Overview of Future Projects

Outline

• HVF 2015+
• Accelarator Research and Development
• Future LLRF projects

Dr. Holger Schlarb
MSK, DESY
13.05.2014
Helmholtz Validierungsfond
“MTCA.4 for Industry”
- Establish MTCA.4 electronic crate system in:
  - the accelerator community
  - various industrial sectors
  - the scientific community

  by reducing the *market entry barriers* and foster MTCA.4 to industry

- Build consortium: **Funding 3.9 Mio€**
Status 01. 04. 2014

Cooperation partners

• **Original HVF Consortium (7):**
  - ELMA
  - Schroff
  - AMPEigon
  - struck innovative systems
  - TEWS
  - AD-TE-C

• **New Partners (6):**
  - INTERFACE CONCEPT
  - eicSys GmbH
  - COSYLAB
  - powerBridge
  - CAEN
  - SINTEC

• **Negotiation phase (7):**
  - vatech
  - HARTING
  - kontron
  - IOXOS
  - WIENER
  - Laurin AG
Helmholtz Validation Fund - Work Packages

AP1: RF control system in MTCA.4
AP1.1 Revision of existing modules
AP1.2 Cost opt. for Single Cavities Applications
AP1.3 Extending Portfolio in Frequency
AP1.4 Supplementary systems for RF control
AP1.5 Introduction of RTM-RF Backplane

AP2: Completion of MTCA.4 for industry and institutions
AP2.1 Extension of product portfolio for MTCA.4
AP2.2 EMI optimization and classification of MTCA.4 components
AP2.3 Application of MTCA.4 in industry
AP2.4 Evaluation of MTCA.4 market
AP2.5 Integral test of MTCA.4 in large facility, failure analysis

AP3: Support and consulting for industry and institutions
AP3.1 MTCA.4 support and consulting
AP3.2 MTCA.4 users guide
AP3.4 Products marketing & information (Webpage/Exhibition/Workshops)

4x10 Gbps
Helmholtz Validation Fund – 2015 beyond

DESY

MTCA.4 Innovation Lab

DESY Groups: TT, MSK, …

- Service & Maintenance Licensed Board / MMC
  (External for Industry and Institutes)
- EMI Laboratory
  (Service internally / external)
- Industrialize future MTCA.4 modules for market
  (DESY developments)
- Forward development of MTCA.4 standard and modules
- Training, Service und Support
- Network Events
  (MTCA/Interoperability-WS)
- System Integration / Commissioning / User Support
  (within DESY)

Funding

- Acquisition of third party funding
- DESY Baseline Fundung
- License fee

Spin-offs

GmbH associated to DESY

DESY Technology Centre

- Cryotech
  Service Group
- Detector Developments
- Material Processing Service Group
- …
  Service Group
- Synchronization / Laser Optics
  Service Group
- MTCA.4 Service Group
  - Test and Certification
  - Development contract
  - Service and Support
  - R&D- Cooperation
  - Third party Acquisition
  - Consulting

Measurement, Controls, Communication Systems

Start this year

2015-2016… beyond

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Accelerator Research & Development (ARD) Program

2015 – 2019

(1) Superconducting RF Technologies  →  MSK
(2) Hadron accelerators
(3) Ps and fs Electron and Photon Beams  →  MSK
(4) Plasma acceleration  →  MSK
• CW operation for European XFEL

+ strong Link to HZDR / HZB
- RF control towards sub-femtosecond stability
• Technology transfer MTCA.4 / LLRF / Controls / high speed Feedback Algorithm

Generic software architecture:

- Board Support Package
- Firmware
- Register Map
- Driver
- Mapping Library
- C++ Device API
- Control System Tools
- LLRF Library
- C++ LLRF API
- Open Source
  - Driver
  - Base API
  - Hardware Monitor
  - Control System Tools
- Closed Source (example)
  - Low Level Radio Frequency (LLRF) control library for the accelerator
- Servers
  - Control system dependent

ARD - ST3: Pico- and fs Electron and Photon Beams
**ARD - ST3: Pico- and fs Electron and Photon Beams**

- **CW optical synchronization**

Appropriate scheme for large distances and facilities with mainly RF stations
⇒ XFEL upgrade of main linac
⇒ ILC
⇒ SINBAD (see talk from R. Assmann)

Scheme of the synchronization reference distribution

**R&D by:**
J. Frisch, NLC  
K. Czuba, TESLA  
T. Naito, ILC/ERL

**Renaissances:**  
PSI&I-TECH (SwissFEL)

**Goal:**  
Jitter < 10 fs rms  
Drift < 50 fs pkpk  
Costs < 10k/link (x5)  
fully integrate MTCA

**New:**  
- remove link actuator  
- use fs 360deg phase detector  
- only digital correction
ARD - ST3: Pico- and fs Electron and Photon Beams

- Pulsed optical synchronization system
ARD – ST4: REGAE precision synchronization

- RF Interferometer
- LLRF Single cav.
- L2RF@800nm
- RF Cavity
ARD – ST4: FLASHForward

Improvement LLRF, Upgrade Synchronization, Large bandwidth NRF Cavity FB

Beam and/or Laser driven Plasma Wake Field Acceleration

Broad band Long. FB

Design and Integration of NC cavity

2015-2016

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ARD – ST4: SINBAD > 2016

Laser / Synchronisation / Stabilisation Systems

**Compact Atto-Second Light Source**
50 as, ICS
ERC Synergy Grant 14 M€, DESY, Uni HH, Arizona

**Ultrashort electron pulse**
< 1 fs with conventional technology
ARD, DESY, Uni HH, KIT

**Develop ability to use plasma acceleration, scalability**
> 1 GeV/m, useable beam quality, FEL?
LAOLA, ARD, DESY, Uni HH

**Room for further phases and users**
Third party funding, interest from ELI, ...

Footprint: 90 m x 50 m
Excellent integration into DESY accelerator park!

1 GeV allows FEL studies, seeding, ... in DORIS, outside of user’s operation.

Shows enormous potential of DORIS für accelerator R&D!

PIA allows positrons \(\rightarrow\) needed for collider applications (HEP)!

Must address RP aspects in transfer tunnel below building 30.

Mayor LLRF Upgrade: first evaluation autumn 2014
LLRF Projects

2014 – 2019
LLRF Projects

**FLUTE**: 2 Systeme (S)
- Bunch compressor
- Linac 3 GHz: ~5.2 m
- Laser mirror
- CTF3 Laser gun

**ELBE**: 6 Systeme (L)
- Beam diagnostics

**BERLinPro**: 7 Systeme (L)
- Linac design

**Candle**: 2+1 Systeme (S)
- Armenia

**ESS**: 218 Systeme
- Lund

Synergien mit ARD Programm

**DESY**: Potential candidate for building LLRF system
- 2016-2024

www.ess-scandinavia.eu
Summary

• Significant number of future projects will keep us extremely busy…

• Primarily application of developed hardware

• Mayor part relates Firmware & Software

• System design / Commissioning / Operation / Maintenance