Upgrade of the AGOR cyclotron control system at UMCG-PARTREC

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The AGOR superconducting cyclotron of PARTREC, delivering beams of high energy protons and other ions.

Particle Therapy Research Center – PARTREC

umcgresearch.org/w/partrec

- dedicated research facility
- focus on multidisciplinary research
  - o to improve the quality of proton beam radiotherapy treatment
  - o to explore the benefits of other particle beams for cancer treatment
- technological development is a major part of the R&D program
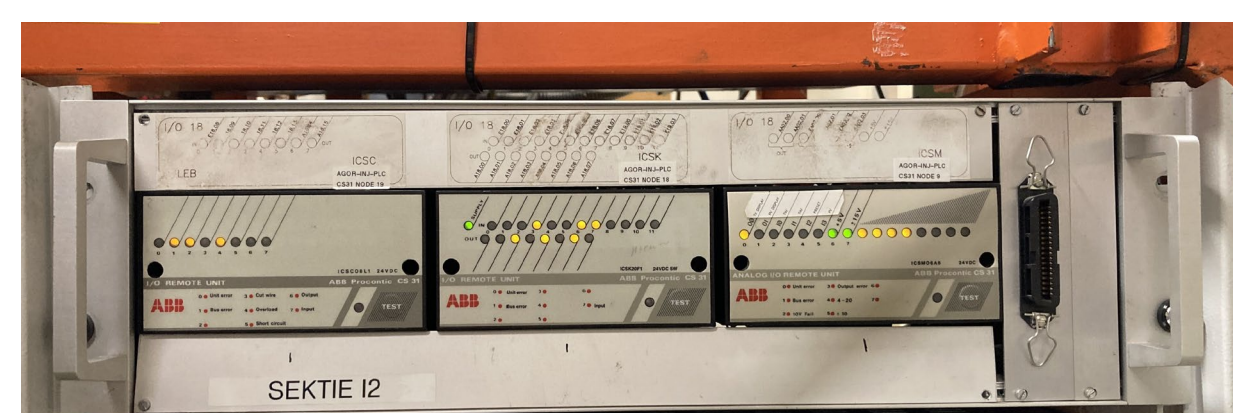- ~10 scientific personnel and ~25 technical staff
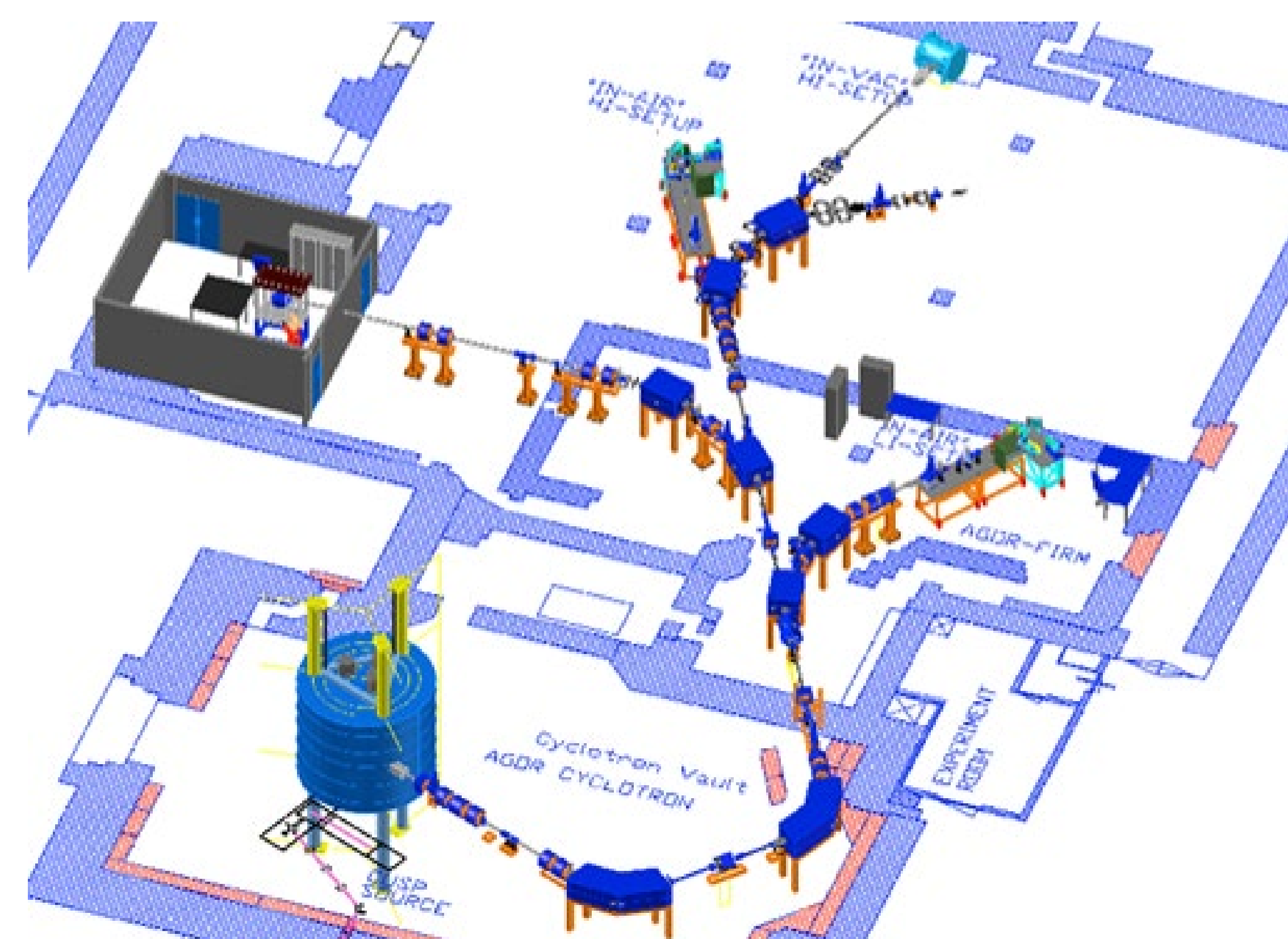
