SARAF Phase II

CEA/Irfu-IAEC/SNRC

Architecture and MTCA Technology for the SARAF control system project

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Epics meeting

June 2019

Topics

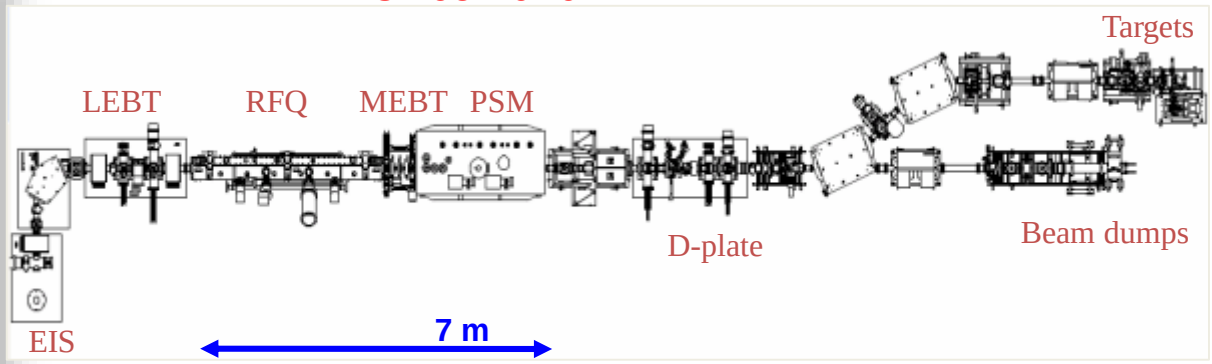
- SARAF program outline
- SARAF Local Control Systems
- Summary

SARAF – Soreq Applied Research Accelerator Facility

- SARAF is constructed at Soreq NRC (SNRC), Israel. The main goals of the program are:
  - To enlarge the experimental nuclear science infrastructure and promote research in Israel
  - To develop and produce radioisotopes for bio-medical applications
  - To modernize the source of neutrons at SNRC and extend neutron based research and applications

SARAF Phase I

In operation
since 2010



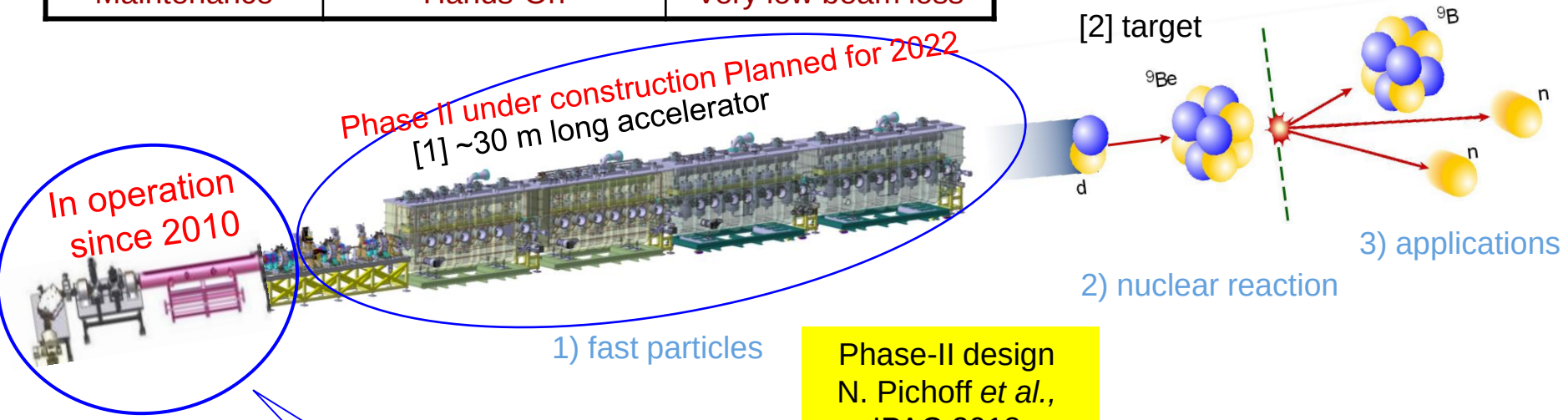
SARAF concept and top level requirements

Parameter	Value	Comment
Ion Species	Protons/Deuterons	M/q ≤ 2
Energy Range	5 – 40 MeV	Variable energy
Current Range	0.04 – 5 mA	CW (and pulsed)
Maintenance	Hands-On	Very low beam loss

