



The Virtual European XFEL Accelerator

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

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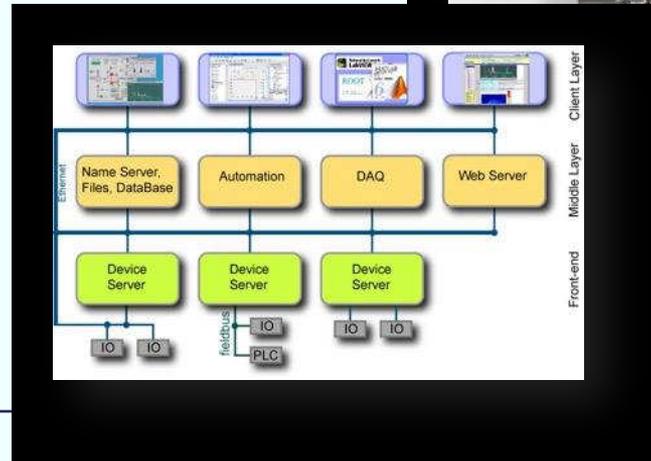
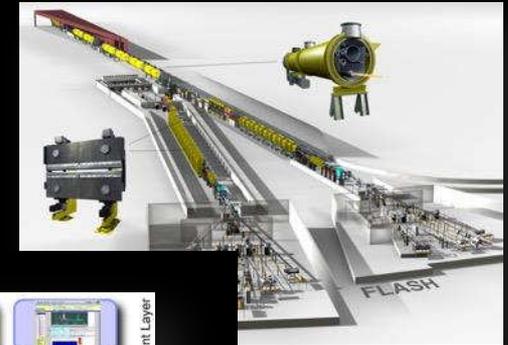
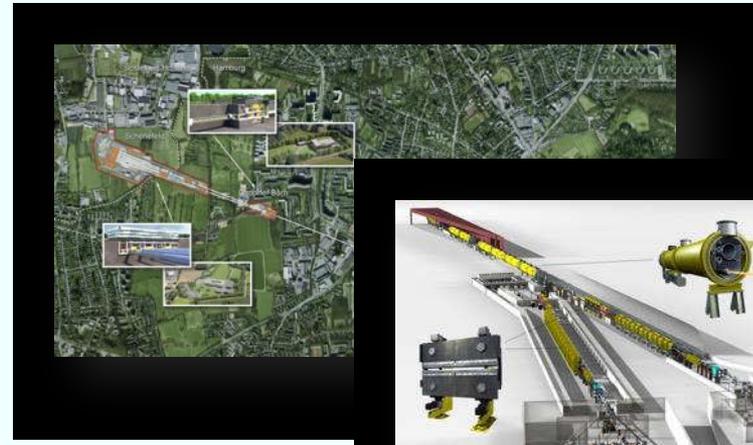


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Can **not** talk about:

- 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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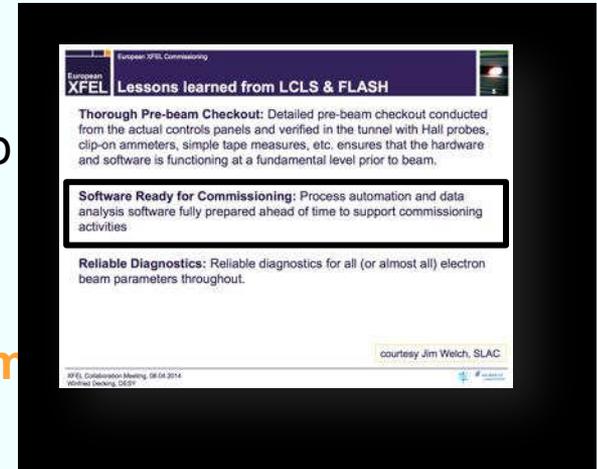
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■ FLASH is the *little brother* of XFEL

- 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 but ...

The screenshot shows the website for the European XFEL Pilot Facility FLASH. The main heading is 'ENLIGHTENING SCIENCE'. Below it, there's a navigation menu with options like 'Overview', 'Research', 'Construction progress', 'Gallery', 'News, events', and 'Information for...'. The main content area is titled 'PILOT FACILITY FLASH' and contains several paragraphs of text describing the facility. There are also two images: one showing the internal structure of the laser and another showing an experiment setup. A sidebar on the right contains a list of links including 'Overview', 'Facilities', 'Location, sites, layouts', 'Safety & environment', 'Economic impact', 'FLASH', 'DESY', 'In cooperation', 'Milestones', 'Research', 'Construction', 'Construction progress', 'News', 'Events', 'Galleries', 'Downloads', and 'Helpdesk'.

XFEL is 10 times as big!