Layout of the PARTREC facility, showing the AGOR cyclotron at the bottom left and the beam lines transporting beams to several experimental areas.
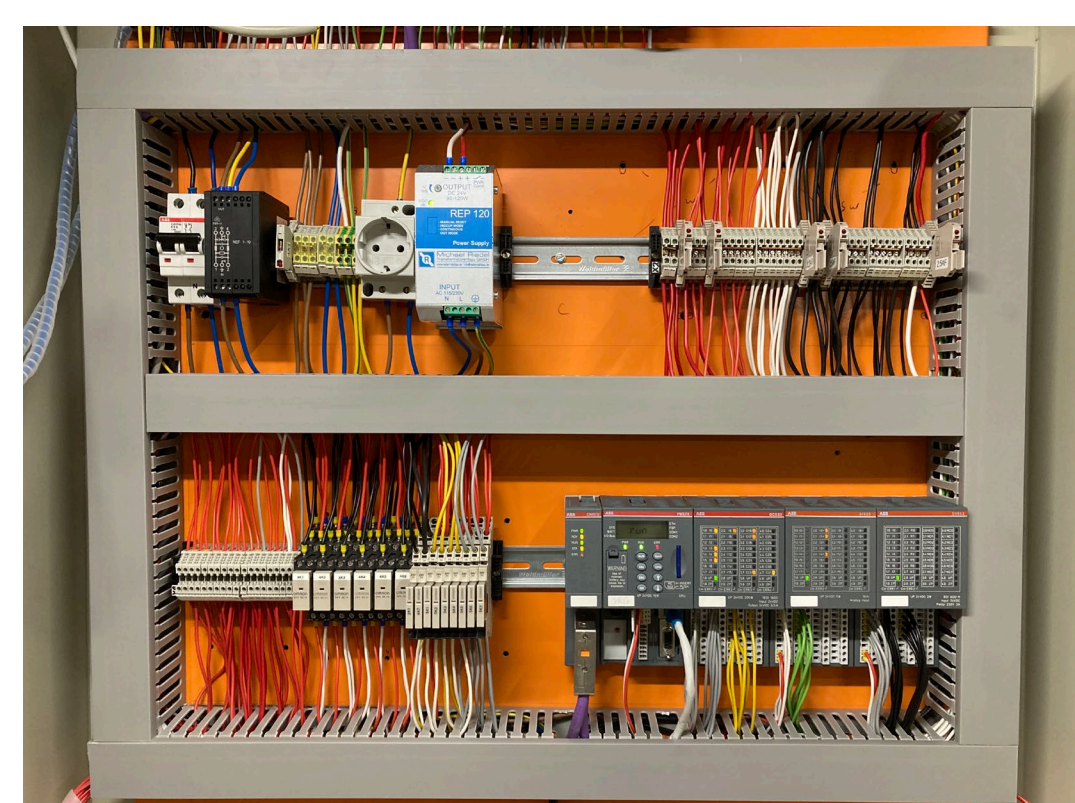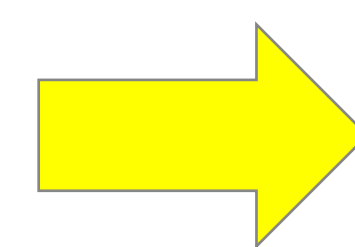
Current upgrades
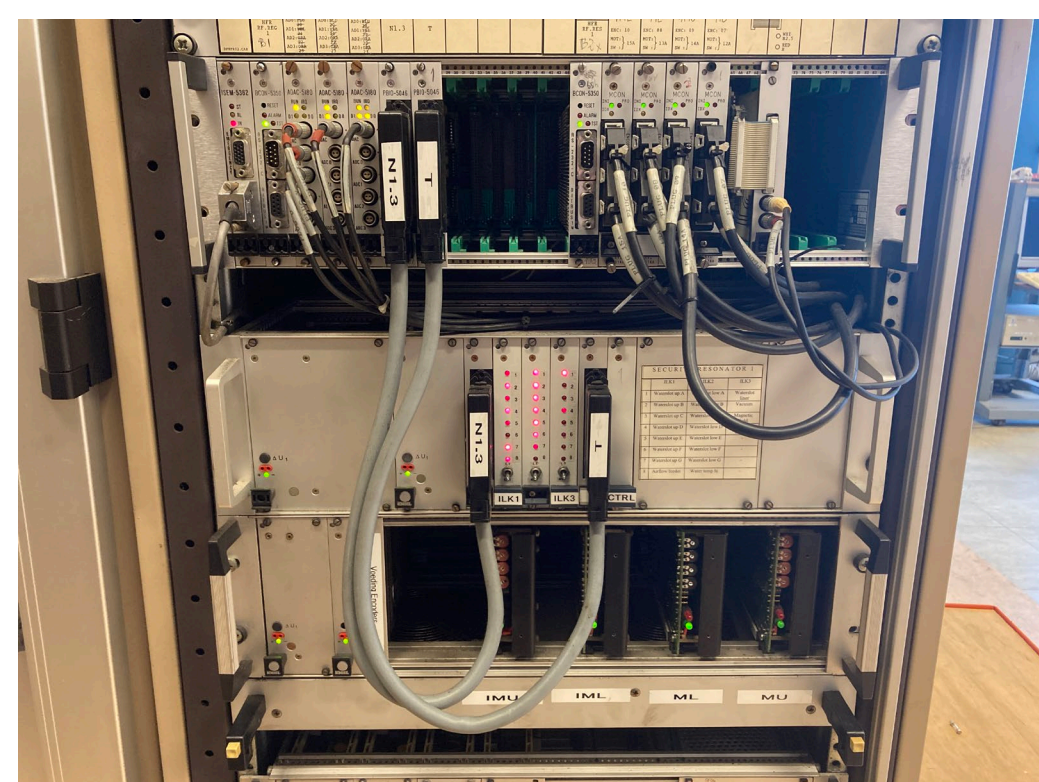
PLCs:
- ➔ Old: ABB CS31 and KT97
- ➔ New: ABB AC500

