Cosylab Switzerland and SKA

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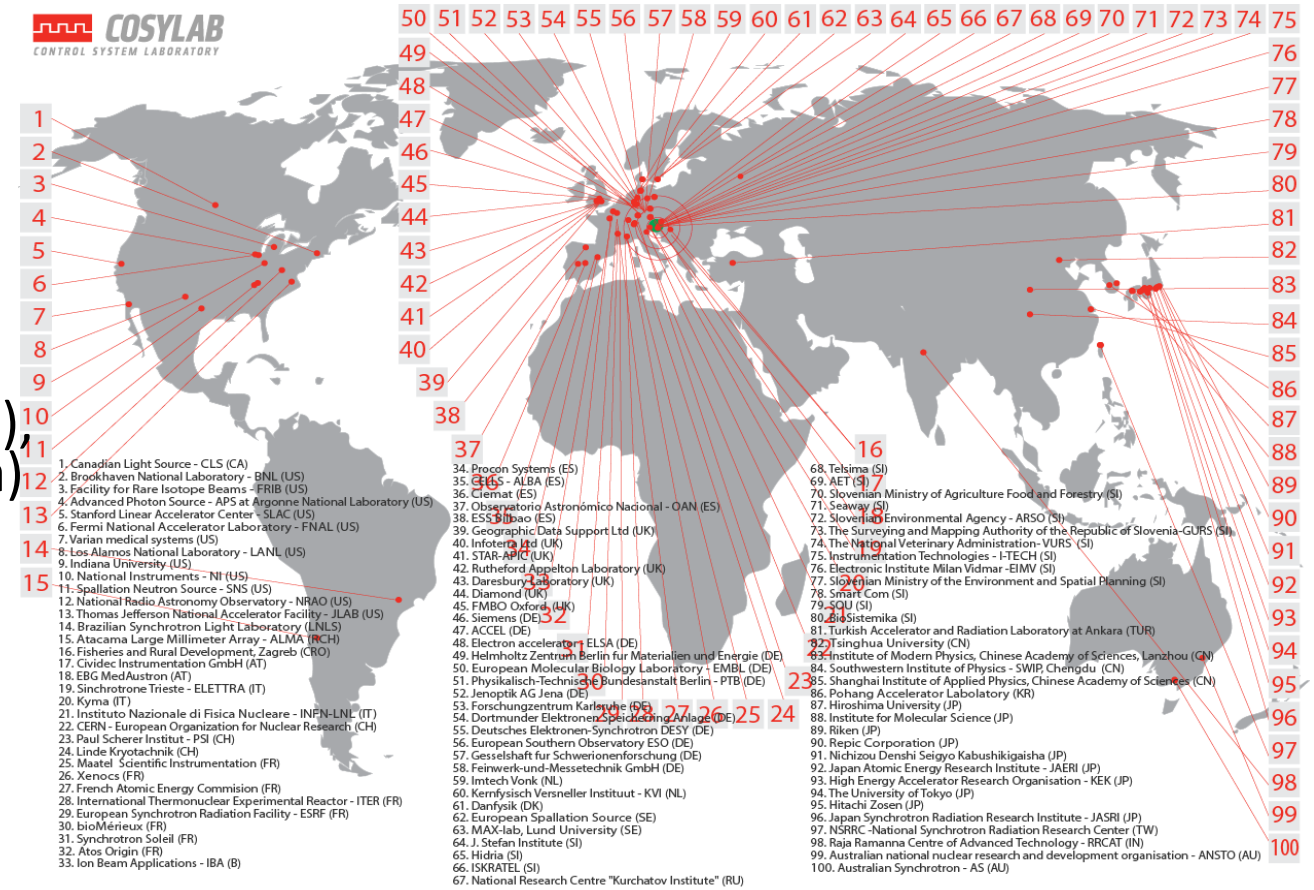
Cosylab in short

- Innovator and global leader in software for the world's most complex, precise and advanced machines
  - Particle accelerators, nuclear fusion, radio-telescopes
  - Atomic force microscopes, real-time seed classification
- Founded in 2001. Now 200 people (160+ FTE engineering)
- HQ in Slovenia with branches and teams in **Switzerland**, Sweden, South Korea, Japan, USA, China
- Reliability, PA/QA, careful integration
  - **ISO 9001** Quality management systems - Requirements
  - **ISO 13485** Medical devices - Quality management systems
  - **ISO 14971** Medical devices - Application of risk management to medical devices

Cosylab

- World leader in **System Integration and Software** for particle accelerators for research and cancer therapy
  - 43% market share
- Selected references:
  - **Accelerators**: FAIR (Darmstadt), LHC, White Rabbit (CERN), SwissFEL (PSI), LCLS/LCLS-II (SLAC)
  - **Neutron sources**: SNS (Oak Ridge), ESS (Lund)
  - **Cancer therapy**: MedAustron (Austria), iBNCT (Japan), HIMM (Lanzhou, China)
  - **Astronomy & Astrophysics**: ALMA (Munich, Atacama Desert), ESO E-ELT (Cerro Amazones), CTA (Cherenkov Telescope Array)
  - **Fusion**: ITER (Cadarache)



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- People: 13 FTE
  - 2 computer scientists
  - 7 electronic engineers
  - 4 physicists
- Sites:
  - Park InnovAare PSI West, Villigen (main office)
  - Meyrin (Geneva)
- Projects:
  - SwissFEL, SLS, PANDA at PSI
  - Proton therapy for cancer treatment
  - QualySense (industrial)
  - Space
- Focus:
  - Control systems
  - Integration & synchronization of heterogeneous devices
  - Fast real-time control, synchronization
  - SW engineering