Planned for 2023

[3] radiation and isotopes

[2] target



1) fast particles

2) nuclear reaction

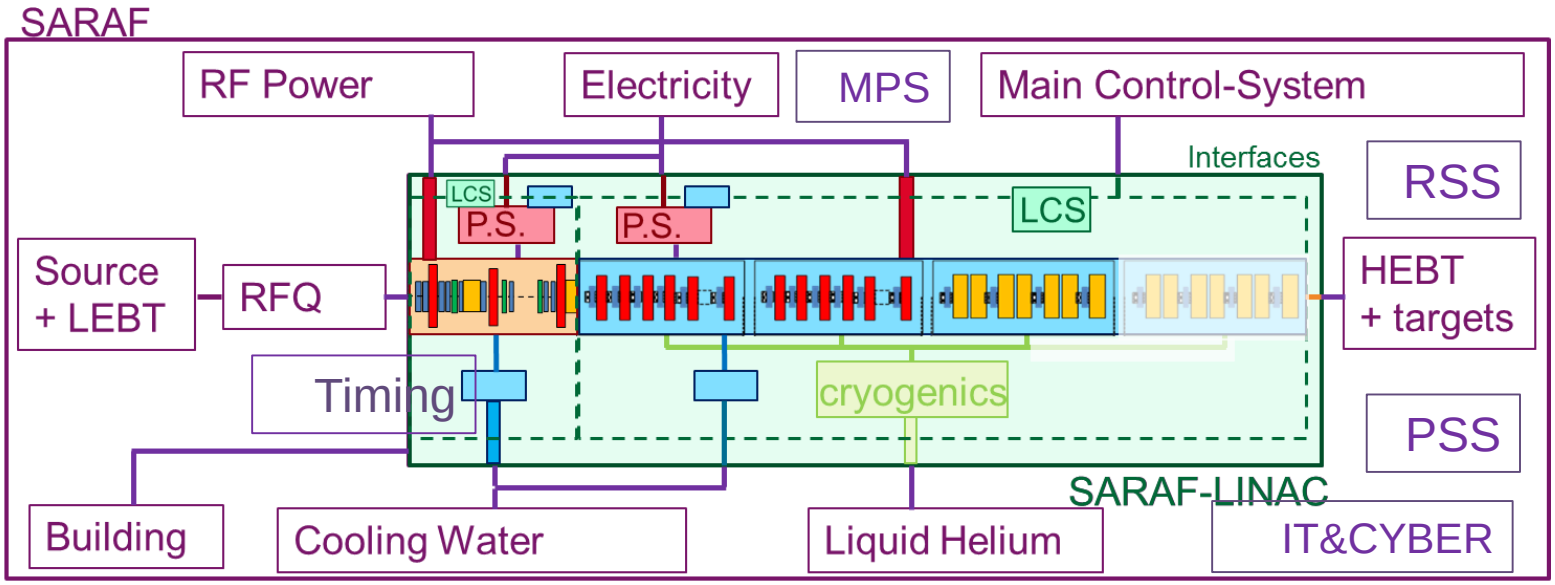
3) applications

Phase-II design
N. Pichoff *et al.*,
IPAC 2018

Phase-I in routine operation, built to test characterize and prove the novel technologies

The SARAF Linac

Deliverable



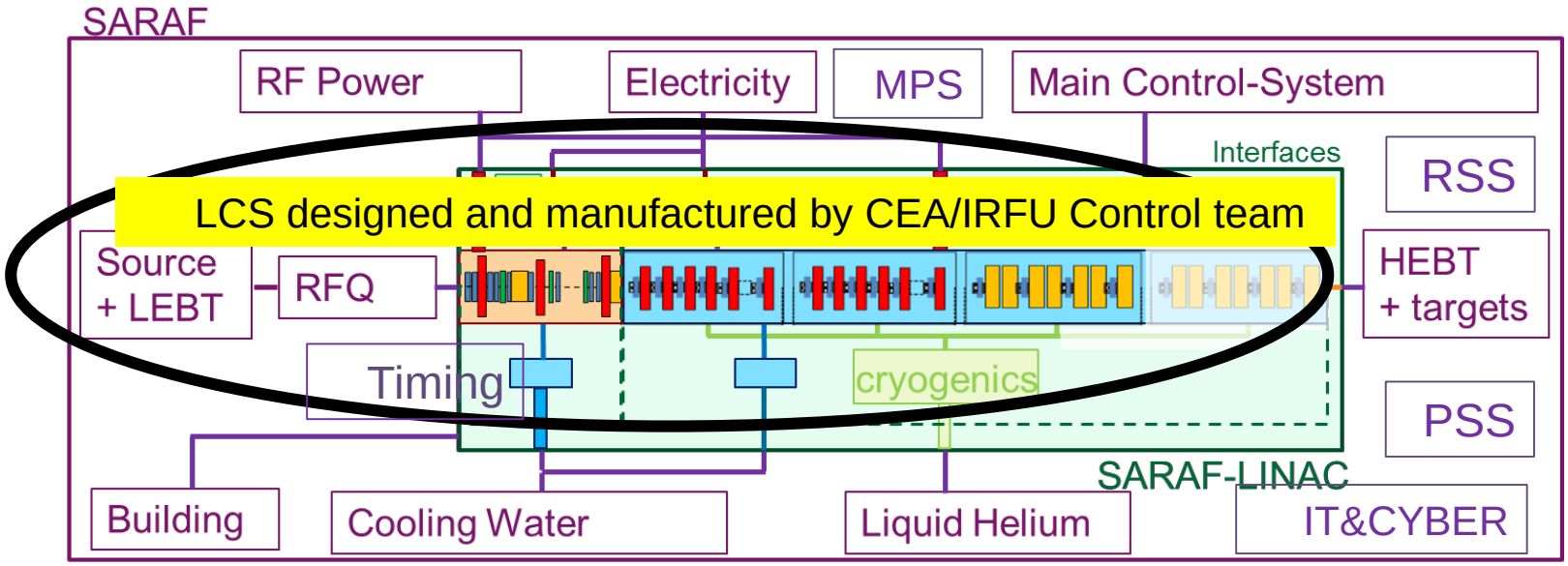
Schedule

SARAF phase I – was built in collaboration with ACCEL, and operational since 2010

SARAF phase II – under construction, in collaboration with CEA
And planned to be operational at 2022