From FLASH to XFEL

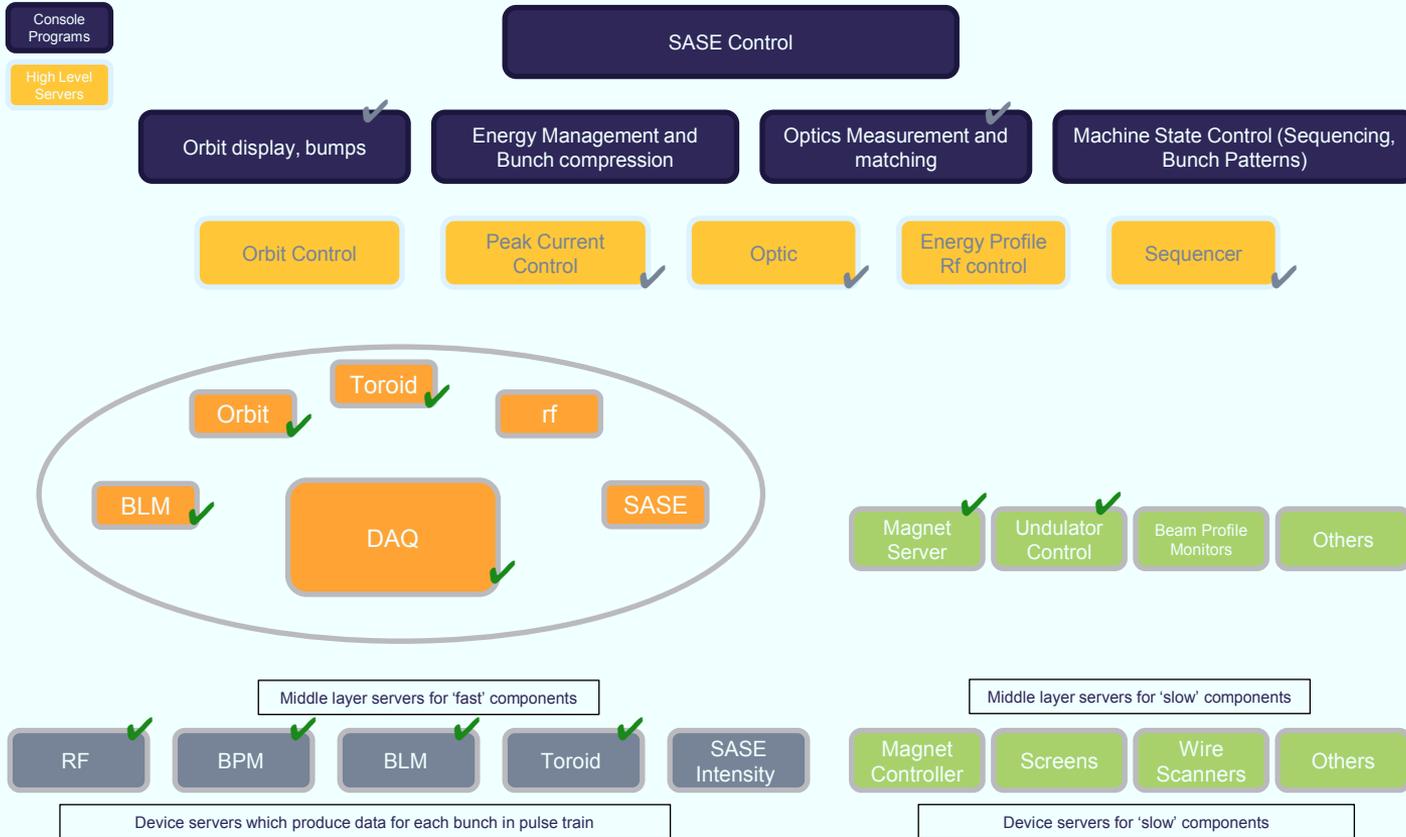


FLASH ~ 30 crates producing < 100 Mbyte/s
XFEL ~ 200 crates producing >> 100 Mbyte/s

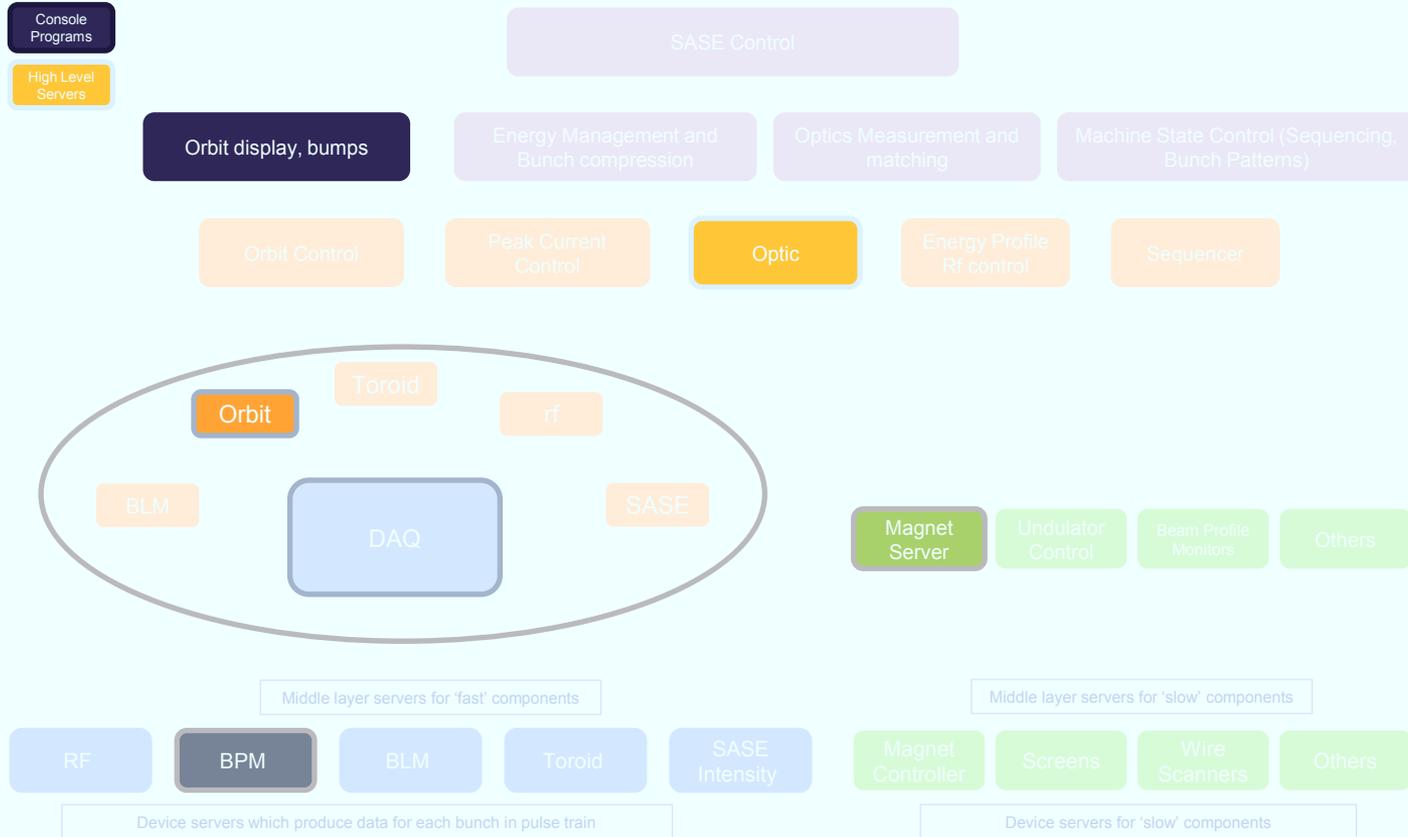
- High data rates **require data reduction**
- **Synchronize data** from various sources
- Have to think more in **physics entities**

