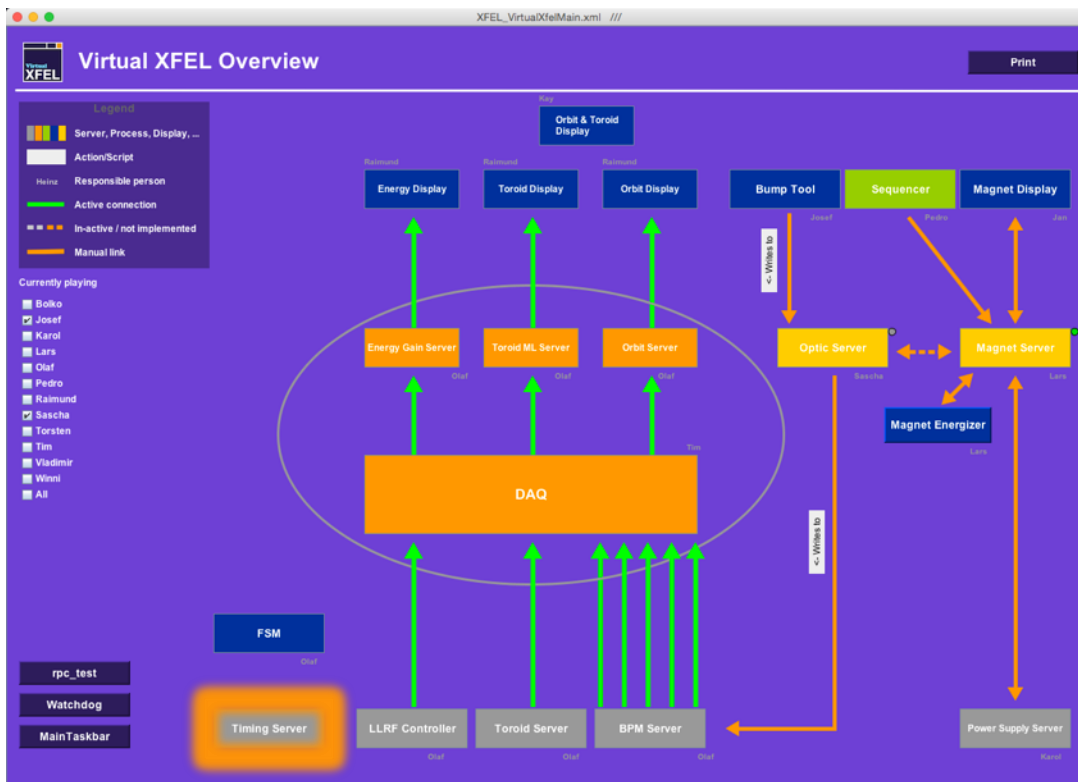
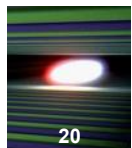
The virtual XFEL – Data throughput

The screenshot displays the 'Virtual XFEL Overview' software interface. The main window is titled 'Virtual XFEL Overview' and includes a 'Print' button in the top right corner. A legend on the left side identifies symbols for 'Server, Process, Display, ...', 'Action/Script', 'Responsible person', 'Active connection', 'In-active / not imp...', and 'Manual link'. A list of 'Currently playing' users is shown on the left, including Bolko, Josef, Karol, Lars, Otaf, Pedro, Raimund, Sascha, Torsten, Tim, Vladimir, Woni, and All.