The SARAF Linac

Deliverable



Schedule

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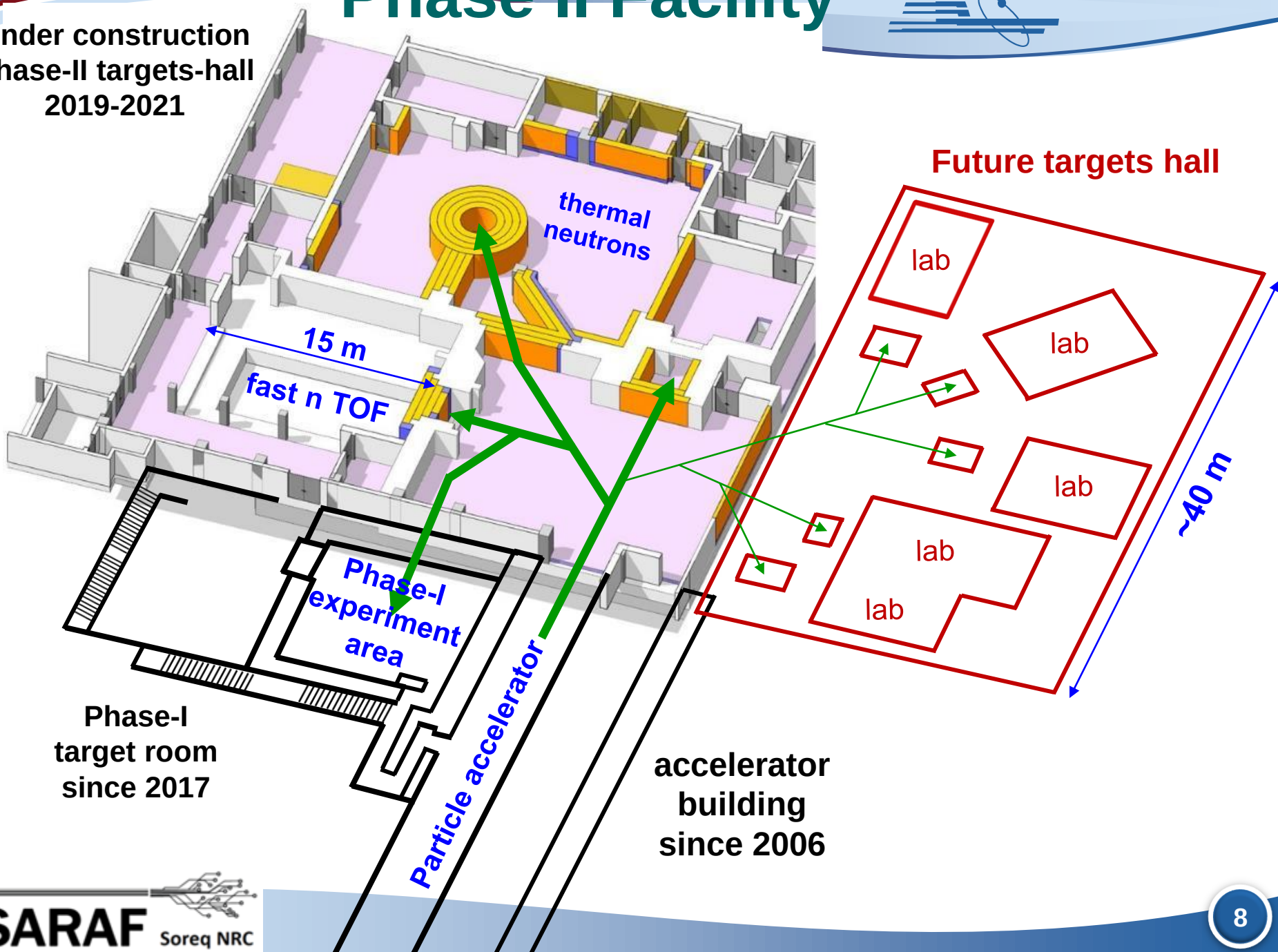
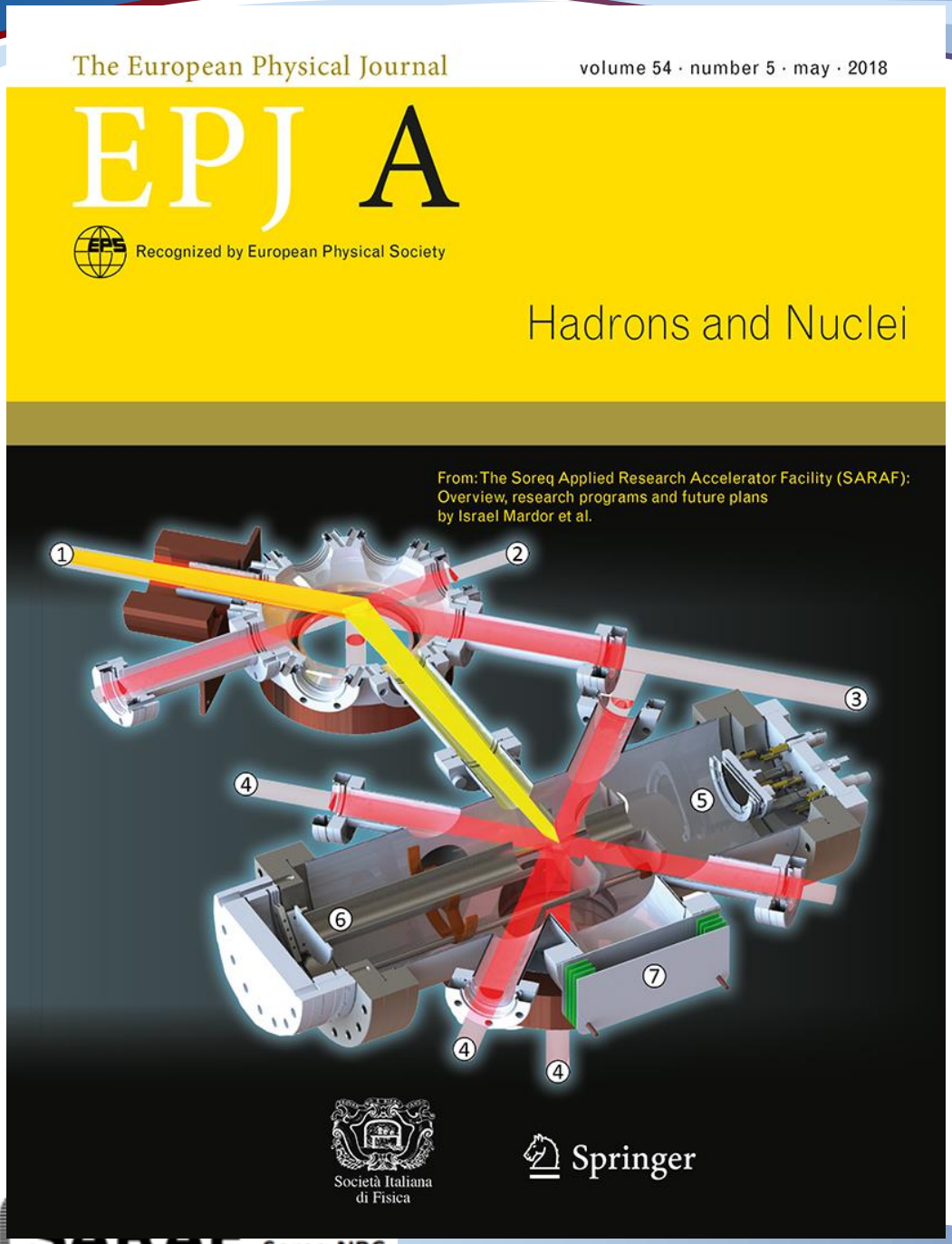
Phase II Facility