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

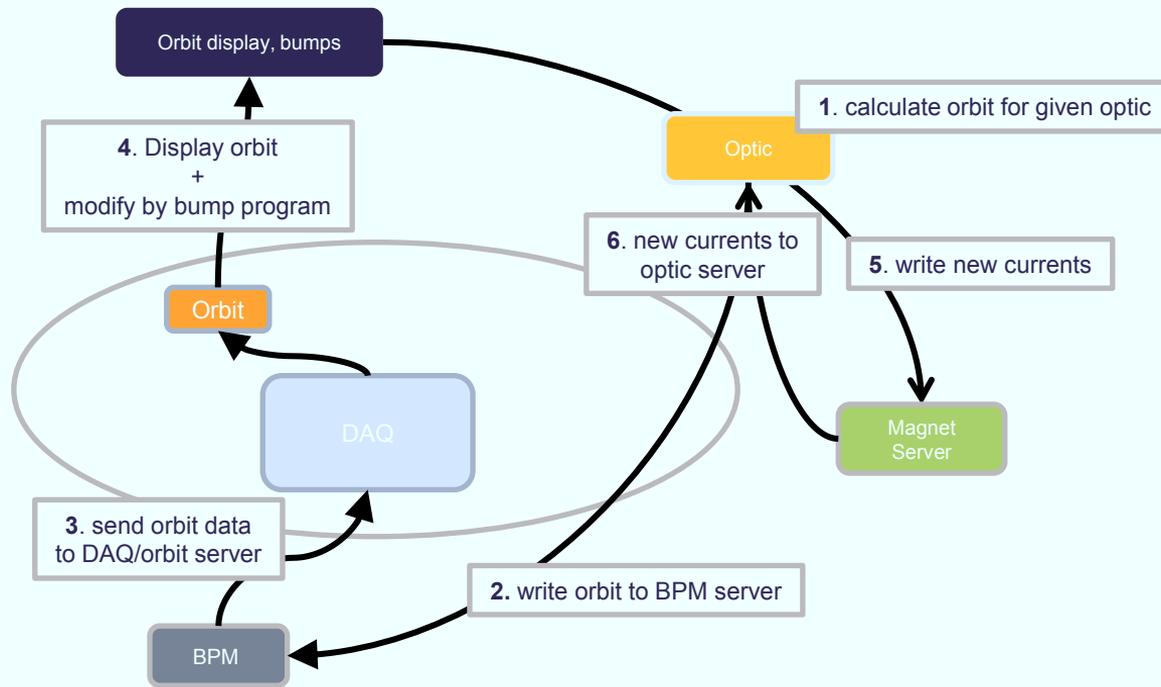
The Data Acquisition System



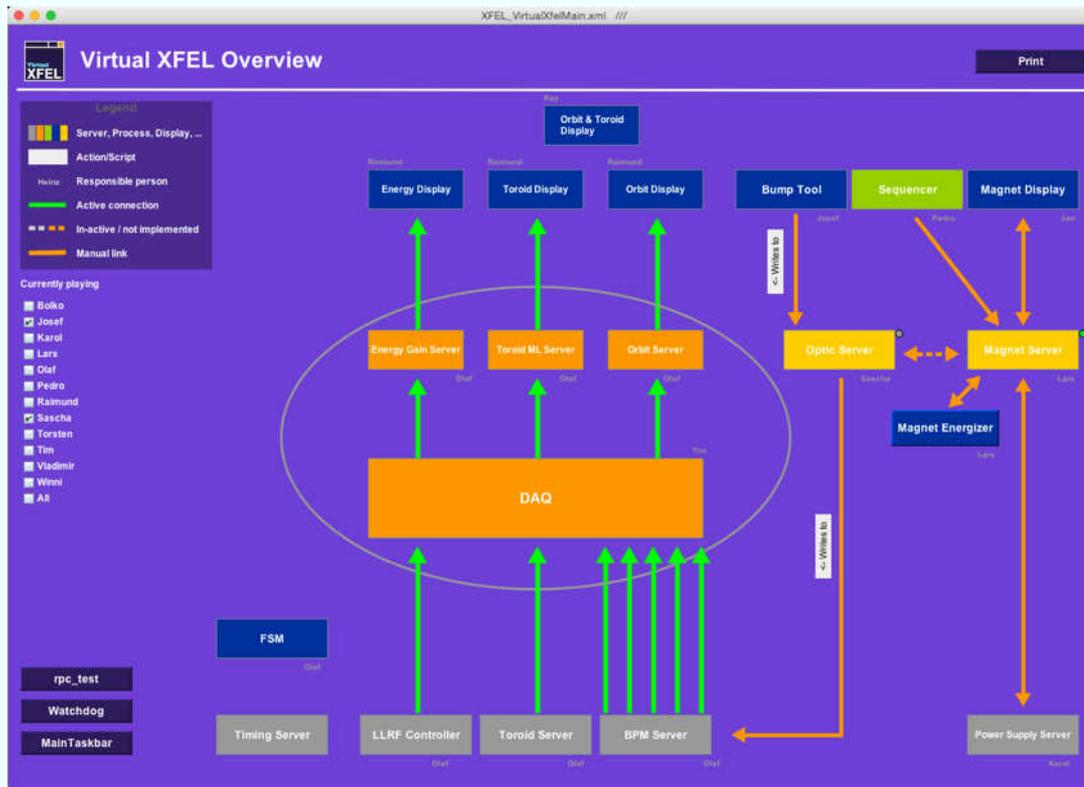
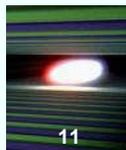
The Data Acquisition System