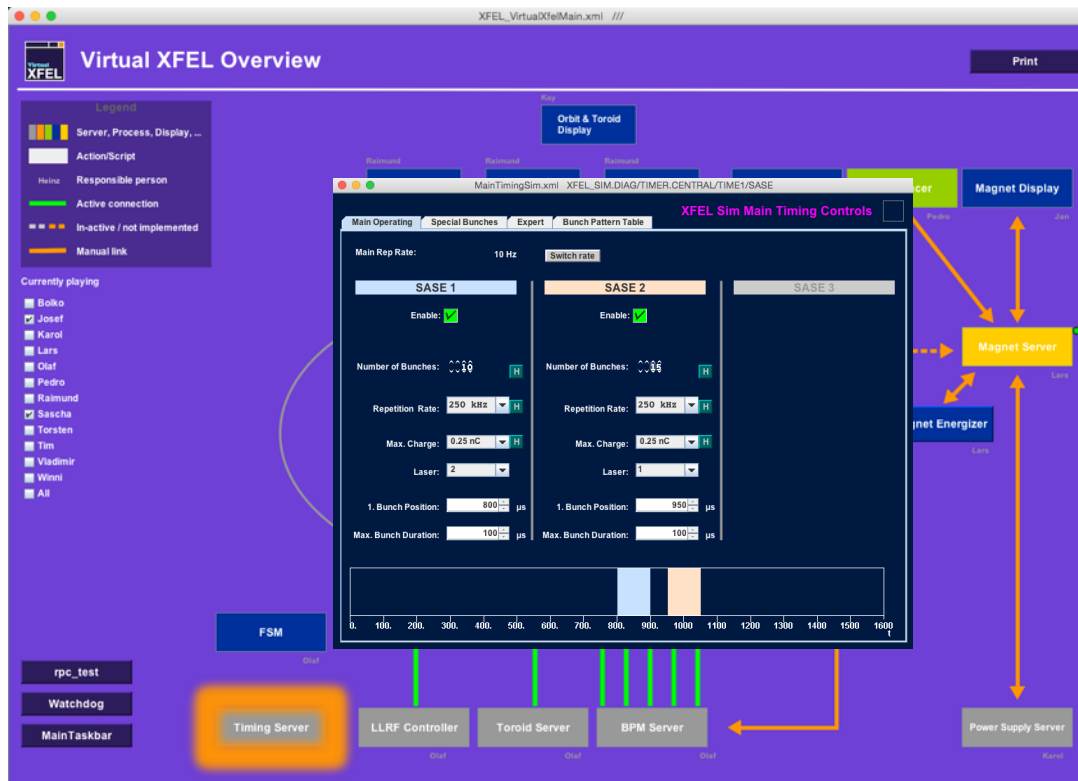
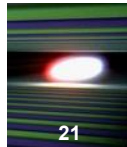
Key components of the interface include:

- XFEL SIM DAQ**: A window showing the status of the DAQ system, including 'Dish Cache Copy and iCache' and 'EventBuilder' status (OFF, OFF, OFF, OFF). It also displays 'Processes' and 'Run Controller' information.
- XFEL DAQ Status**: A window with four graphs showing 'Node Input Rate (MB/s)', 'Node Output Rate (MB/s)', 'Data Directory', and 'Free Space (TB)'. It lists nodes like 'XFEL Main DAQ' and 'XFEL Simulation DAQ'.
- Simulation Server**: A window showing 'Timing info' and 'LLRF' control panels for various components like 'SFS1', 'SFS2', 'SFS3', 'SFS4', 'SFS5', 'SFS6', 'SFS7', 'SFS8', 'SFS9', 'SFS10', 'SFS11', 'SFS12', 'SFS13', 'SFS14', 'SFS15', 'SFS16', 'SFS17', 'SFS18', 'SFS19', 'SFS20', 'SFS21', 'SFS22', 'SFS23', 'SFS24', 'SFS25', 'SFS26', 'SFS27', 'SFS28', 'SFS29', 'SFS30', 'SFS31', 'SFS32', 'SFS33', 'SFS34', 'SFS35', 'SFS36', 'SFS37', 'SFS38', 'SFS39', 'SFS40', 'SFS41', 'SFS42', 'SFS43', 'SFS44', 'SFS45', 'SFS46', 'SFS47', 'SFS48', 'SFS49', 'SFS50', 'SFS51', 'SFS52', 'SFS53', 'SFS54', 'SFS55', 'SFS56', 'SFS57', 'SFS58', 'SFS59', 'SFS60', 'SFS61', 'SFS62', 'SFS63', 'SFS64', 'SFS65', 'SFS66', 'SFS67', 'SFS68', 'SFS69', 'SFS70', 'SFS71', 'SFS72', 'SFS73', 'SFS74', 'SFS75', 'SFS76', 'SFS77', 'SFS78', 'SFS79', 'SFS80', 'SFS81', 'SFS82', 'SFS83', 'SFS84', 'SFS85', 'SFS86', 'SFS87', 'SFS88', 'SFS89', 'SFS90', 'SFS91', 'SFS92', 'SFS93', 'SFS94', 'SFS95', 'SFS96', 'SFS97', 'SFS98', 'SFS99', 'SFS100'.
- System Configuration**: A window showing system settings for 'SYS', 'DISK', 'NET.0', and 'NET.10'.
- Control Panels**: Buttons for 'rpc_test', 'Watchdog', and 'MainTaskbar' are located at the bottom left.
- Other Windows**: 'Orbit & Toroid Display', 'Bump Tool', 'Sequencer', and 'Magnet Display' are visible in the background.