Recent Review of SARAF

- I. Mardor *et al.*, "The Soreq Applied Research Accelerator Facility (SARAF) – Overview, Research Programs and Future Plans", Eur. Phys. Jour. A (2018) 54: 91

LEGACY IN BRIEF

- CEA Irfu Saclay used EPICS based on VME & VxWorks until 2013

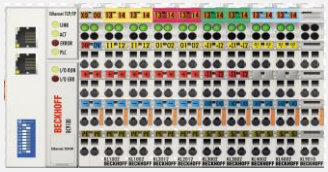
- Collaboration with ESS ICS started in 2014
  - Cryomodule and RF test stands at Saclay (VME64X/Linux/IOxOS/MRF)
  - Source& LEBT control system at Catania(VME64X/Linux/IOxOS/MRF)
  - ESS nBLM test stand at Saclay MTCA/IOxOS

- VME64X/Linux/IOxOS solution used for several SARAF test stands

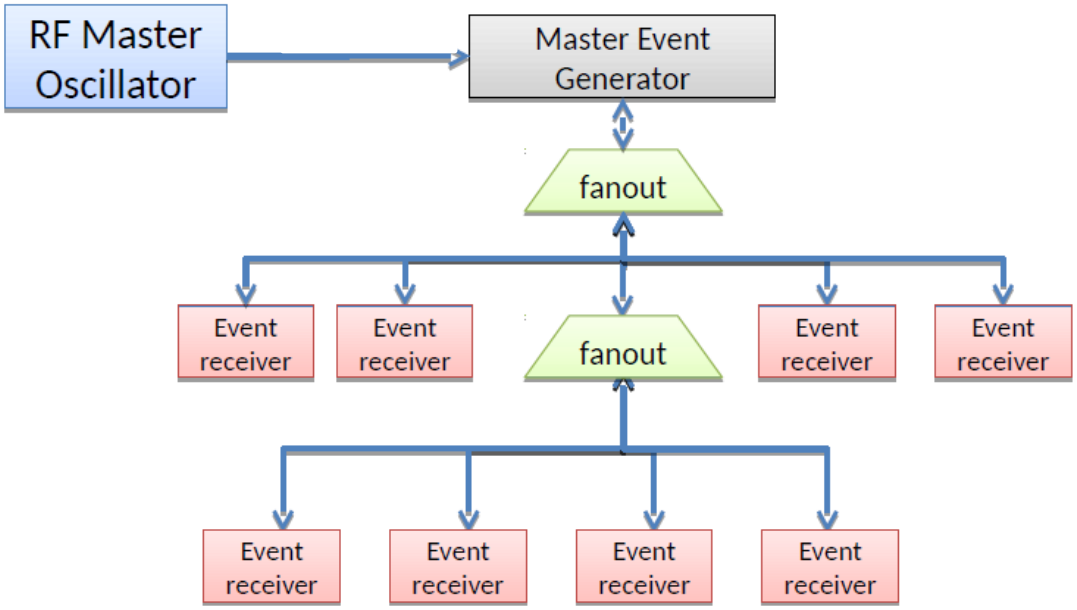
CONTEXT OF THE MIGRATION TO MTCA.4

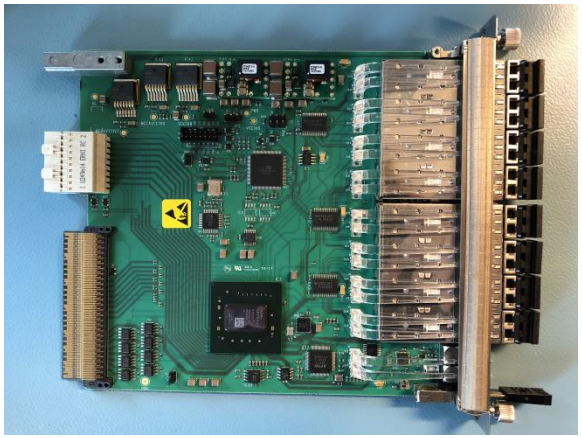
- Progress on MTCA.4 with IOxOS boards by ESS ICS
- Choice of the MRF timing system by SNRC
- Advantages of using both MTCA.4 and the MRF timing system
- Support by ESS/ICS encouraged us to do such a migration
- SNRC accepted CEA's recommendation to migrate to MTCA.4 for the SARAF control system summer 2018
- CEA team updated and standardized the IRFU EPICS Environment with MTCA.4 solutions based on IOxOS, MRF boards and ESS ICS EPICS drivers.

STANDARDIZED COTS SOLUTIONS

Requirements of the devices	Sampling/monitoring frequency range	COTS solutions
Fast acquisition	5 MS/s up to 250 MS/s	MTCA.4 IOxOS AMC IFC-1410 & FMC ADC-3111  
Semi-fast acquisition	50 KS/s up to 5 MS/s	MTCA.4 IOxOS AMC IFC-1410 & FMC ADC-3117  
Remote I/Os control LAN or serial	100 ms up to 1s	Kontron Industrial PC  Beckhoff 
Process for vacuum/ cryogenics & Remote I/Os & Interlock	100 ms up to 1s	Siemens 1500 PLC & I/O boards/ Profinet/Profibus Fieldbuses & remote I/Os 

MRF TIMING SYSTEM TEST STAND (SNRC)