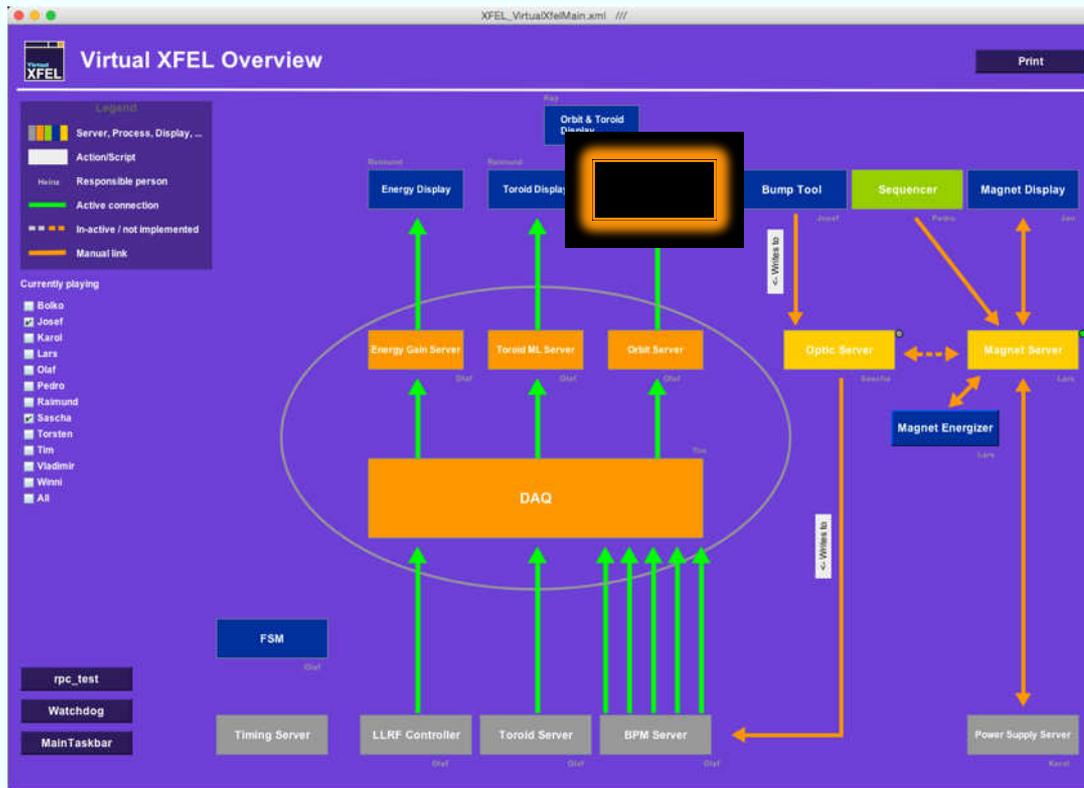
The Data Acquisition System



The virtual XFEL



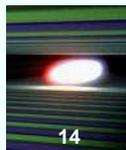
The virtual XFEL – Orbit



The virtual XFEL – Orbit



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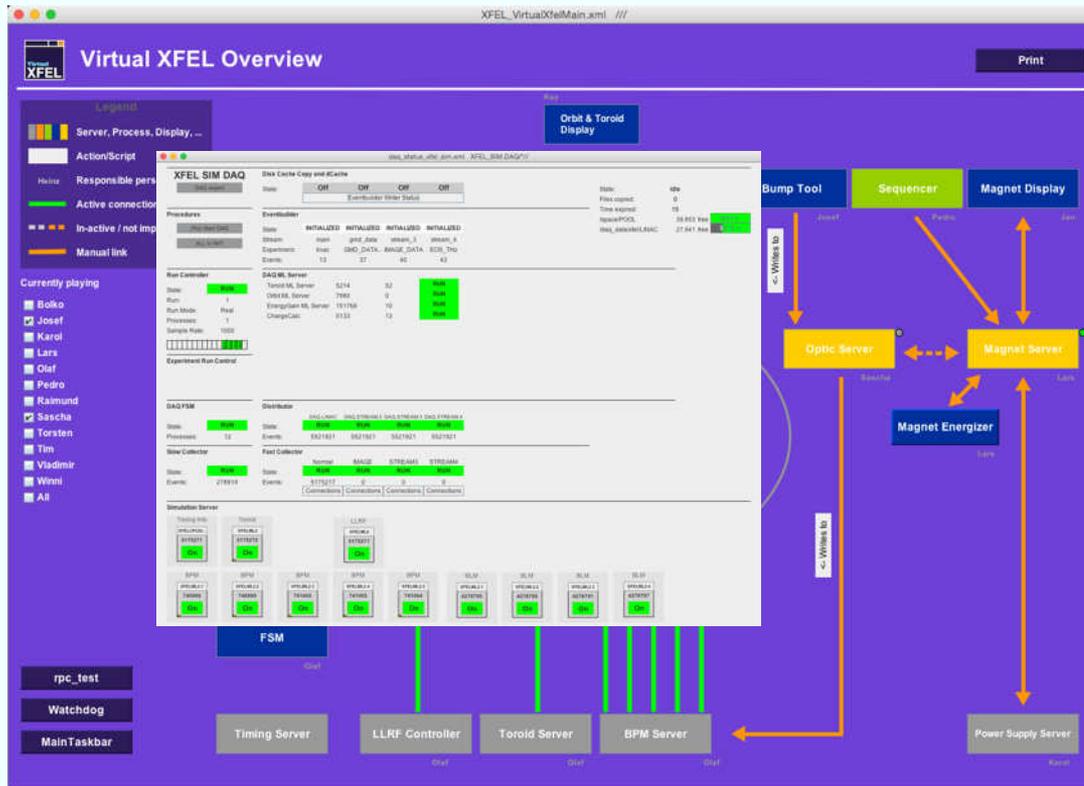
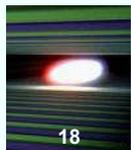
The virtual XFEL – Orbit



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The virtual XFEL – Data throughput



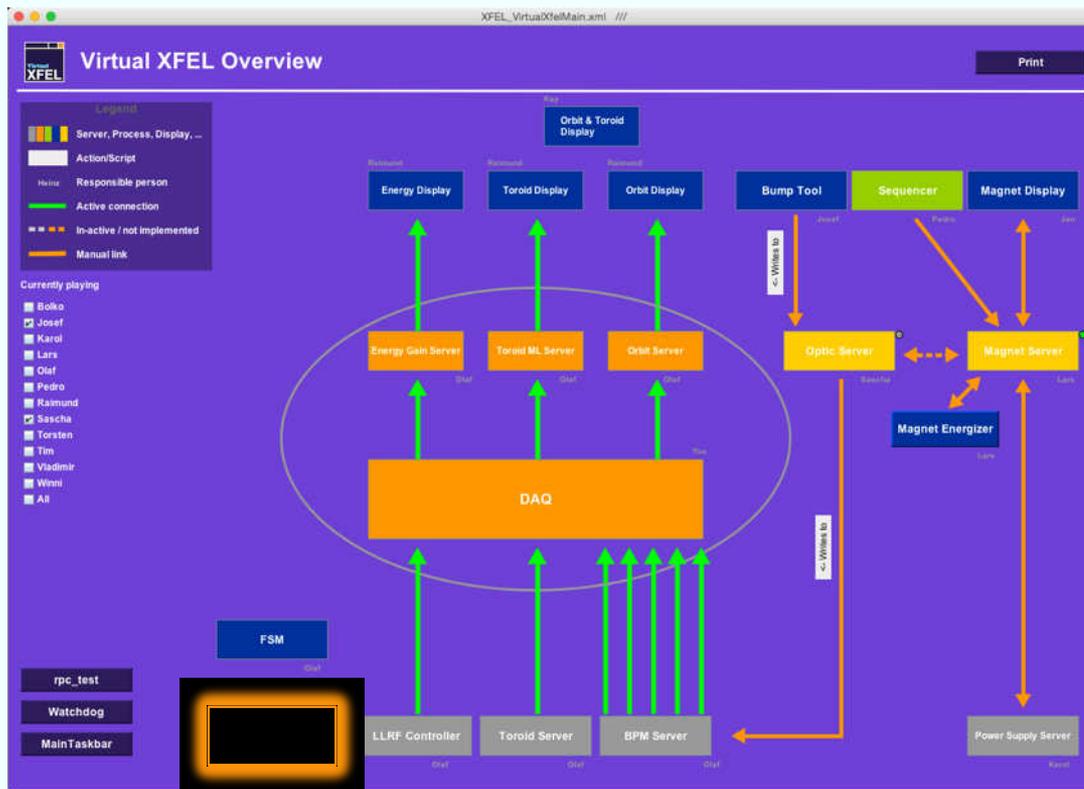
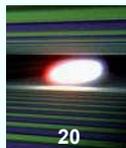
The virtual XFEL – Data throughput