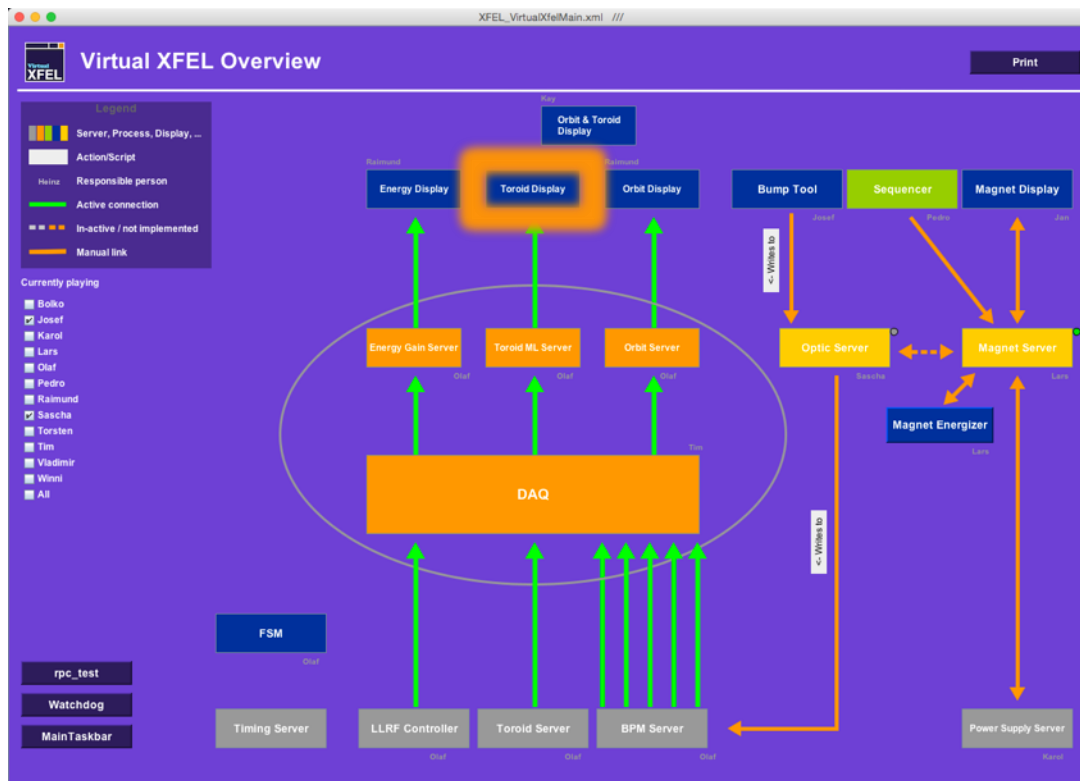
The virtual XFEL – Timing



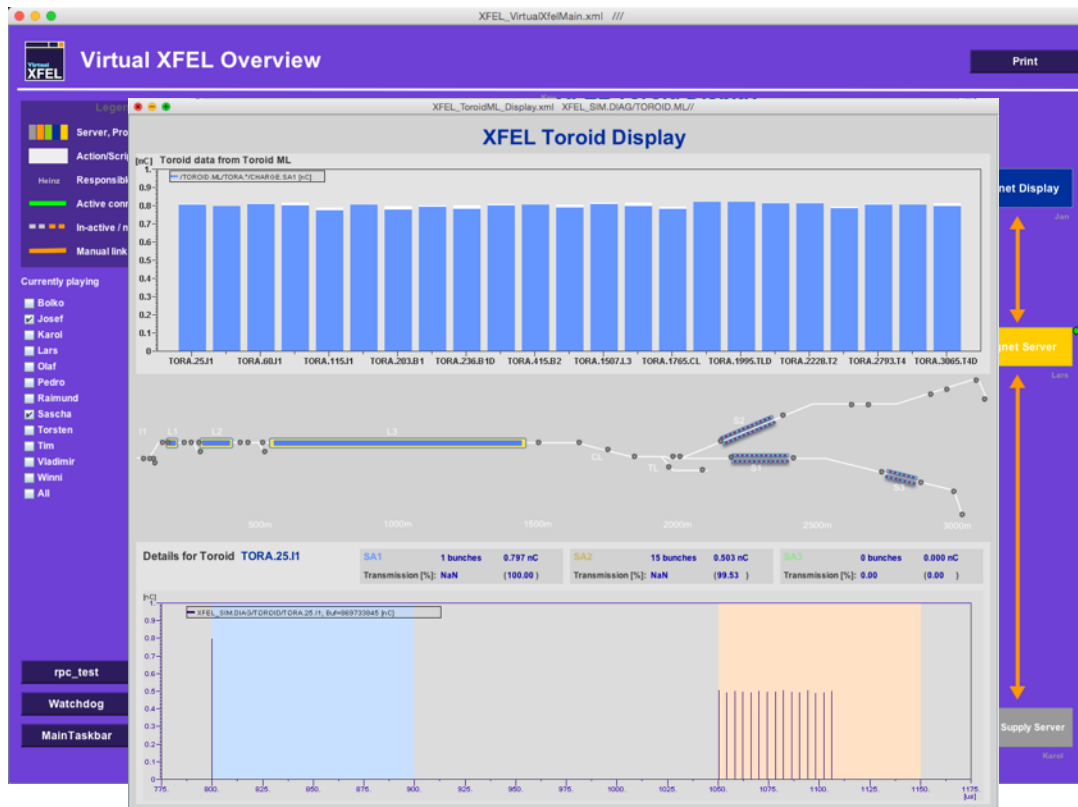
