



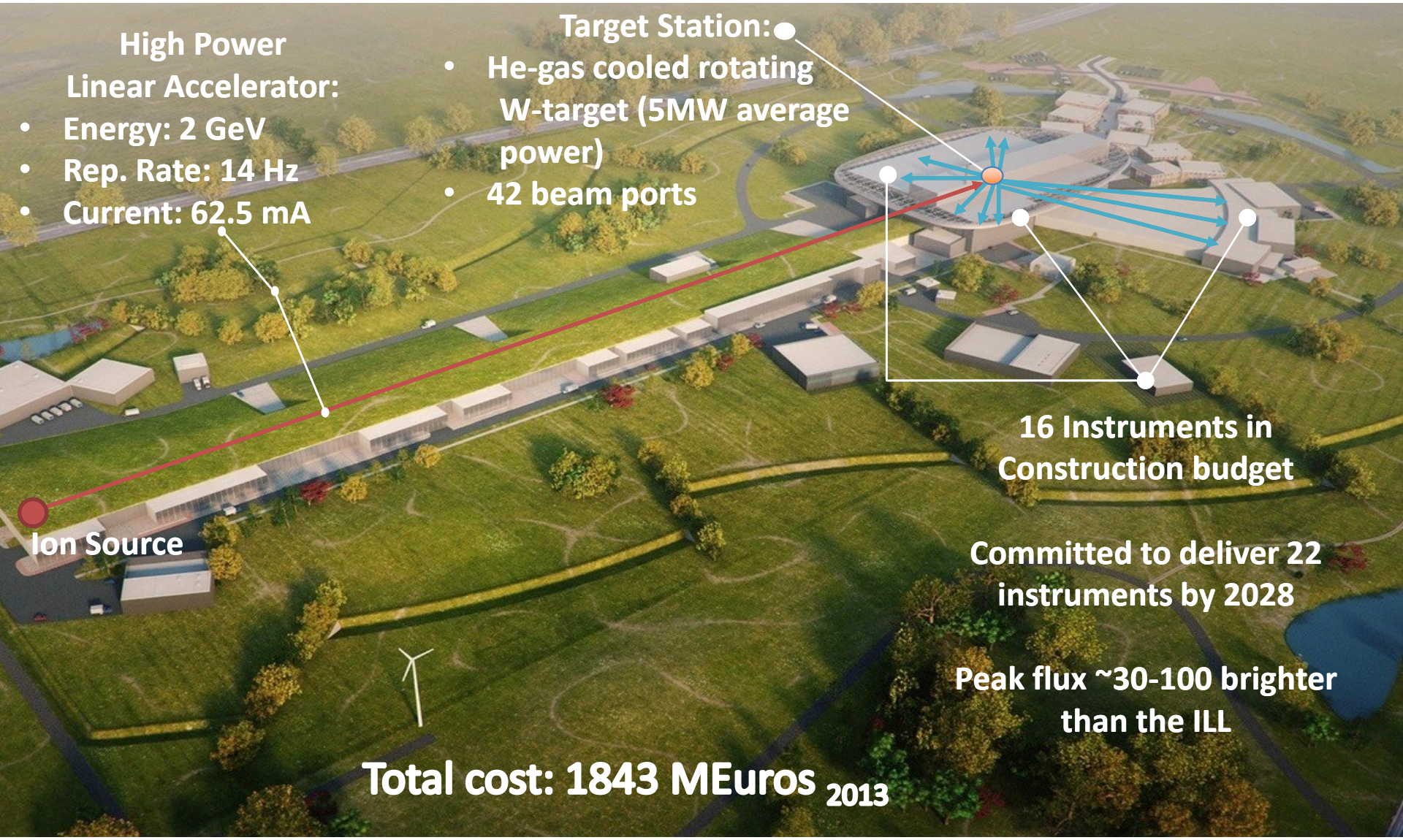
# Overview of the ESS project and the LLRF MTCA developments.