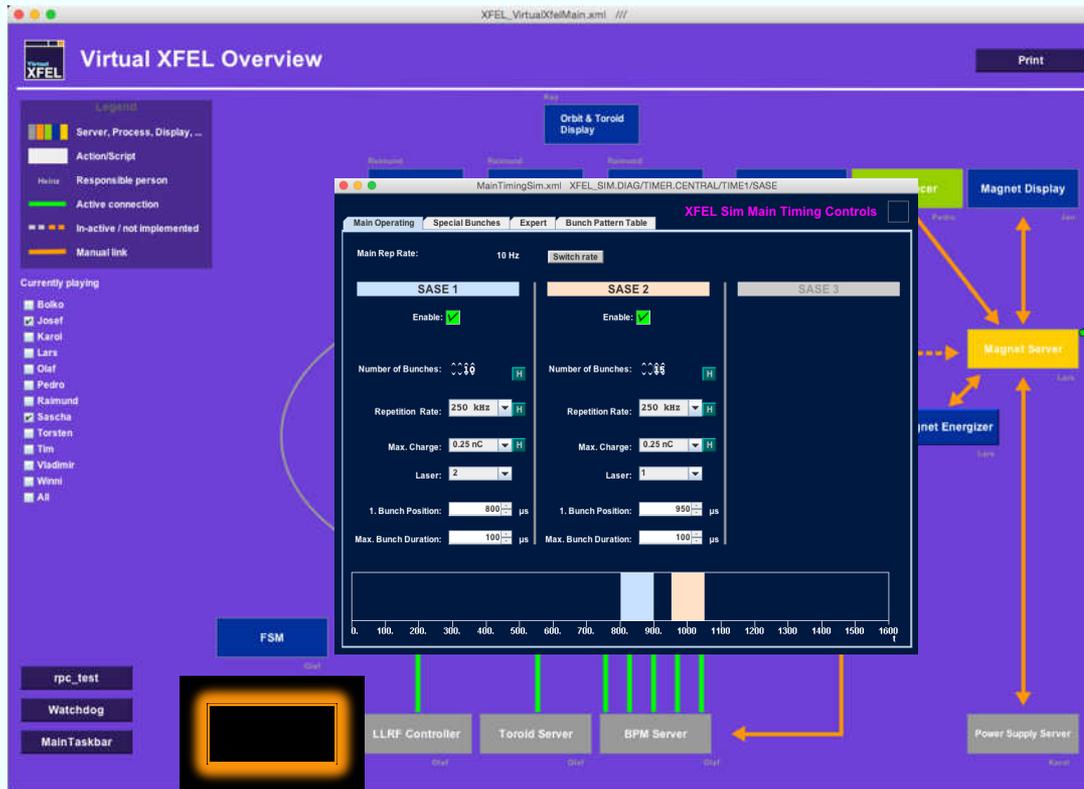
The screenshot displays the 'Virtual XFEL Overview' software interface. Key components include:

- Legend:** Defines symbols for Server, Process, Display, Action/Script, Responsible person, Active connection, In-active / not implemented, and Manual link.
- Currently playing:** A list of active components including Bolo, Josef, Karol, Lars, Olof, Pedro, Raimund, Sascha, Torsten, Tim, Vladimir, Wendi, and Ali.
- XFEL SIM DAQ:** A control panel for the DAQ system with buttons for 'Sink Data Copy and Archive', 'Status', 'Off', 'On', and 'Off'. It includes a table for 'Distributors' and 'New Collector'.
- XFEL DAQ Status:** A monitoring window showing 'Node Input Rate (MB/s)' and 'Node Output Rate (MB/s)' graphs, along with 'Data Directory' and 'Free Space (TB)'.
- System Configuration:** A window showing system details for 'eth11', including IP address, netmask, and broadcast address.
- Control Panels:** Buttons for 'rpc_test', 'Watchdog', 'MainTaskbar', 'Timing Server', and 'LLRF Controller' are visible at the bottom.
- Navigation:** Buttons for 'Orbit & Toroid Display', 'Bump Tool', 'Sequencer', and 'Magnet Display' are located on the right side.