The virtual XFEL – Timing



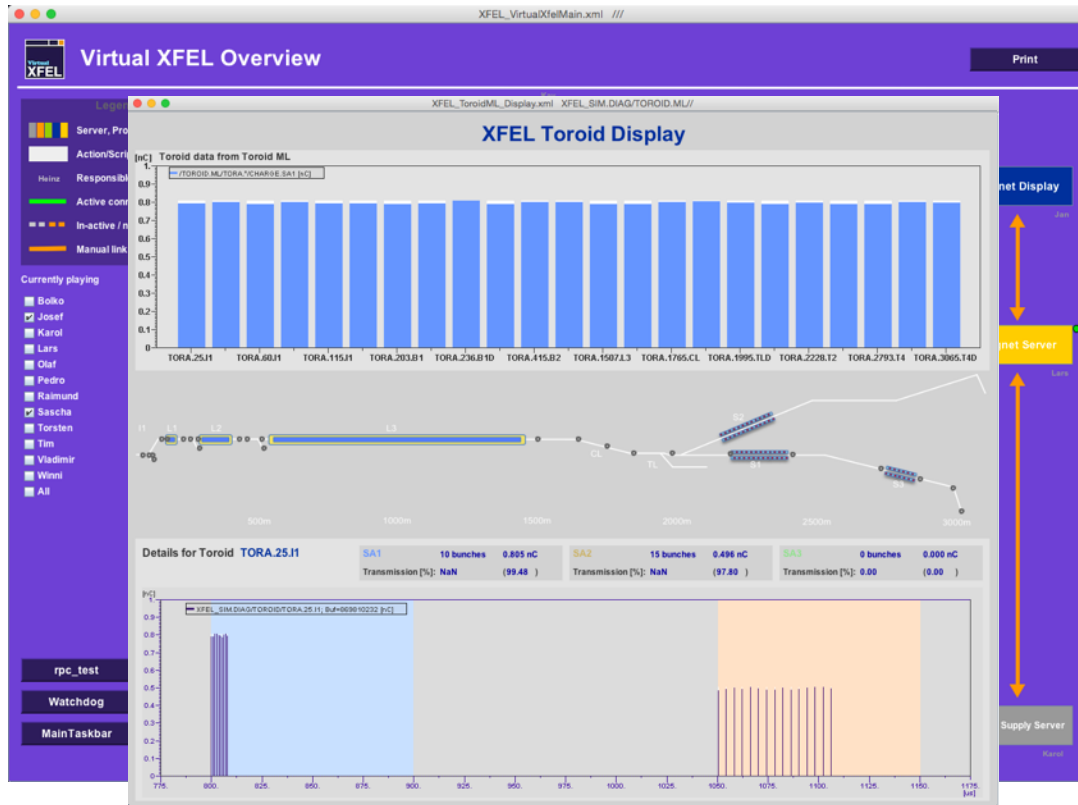
The virtual XFEL – Bunch pattern handling