ANDERS J JOHANSSON, LUND UNIVERSITY

MTCA2017



# European Spallation Source



High Power  
Linear Accelerator:

- Energy: 2 GeV
- Rep. Rate: 14 Hz
- Current: 62.5 mA

Target Station:

- He-gas cooled rotating W-target (5MW average power)
- 42 beam ports

Ion Source

16 Instruments in  
Construction budget

Committed to deliver 22  
instruments by 2028

Peak flux ~30-100 brighter  
than the ILL

Total cost: 1843 MEuros 2013

# Accelerator Technical performances

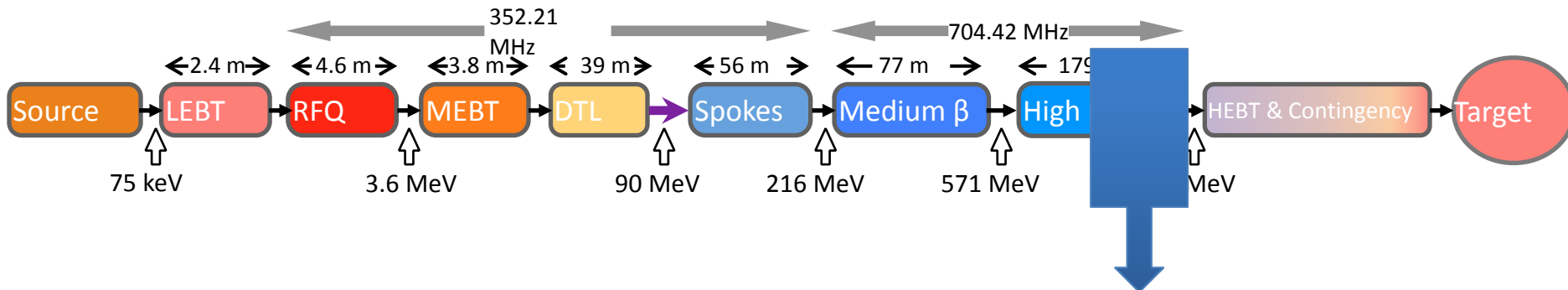
## Design Drivers:

- High Average Beam Power  
5 MW
- High Peak Beam Power  
125 MW
- High Availability



## Key parameters:

- 2.86 ms pulses
- 2 GeV
- 62.5 mA peak
- 14 Hz
- Protons (H+)
- Low losses
- Minimize energy use
- Flexible design for mitigation and future upgrades



44 RF sources for HB part is the scope contingency for accelerator -> 1.22 GeV maximum energy without them.

# Status of ESS construction



Klystron gallery and berm over tunnel.

# Accelerator Tunnel



Phase reference line under installation.