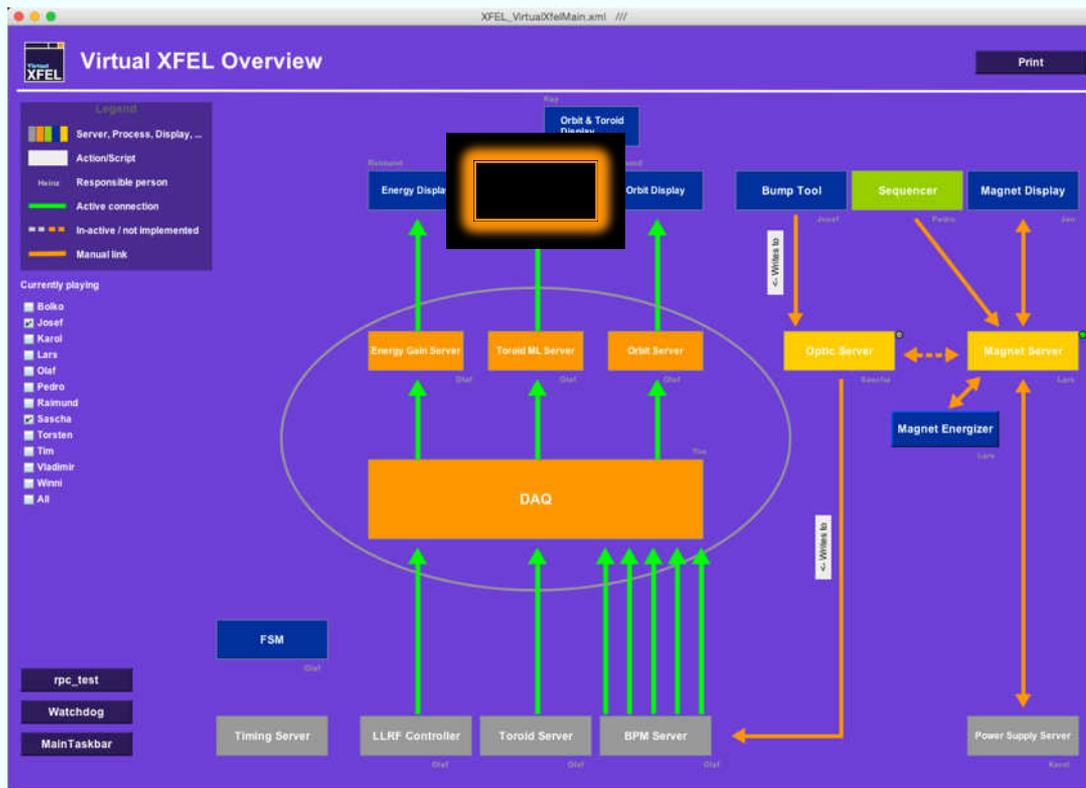
The virtual XFEL – Timing



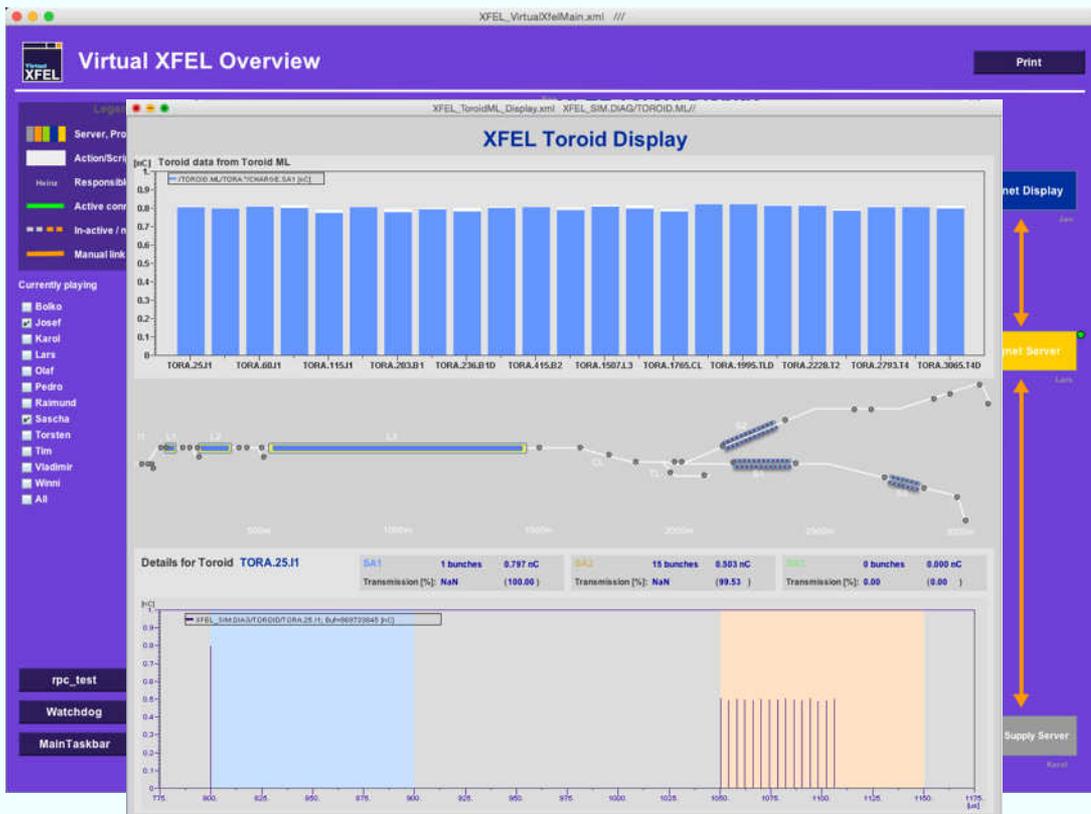
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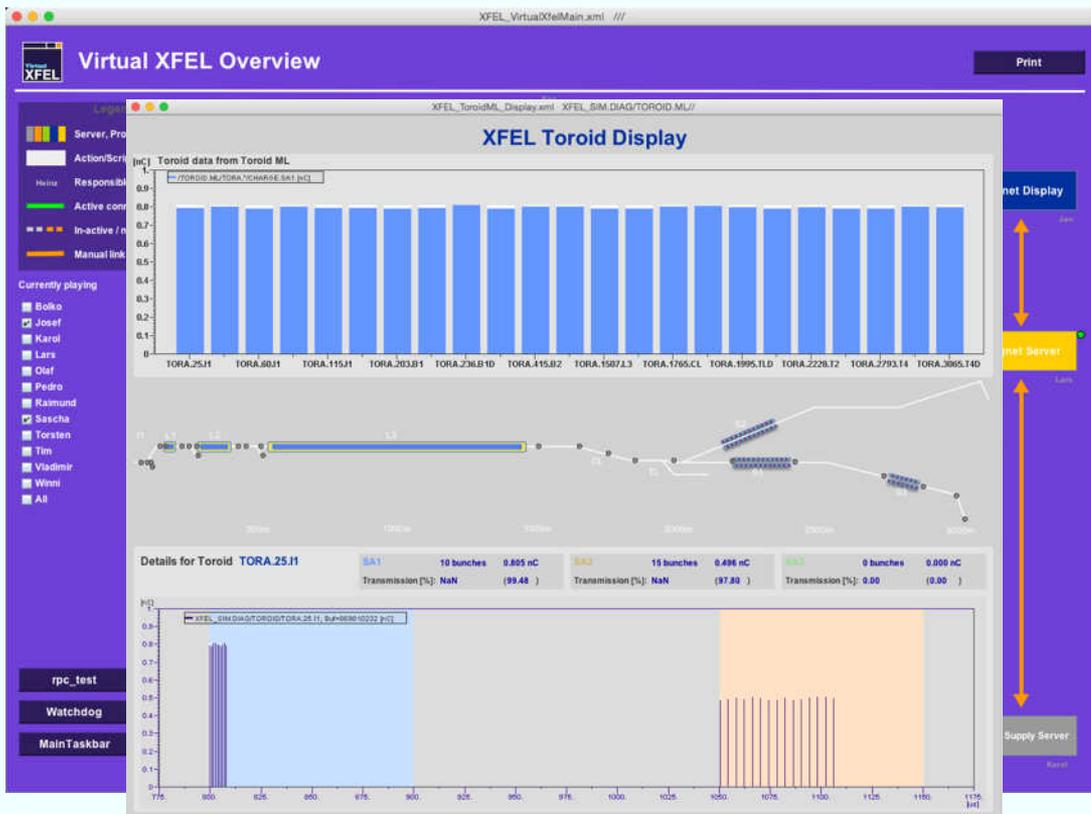
The virtual XFEL – Bunch pattern handling