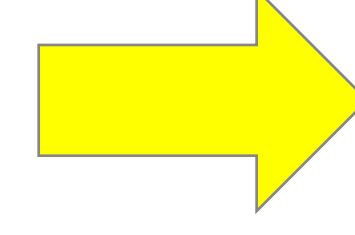*Subrack containing old ABB CS31 PLC I/O units*

Upgraded PLC system with ABB AC500

RF Resonator Control:
- ➔ Old: Bitbus based controllers and I/O
- ➔ New: NI-cRIO rack

Bitbus based controller and I/O units

New NI-cRIO Controller with I/O units

**Beam Profile Electronics and Beam Current Electronics:**
- ➔ Old: in-house developed with outdated fieldbus interface (Bitbus)
- ➔ New: in-house developed as generic I-V converters (to be connected to I/O unit of OT network)

RF Analog Regulation System:
- ➔ Old: 7 discrete electronics modules
- ➔ New: Redesigned and combined into one module

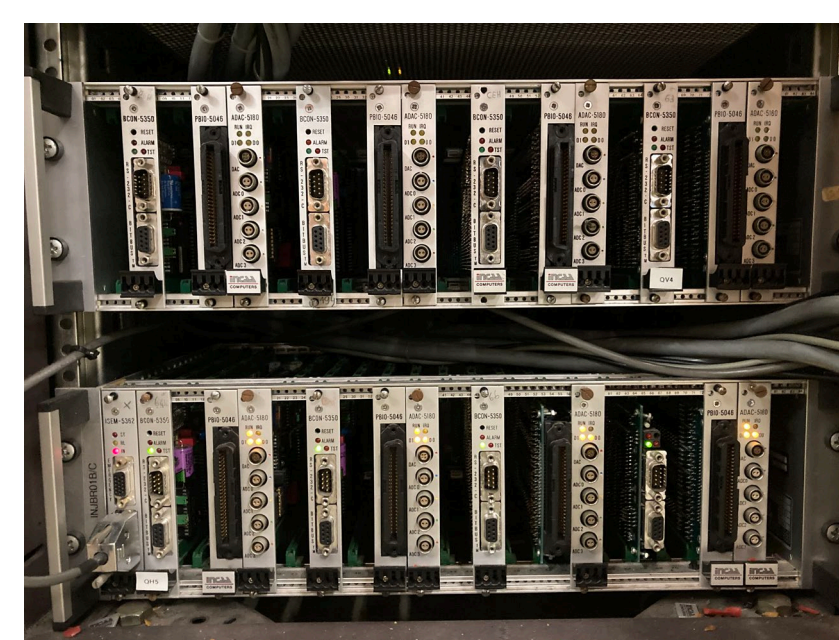*Old situation with discrete modules for every main function*
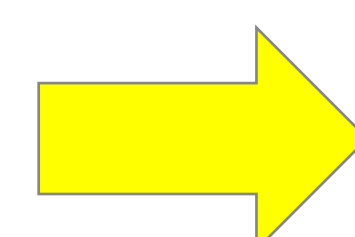
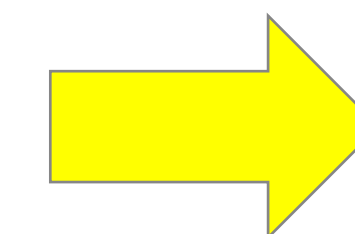*Redesigned module with all functions combined into one cassette*

Pilot projects and future upgrades

Operational Technology (OT) network:
- ➔ Now: Bitbus with custom Bitbus controllers and I/O
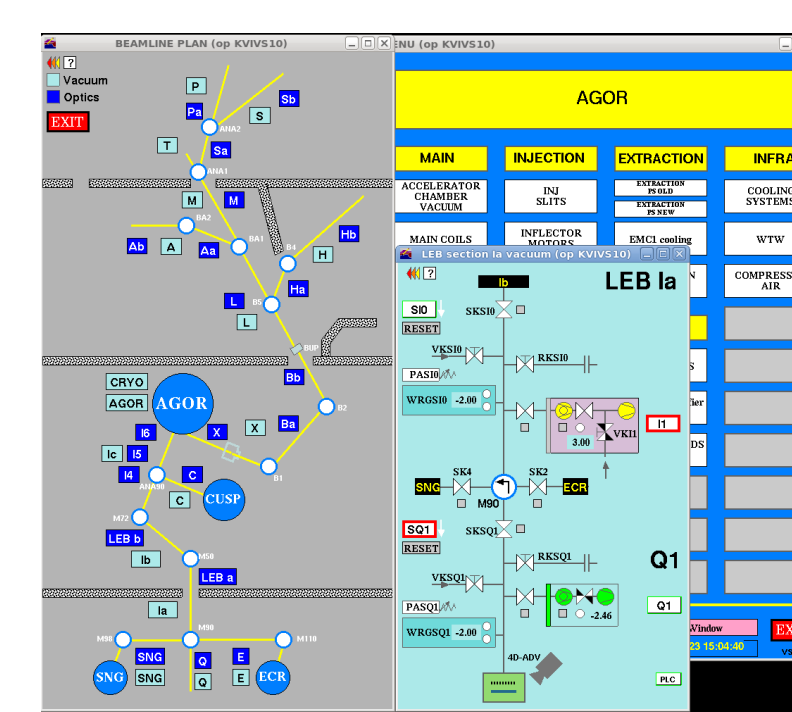- ➔ Pilot: NI-cRIO rack with in-house developed interface cards for both analog and digital I/O

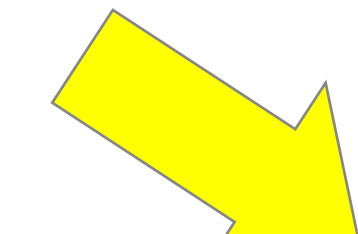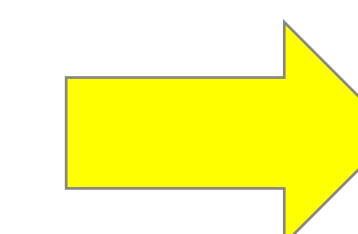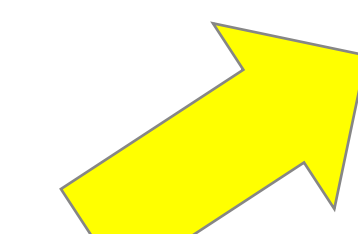*Two Bitbus based subracks for controlling eight power supplies*

NI-cRIO subrack for controlling eight power supplies

Control system software:
- ➔ Now: Vsystem by Vista Control Systems, Inc.
- ➔ Alternative: EPICS
- ➔ Alternative: Siemens PCS7

Vsystem screenshot

Challenges

- ➔**Cyclotron operation:** keep downtime under 1-2 months
- ➔**Manpower:** engineering time is divided between upgrades and operational duties
- ➔**Lead times and availability of components**