# Klystron Gallery



# Target building



# Experimental Hall





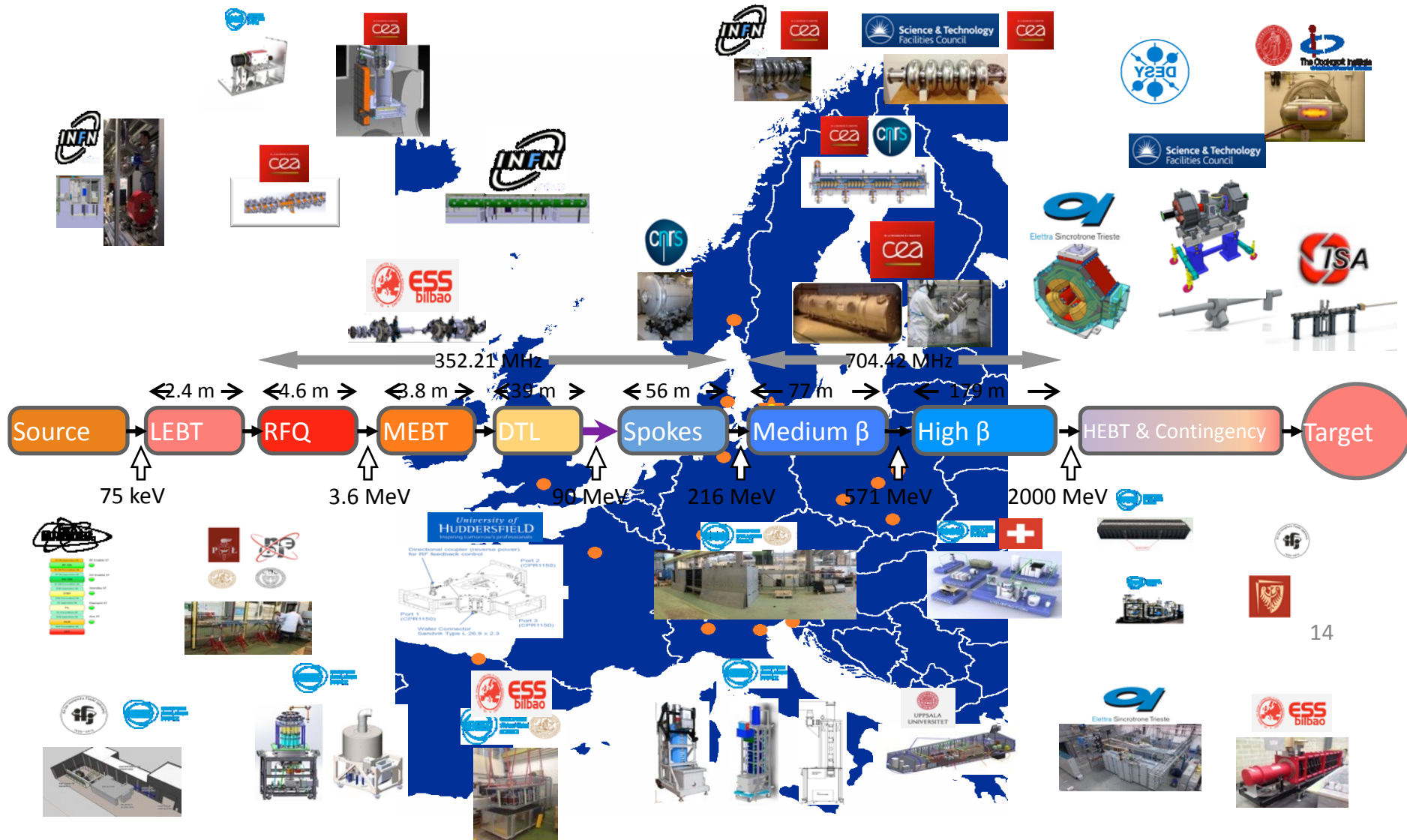
# Heavy machinery started to be installed: Kryo compressors and oil removal system