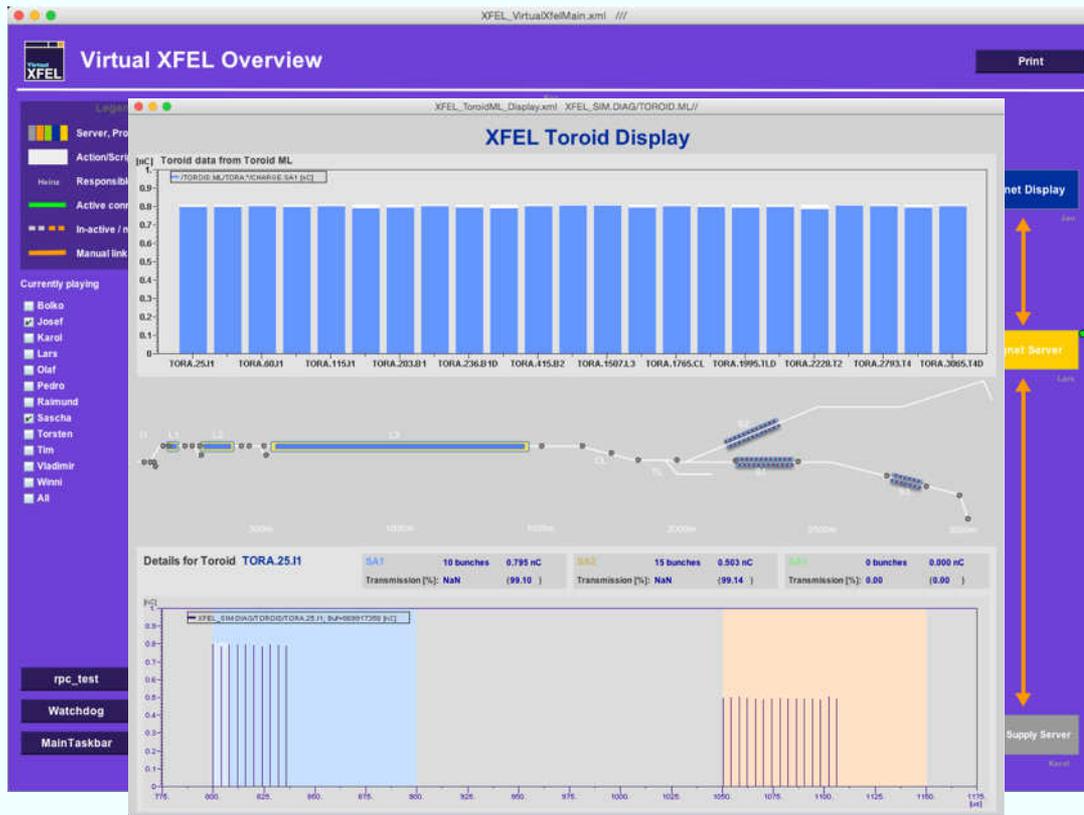
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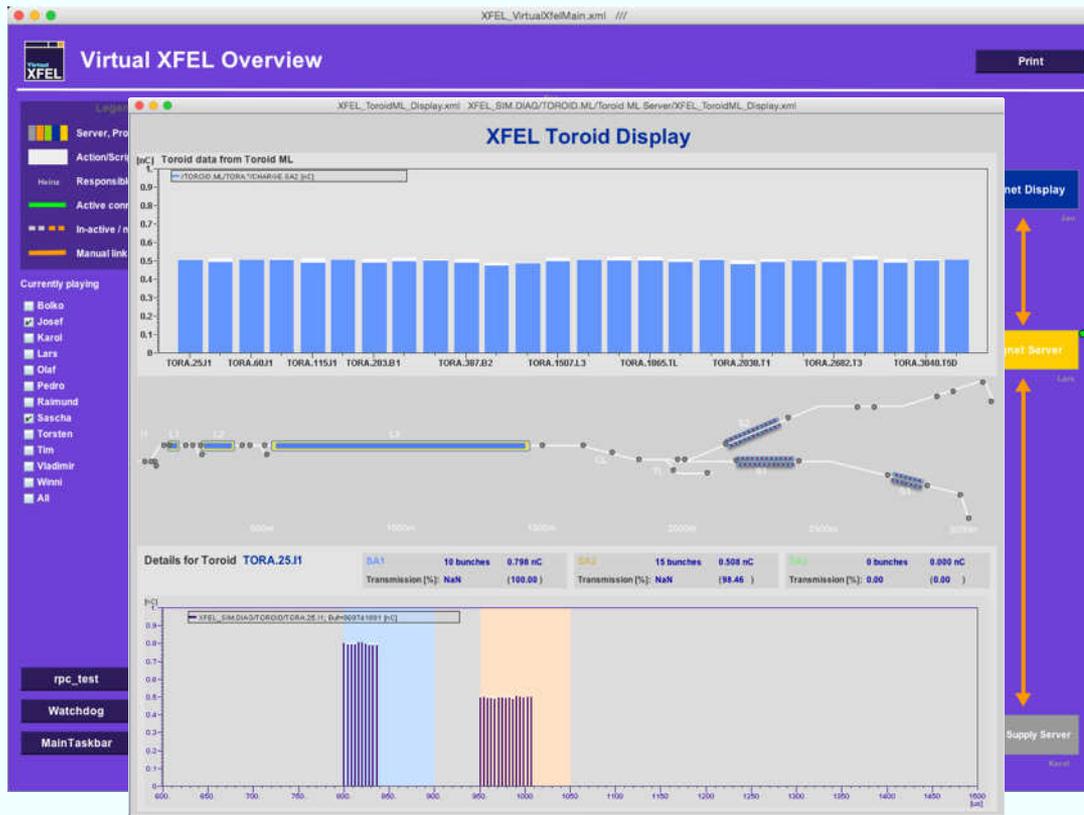
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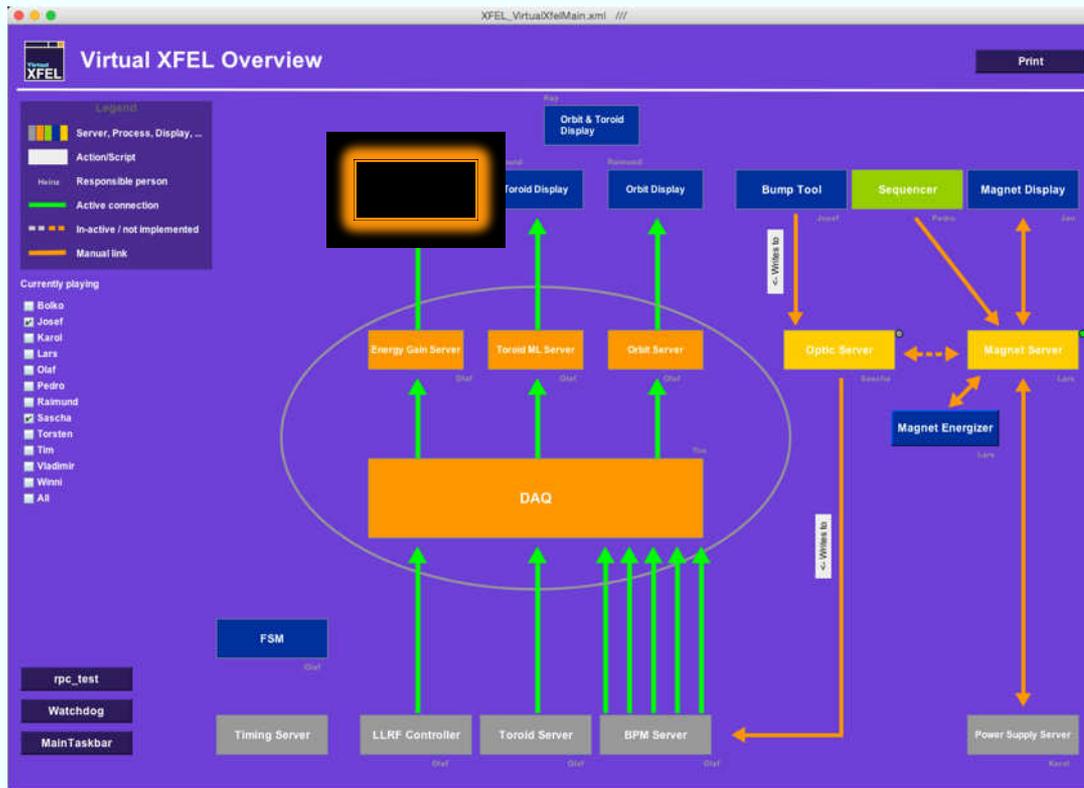