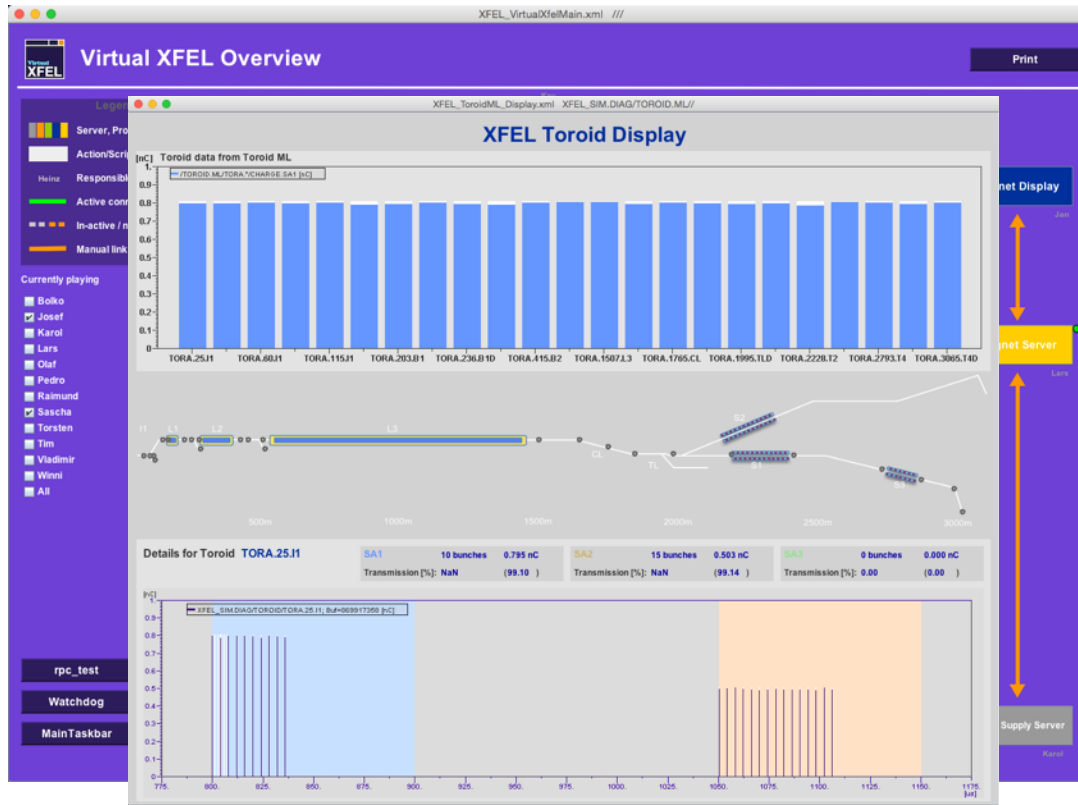
The virtual XFEL – Bunch pattern handling