The SKA and its challenges

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The technological challenges

- Complexity
  - Biggest radio telescope up to date
  - Long baseline interferometer arrays
  - Data from clusters of single telescopes / antennas sent around the globe
  - Enormous amount of data to be processed
- Telescope management
  - Equipment orchestration
  - Monitoring
- Data handling – (~300PB/year)
  - Transfer across globe
  - Storage in data centers
- Computational needs – ~300 PFlops
- Time synchronization and event correlation
  - Local cluster synchronization and proper event time-stamping – at the cluster processor
  - Global time synchronization & correlation

The organizational challenge

From http://ska-sdp.org/sites/default/files/attachments/overview_of_ska_project_and_current_status_1.pdf

The longevity challenge

- Construction
  - 5 years construction (SKA1)
  - + 7 years (SKA2)
- Decades of operations

Careful planning and choice of technological solutions, upgrade strategies and application (software) life-cycle management is essential

Relevant Cosylab experience

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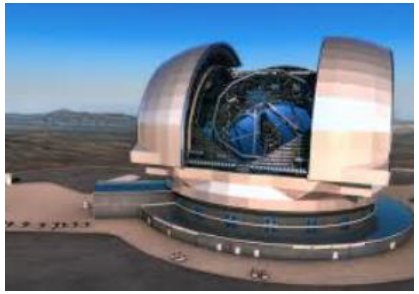
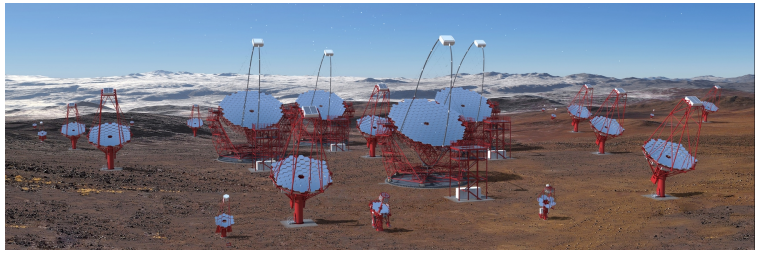
Astronomy and astrophysics

- ALMA Common Software
  - Largest operational radio telescope in the world
  - Cosylab was the sole contractor
  - Cosylab designed and developed the ACS jointly with ESO

- ESO E-ELT Core Integration Infrastructure Software – **ongoing**
  - Largest optical telescope in construction in the world
  - Next-generation core telescope software framework
  - Ongoing project at ESO



- Cherenkov Telescope Array – **ongoing**
  - Initial SW distributions
  - SW development infrastructure, conventions, manuals and process
  - SW development life-cycle guidelines



TANGO chosen for SKA

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A free, open source and object-oriented **Distributed Control Systems framework** used in large scientific facilities (accelerators, wind-tunnels, high power lasers)

- SOLARIS Synchrotron, Poland
  - Cosylab provided the complete accelerator CS turn-key
  - and 2 turn-key Tango/Sardana based beam-line control systems
- MAX IV Synchrotron, Sweden
  - Cosylab provided various sub-systems
    - Example: motion based control for undulators
- ONERA wind-tunnels, France
  - Cosylab provided control system for sub-systems
- NICA - **N**uclotron-based **I**on **C**ollider f**A**cility, Dubna, Russia
  - Cosylab is providing a complete turn-key Tango based ion beam-line control system

Timing & Synchronization

- Event based & time distribution systems experience:
  - Micro Research Finland (MRF) Event Based systems used on particle accelerators
    - European Spallation Source, PAL-XFEL, Solaris, MedAustron, etc
  - IEEE 1558 Precision Time Protocol
    - As used by ITER TCN sub-system
  - CERN WhiteRabbit time distribution
    - Cosylab is delivering the custom developed, open-hardware Timing boards for the GSI FAIR project, based on the CERN WhiteRabbit technology
    - Cosylab provides FESA framework integration of the hardware
  - GPS synchronized timestamping and clock signals
    - At many accelerator facilities the timing clocks are GPS synchronized
    - Example reference project, the timing system at MedAustron
- Ready for the next challenge!

The organizational & longevity challenge

- ITER CODAC (Control, Data Access and Communication) use-case
  - https://www.iter.org/mach/Codac
  - Since 2009 Cosylab has been contracted by ITER to **engineer, maintain & evolve** the core software Control System framework for one of the world's largest collaborative scientific projects
- **Similar organizational challenge as SKA!**
  - ~100 organizations world-wide use CODAC to build sub-systems that will all come together at the ITER site in Cadarache, France
  - Research institutions & industry alike
- Strong emphasis on:
  - Standardization, both of software distribution and hardware catalog
  - Well defined and documented processes
  - Complete life-cycle management
  - Obsolescence planning
  - Documentation, training materials and hand-on training workshops
  - User support (engineering users)
- Setting similar infrastructure for CTA now

Why SKA is important for Cosylab Switzerland

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Strategy of Cosylab Switzerland

- CSL CH's aim is to grow and achieve greater independence from HQ
  - To answer not only the unique needs of the Swiss big-science and industrial markets, but also provide cutting edge services worldwide

- Actively looking for opportunities in
  - **Core: scientific projects**
  - Core: medical applications
  - New: industrial applications
  - New: space

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- Existing competences fit SKA very well
- Long-term projects like SKA give CSL CH the opportunity to
  - Hire new experts in Switzerland
  - Leverage on HQ know-how to achieve knowledge transfer to Switzerland
  - Create dedicated Swiss team for SKA Telescope Management and Element Monitoring & Control

SKA gives CSL CH a chance to hire and train young scientists, engineers, and developers who will be at the leading edge of technology

THANK YOU!

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