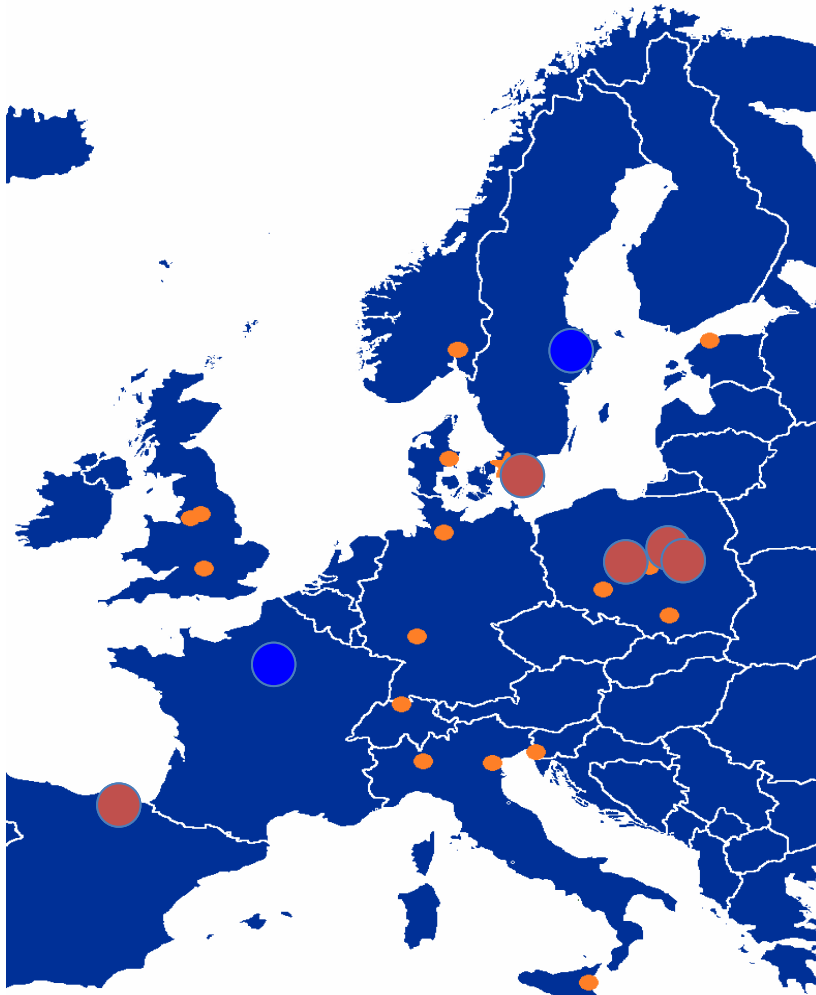
# Kryosystem Cold Box



# Accelerator Collaboration



# ESS LLRF Collaboration



## **Sweden**

ESS ERIC

Lund University

## **Poland**

National Centre for Nuclear Research

Lodz University of Technology

Warsaw University of Technology

## **Spain**

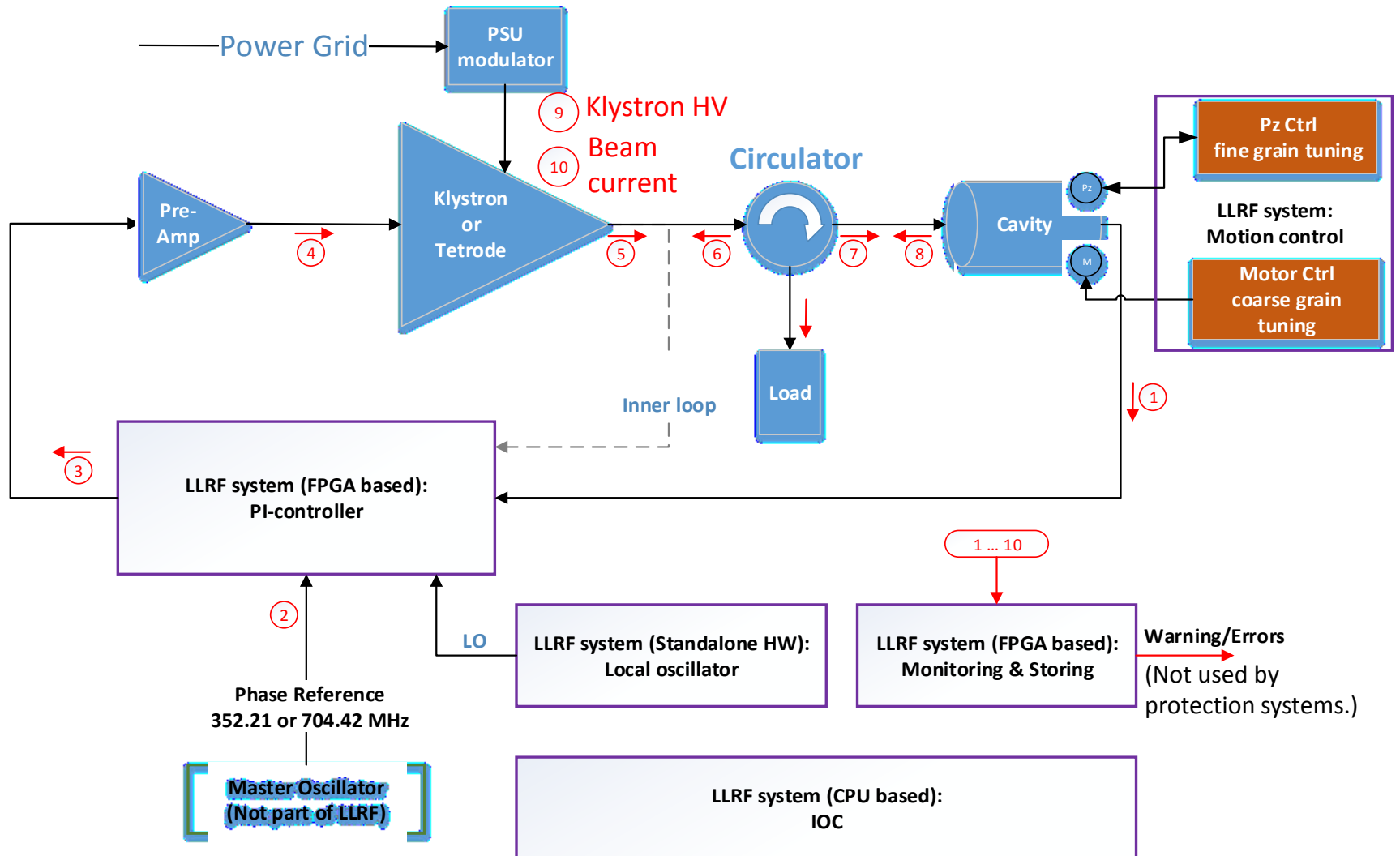
ESS Bilbao

## **Additional test labs**

Uppsala University, Sweden

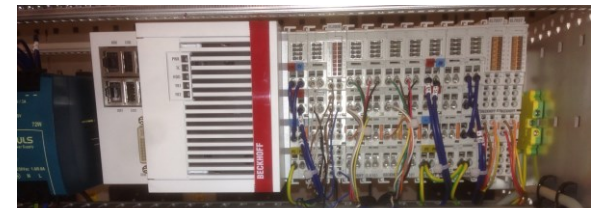
CEA, France

# LLRF system : General view

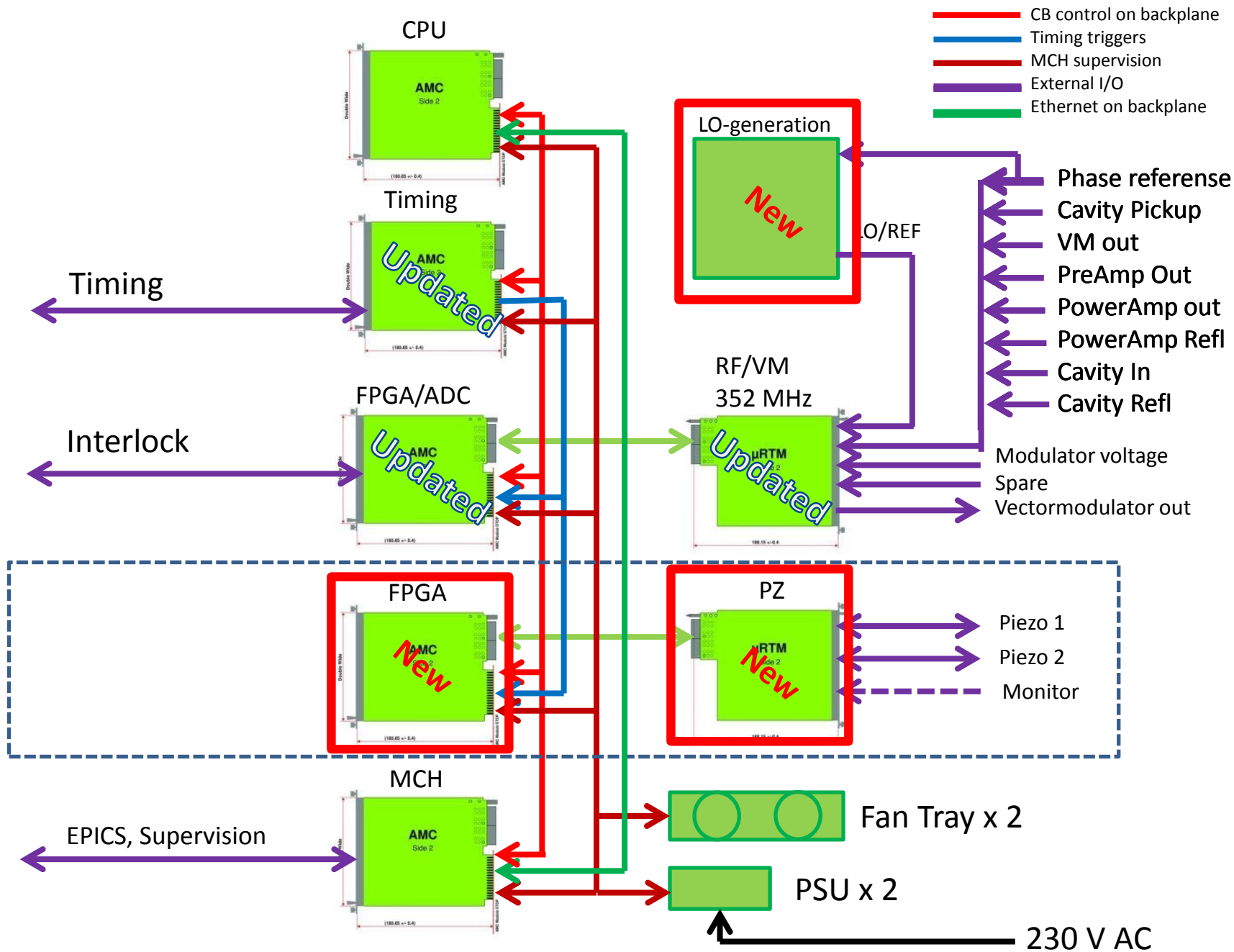


# Hardware selected

- MTCA-based system:
  - FPGA and ADC on AMC (front-board).
  - Down-conversion and vector modulator on RTM (back-board).
  - Co-location of other functions in the crate.
- CPU for control in crate
  - Running IOC for EPICS control system.
- Beckhoff system for stepper motor control.



# 352.21 MHz MTCA.4 example - Spoke



# Hardware developed and in development:

- **New Kintex Ultrascale AMC digitizer board**  
(Struck GmbH)
- **New 352 MHz RTM board**  
(Struck GmbH/DESY)
- **New low-cost FPGA AMC-card**  
(National Centre for Nuclear Research) (in development)
- **New LO-generation RTM board (704MHz)**  
(Warsaw University of Technology) (in development)
- **New Piezo driver RTM board**  
(Lodz University of Technology) (in development)
- **New LO-generation box (352 MHz)**  
(ESS Bilbao) (in development)
- **Cavity simulator for test and commissioning**  
(Warsaw University of Technology) (in development)



# Revised timeplan

- Originally expected first beam in 2019.
- Delays in the project have lead to a revised time-plan:
  - Ion-source installation starts November 2017.
  - Warm linac (90 MeV) commissioning starting in August 2019.
  - Complete linac (1.2 GeV) commissioning finished 1 October 2020.

# Thanks to the LLRF team in Lund

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- Markus Törmänen
- Christian Amstutz
- Rihua Zeng

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# Thank you!