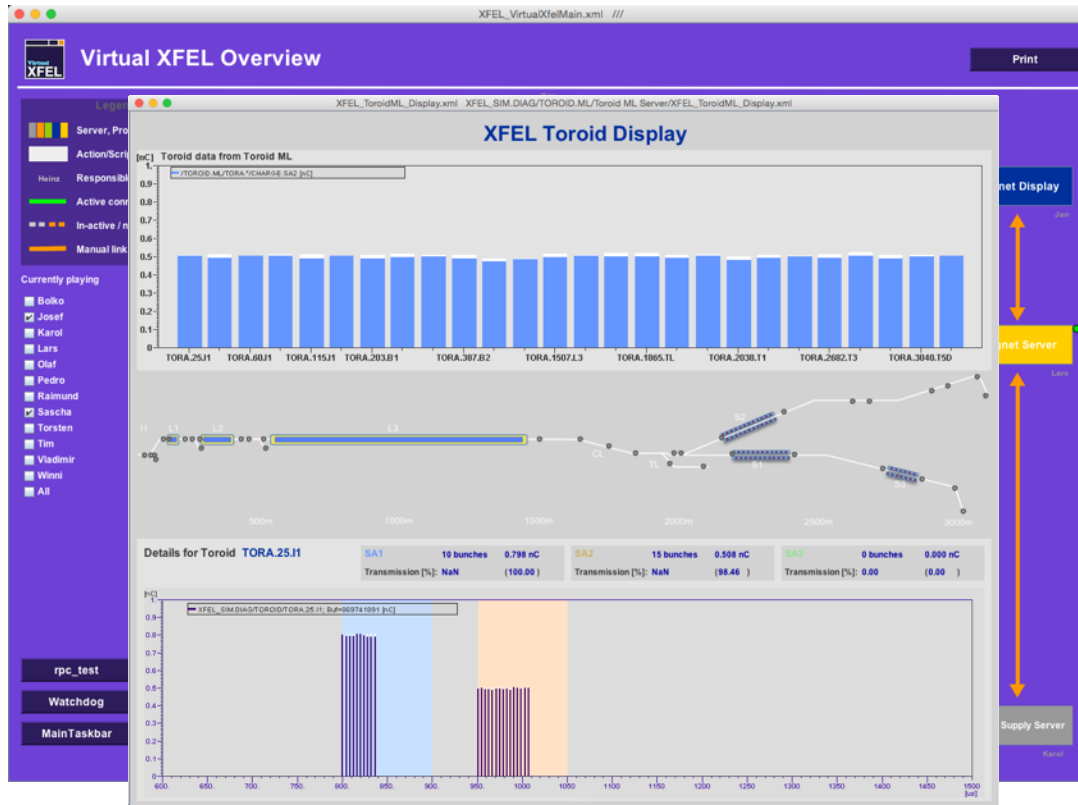
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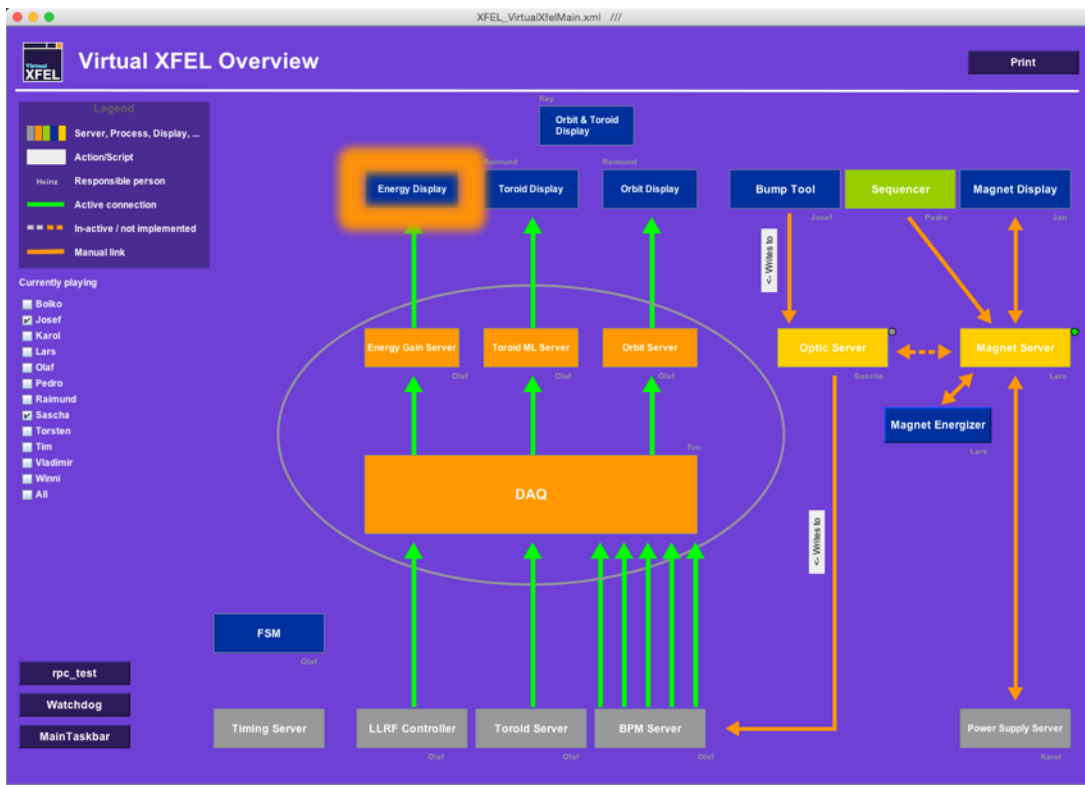