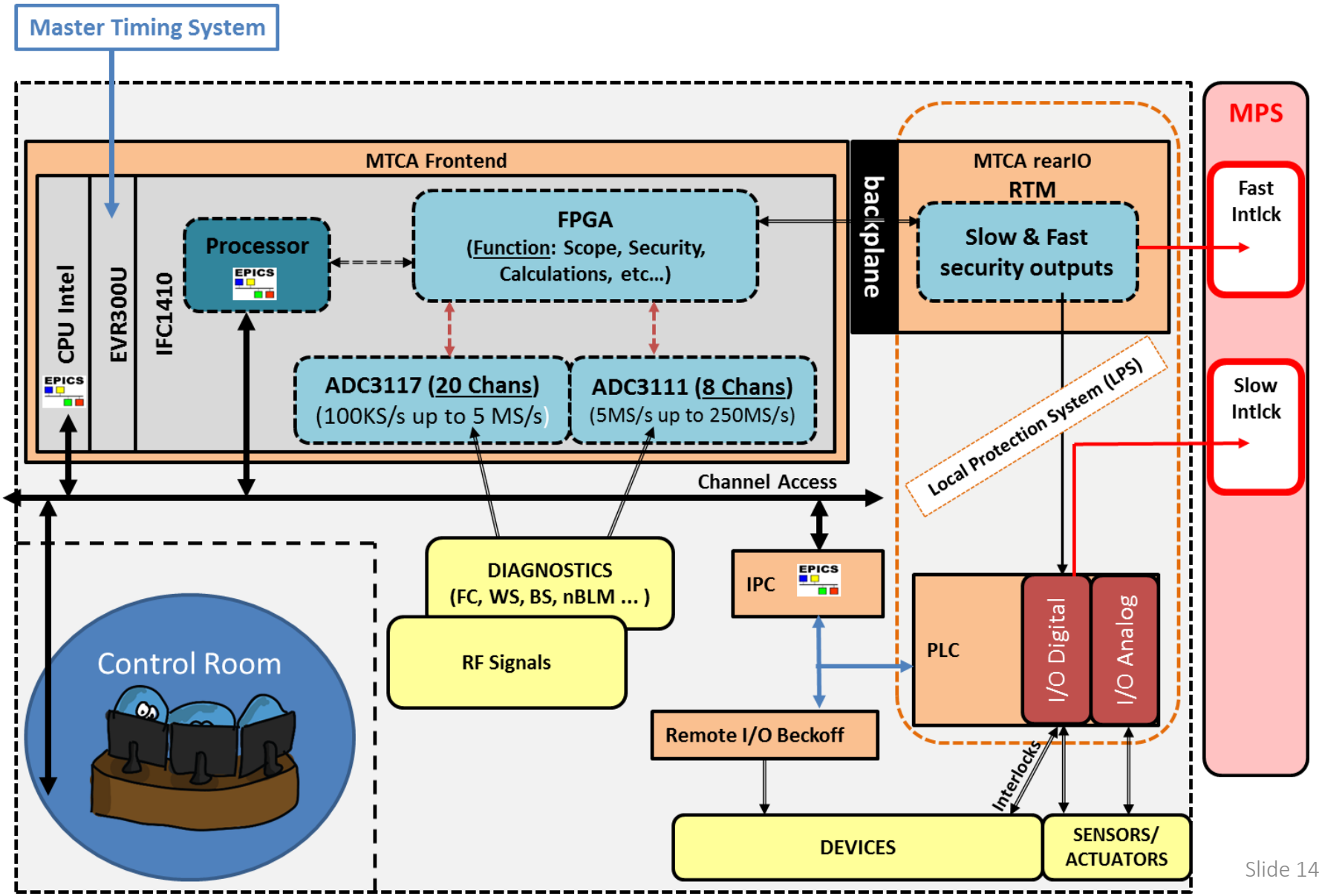


- Acts as EVG and fan-out

Chosen CPU = NAT-MCH-RTM-COMex-E3
with NAT-MCH-PHYS80

- Can send triggers on the backplane
- Can be set to generate events

EPICS STANDARD PLATFORM BASED ON COTS

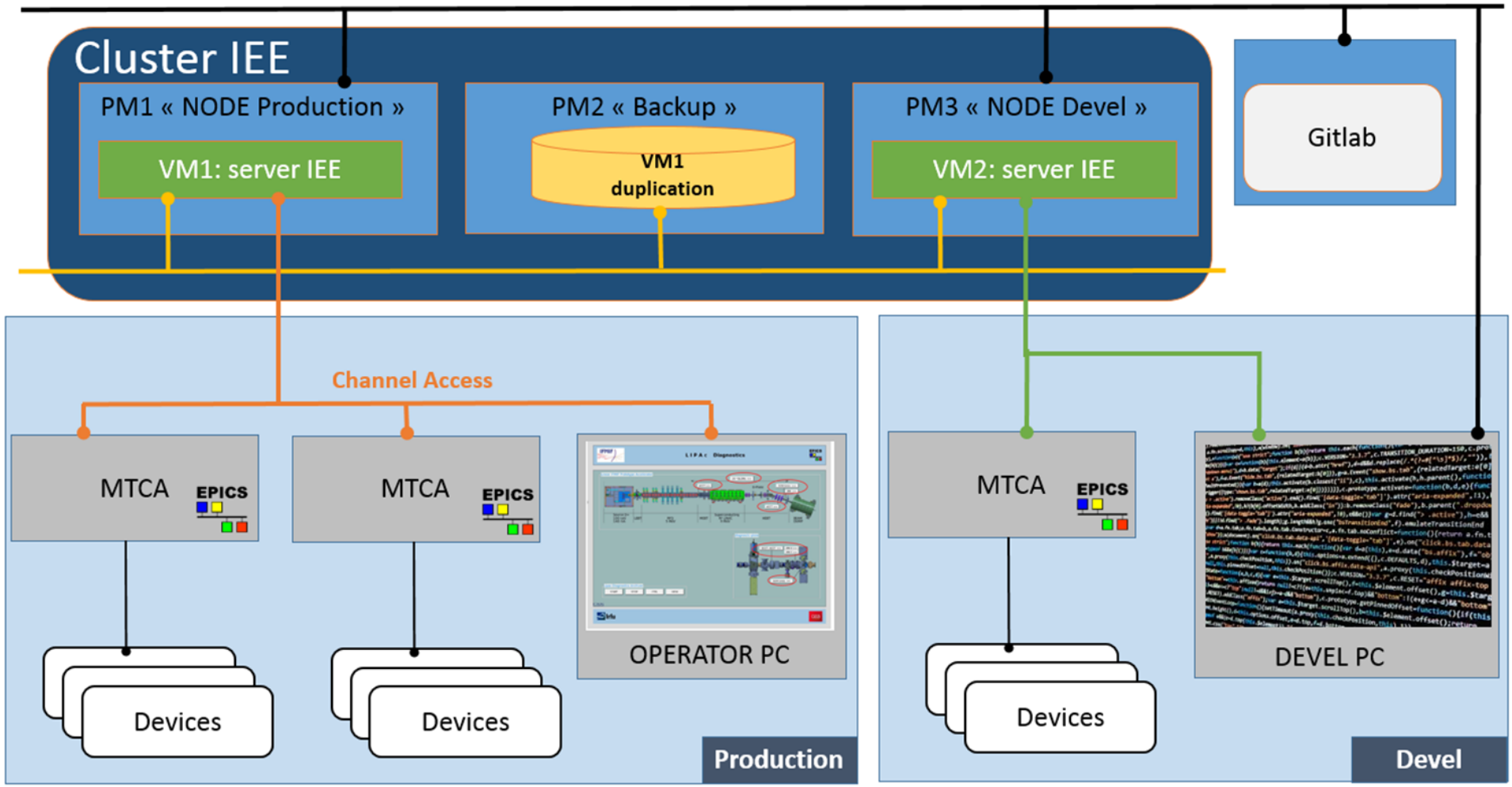


IRFU EPICS ENVIRONMENT

- **The development and production workflow IEE is used for each Local Control System:**
  - **Injector LCS**
  - **MEBT LCS**
  - **Super Conducting Linac LCS**

- Purposes:
  - Configuring in an identical way development and operation
    by installing the same distribution of Linux packages and the same version of EPICS software
  - Standardizing EPICS development with software module templates