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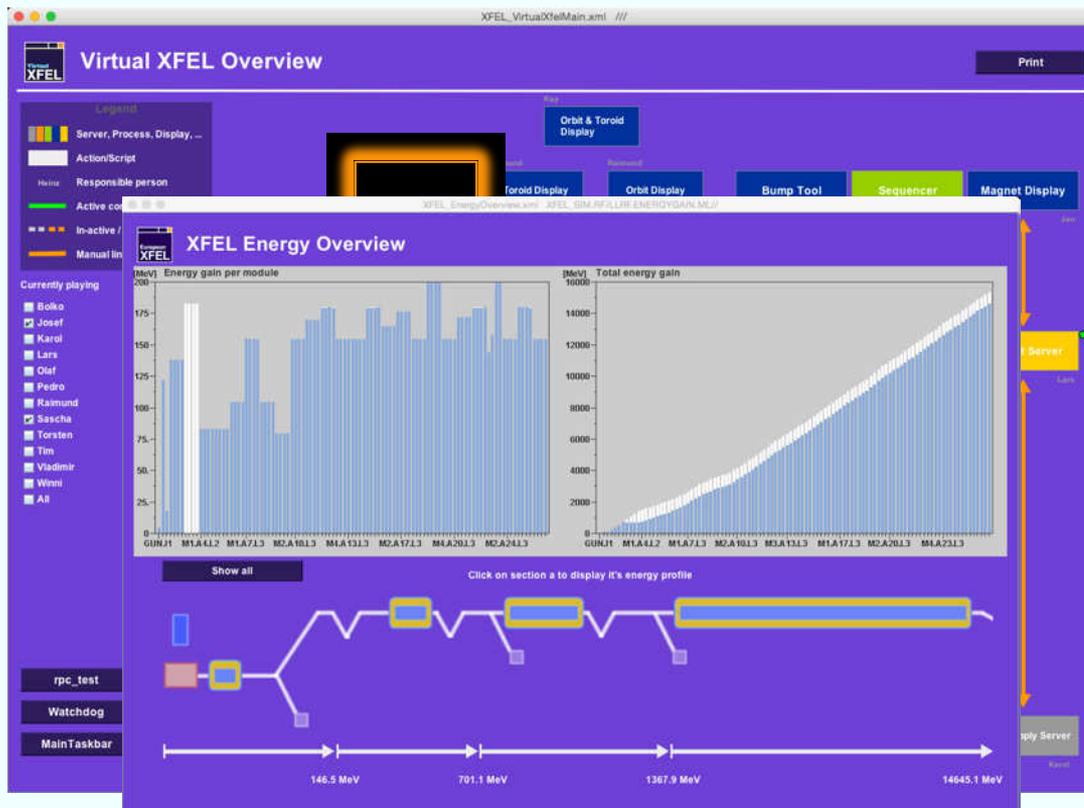
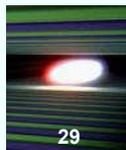
The virtual XFEL – LLRF



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!