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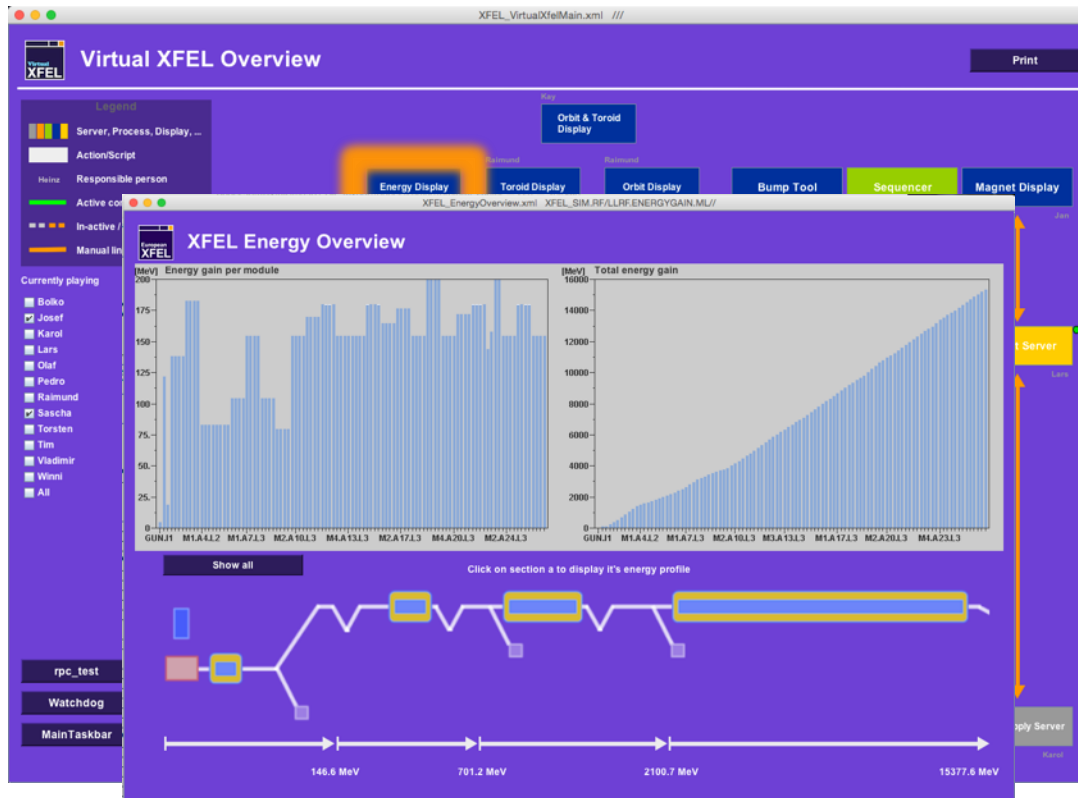
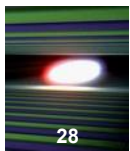
The virtual XFEL – Bunch pattern handling