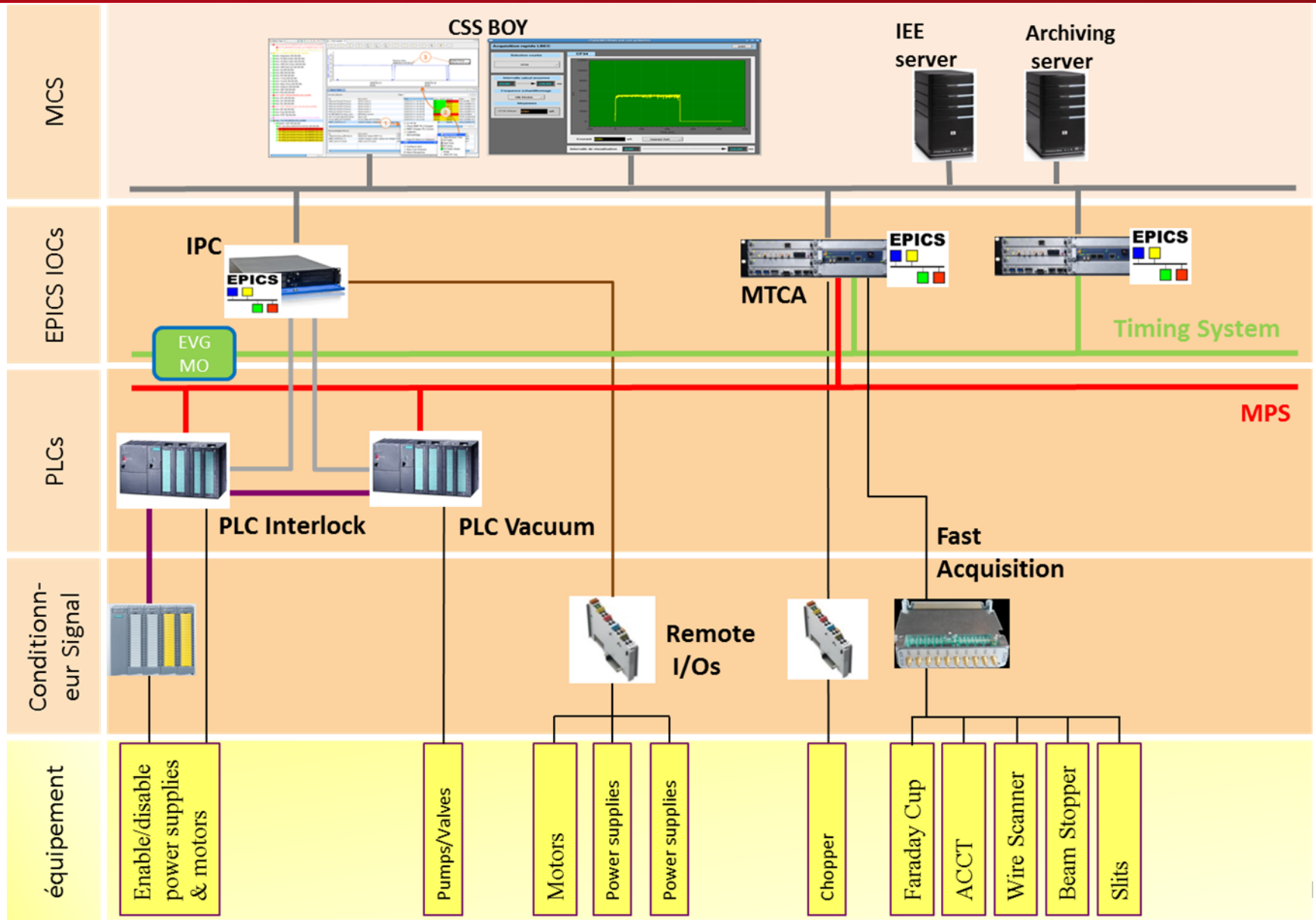
DEVELOPMENT & PRODUCTION WORKFLOW



*PMx: Physical Machine

On behalf of Jean-François DENIS

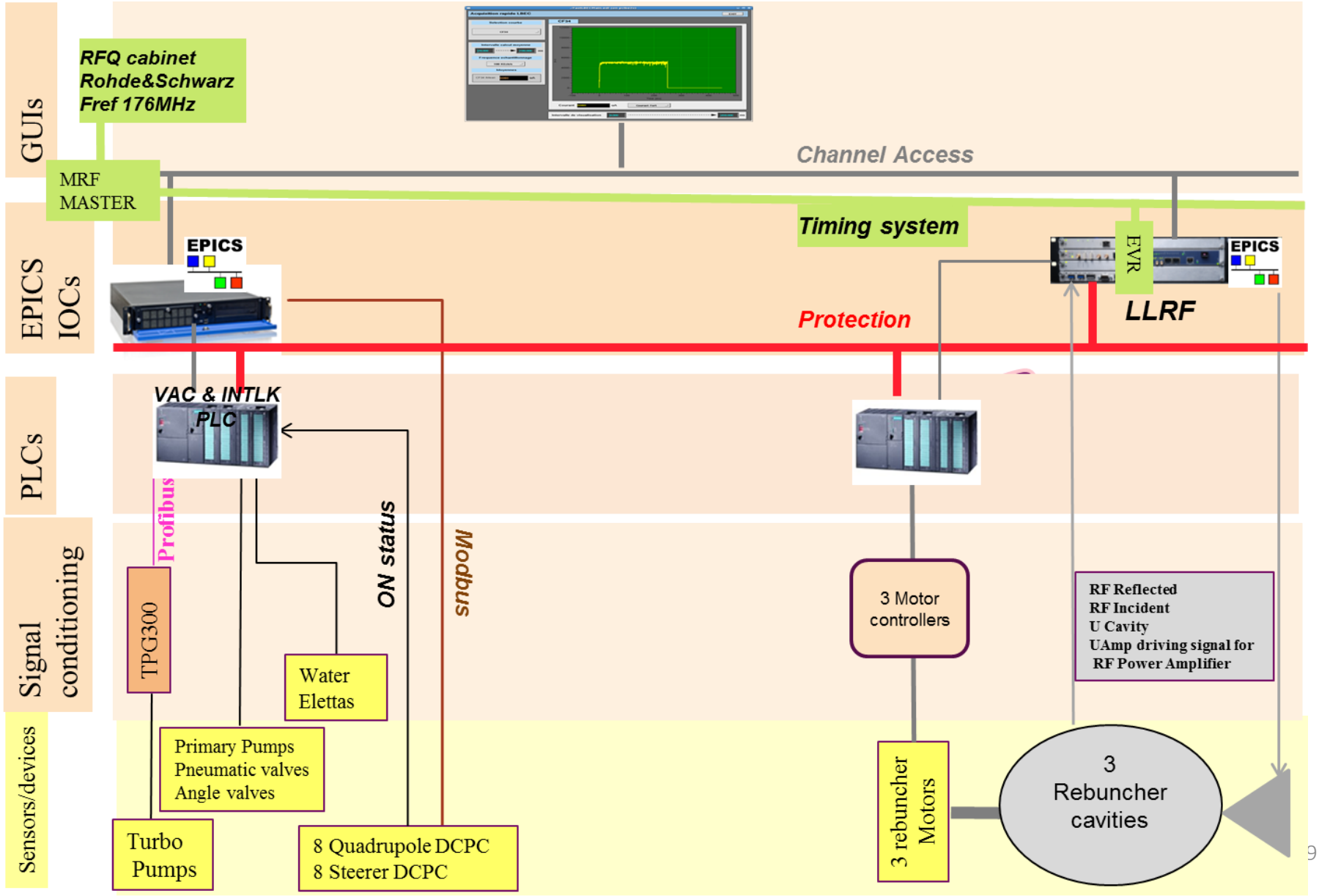
SOURCE & LEBT LCS UPGRADE



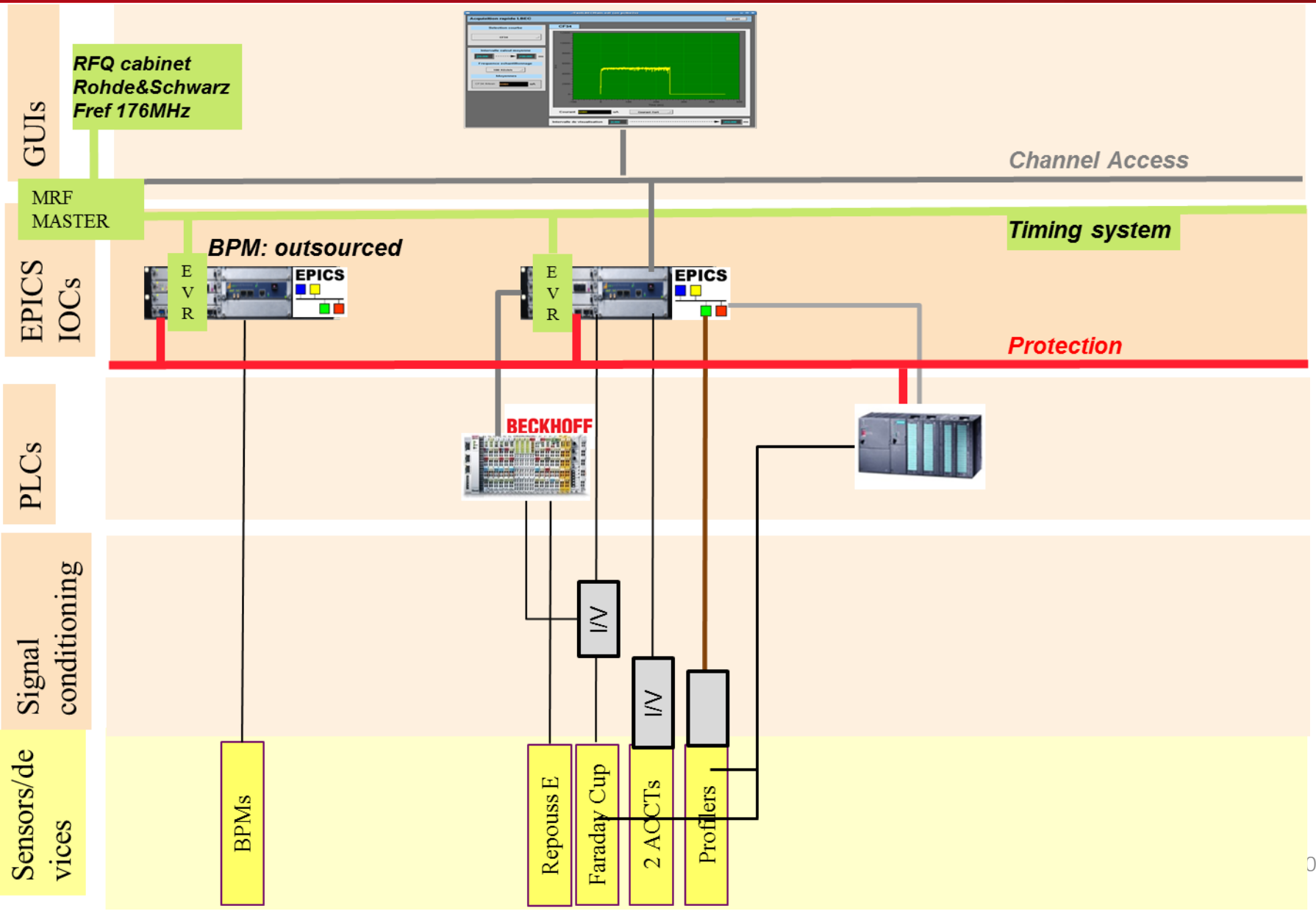
MEBT COMPONENT REQUIREMENTS

Subsystem	Requirements	Solutions
Vacuum	**Vacuum + Water**	**Siemens PLC**
Power Converters	**8 quadrupole power converters with** **8 steering magnets power converters**	**Modbus** **Modbus**
3 Rebunchers	**including 3 LLRF outsourced** **motorisation**	**MTCA.4 Solution** **Siemens PLC**