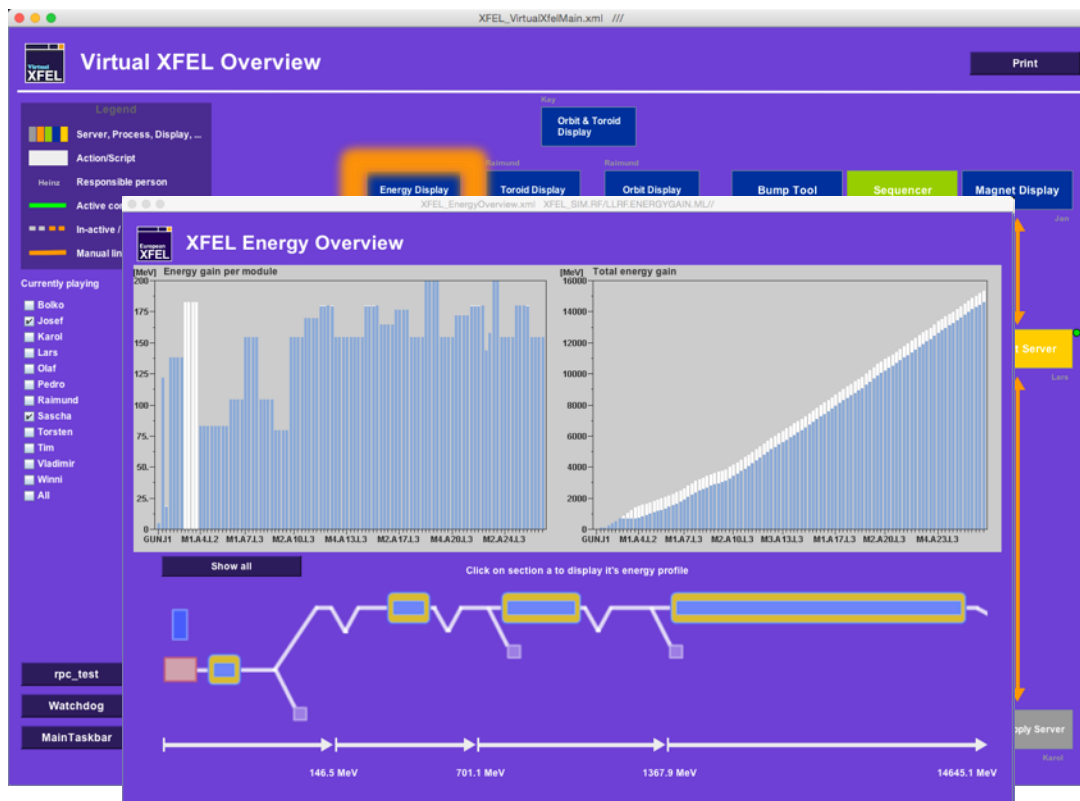
The virtual XFEL – LLRF



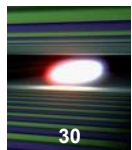
The virtual XFEL – LLRF



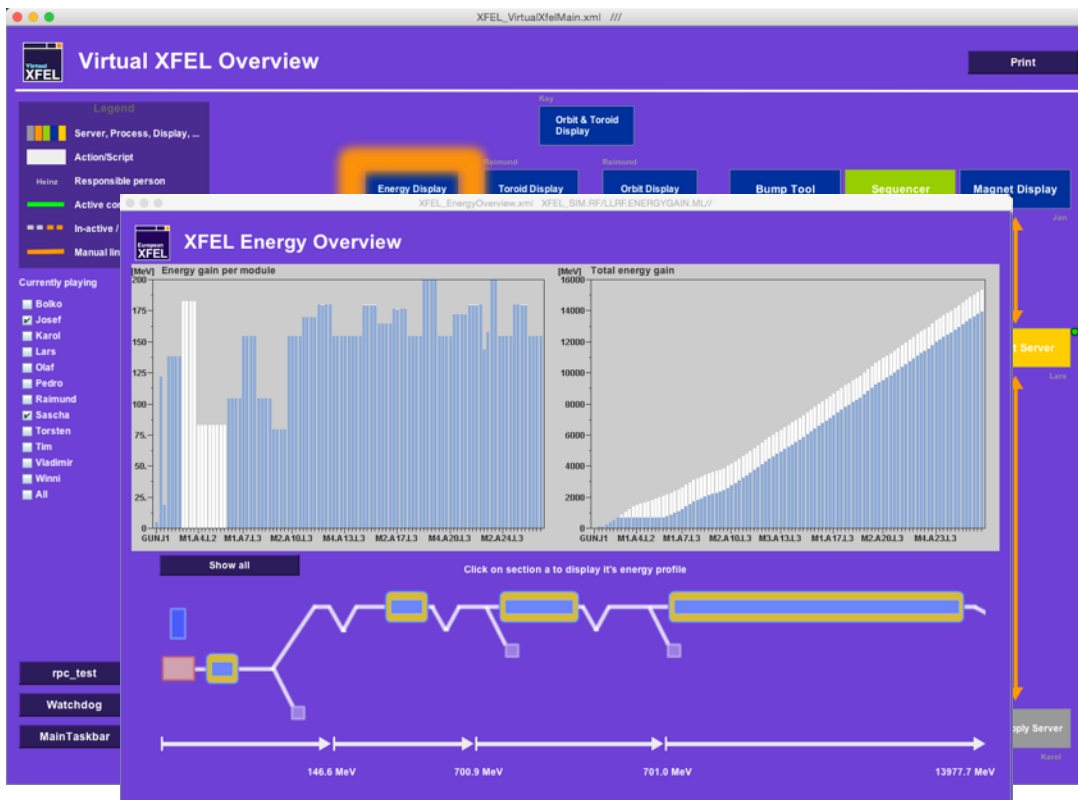
The virtual XFEL – LLRF

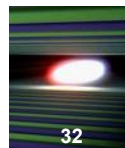


The virtual XFEL – LLRF



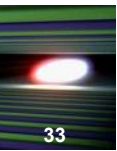
The virtual XFEL – LLRF





- The VXFEL **allowed** us to:
 - Test the **network** and **data throughput**
 - Tests of the **Timing System** and **Bunch Pattern Handling**
 - Is a test bed for all **High Level Software**
 - Test **naming conventions** and prepare server **configurations**
 - **Port** software from the VXFEL **1:1** to the XFEL
 - Develop and test **display concepts and displays**
 - ...

- The VXFEL **does not** or only partly allow to:
 - Test **hardware**
 - Do **physical simulations**



- **Started as pure test** for data throughput
- **Turned out to be vital tool** for testing much more aspects of the software
- Even further proved to be an essential tool for **development of GUIs**
- Allows to some extend **physics experiments**

→ **VXFEL got it's dedicated hardware and will be kept running!**

Thank you for your attention!