Diagnostics	**Faraday Cup** **2 ACCTs** **Harps profilers** **BPMs outsourced**	**MTCA.4/IOxOS ADC3117** **Modbus** **MTCA.4 CFT**

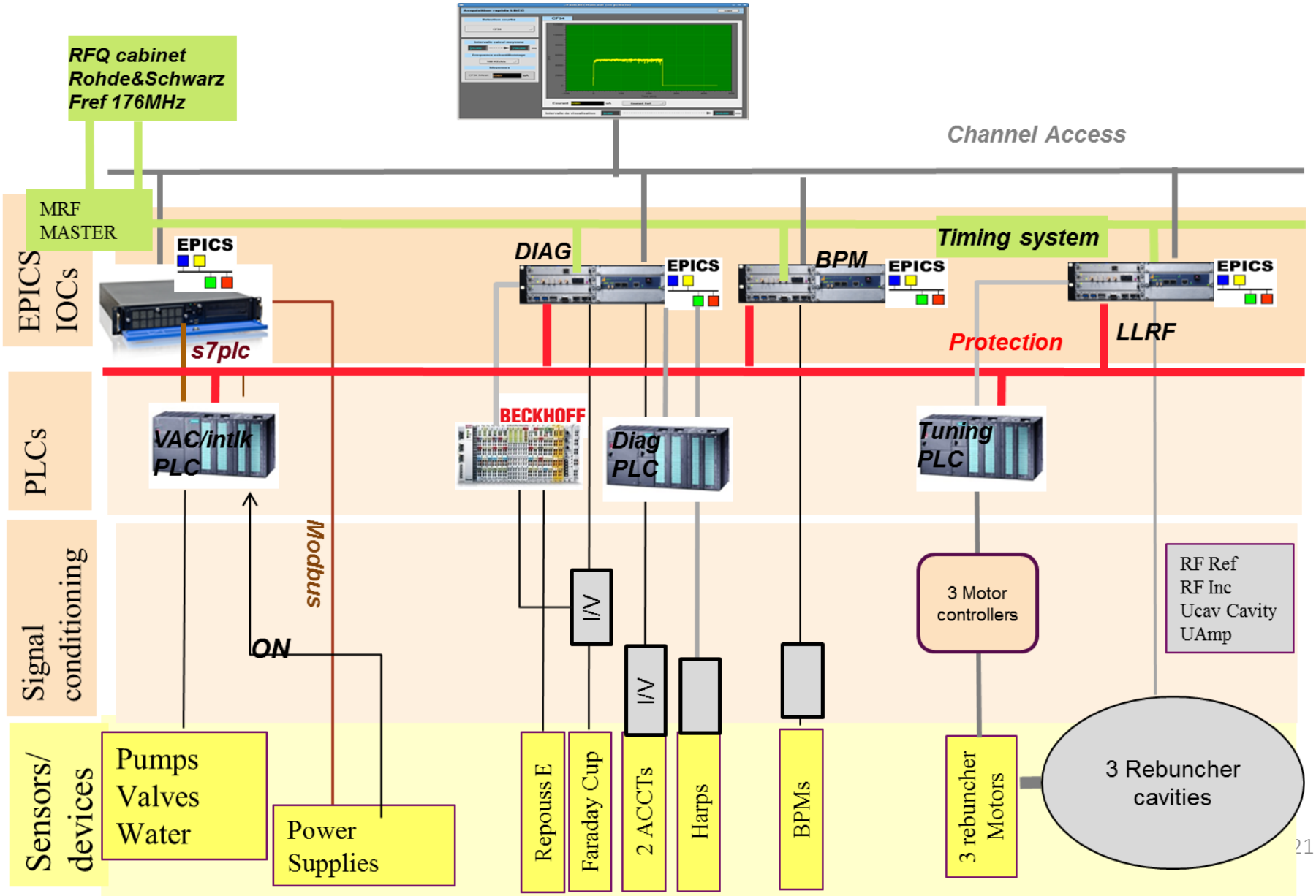
MEBT VACUUM & WATER & POWER SUPPLIES LCS



MEBT DIAGNOSTICS LCS



MEBT & ITS DIAGNOSTICS LCS

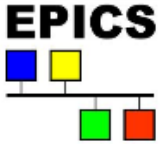


SUMMARY

- Injector CS is planned to be delivered and integrated in Q1 2020
- MEBT CS planned to be delivered in Q2 2020
- Preliminary architecture for the SCL is currently starting
- also using MTCA solutions
  - CM1: 6 LLRFs for cavities
  - CM2: 7 LLRFs
  - CM3: 7 LLRFs
  - CM4: 7 LLRFs
  - 16 BPMs
  - 20 nBLMs

MERCI **THANK YOU** **תודה**

- EPICS Community



- Our colleagues:
  - **CEA IRFU EPICS team:** Jean-François Denis, Francis Gohier, Alexis Gaget, Yves Lussignol, Victor Nadot, Kathy Saintin
  - **CEA IRFU PLC team:** Tom Joannem, Nicolas Solenne
  - **CEA IRFU Cabinet & Instrumentation team:** Ange Lotodé, Patrice Guiho, Victor Silva
  - **SNRC Control and Operation team**: Leo Weissman, Amichay Perry, Noam Tamim, Ilan Shmuely, Tamir Zchut, Hodaya Dafna

- And Special thanks to Timo for supporting