UPGRADING THE IRRAD CONTROL SYSTEM GUIs USING OPEN-LICENSE AND CROSS-PLATFORM TECHNOLOGIES

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Outline

- CERN Accelerator Complex
- CERN Proton Irradiation Facility (IRRAD)
- IRRAD Control System Upgrades
  - IRRAD Tables
  - Shuttle
- Lessons Learned
- Future Work
- Summary

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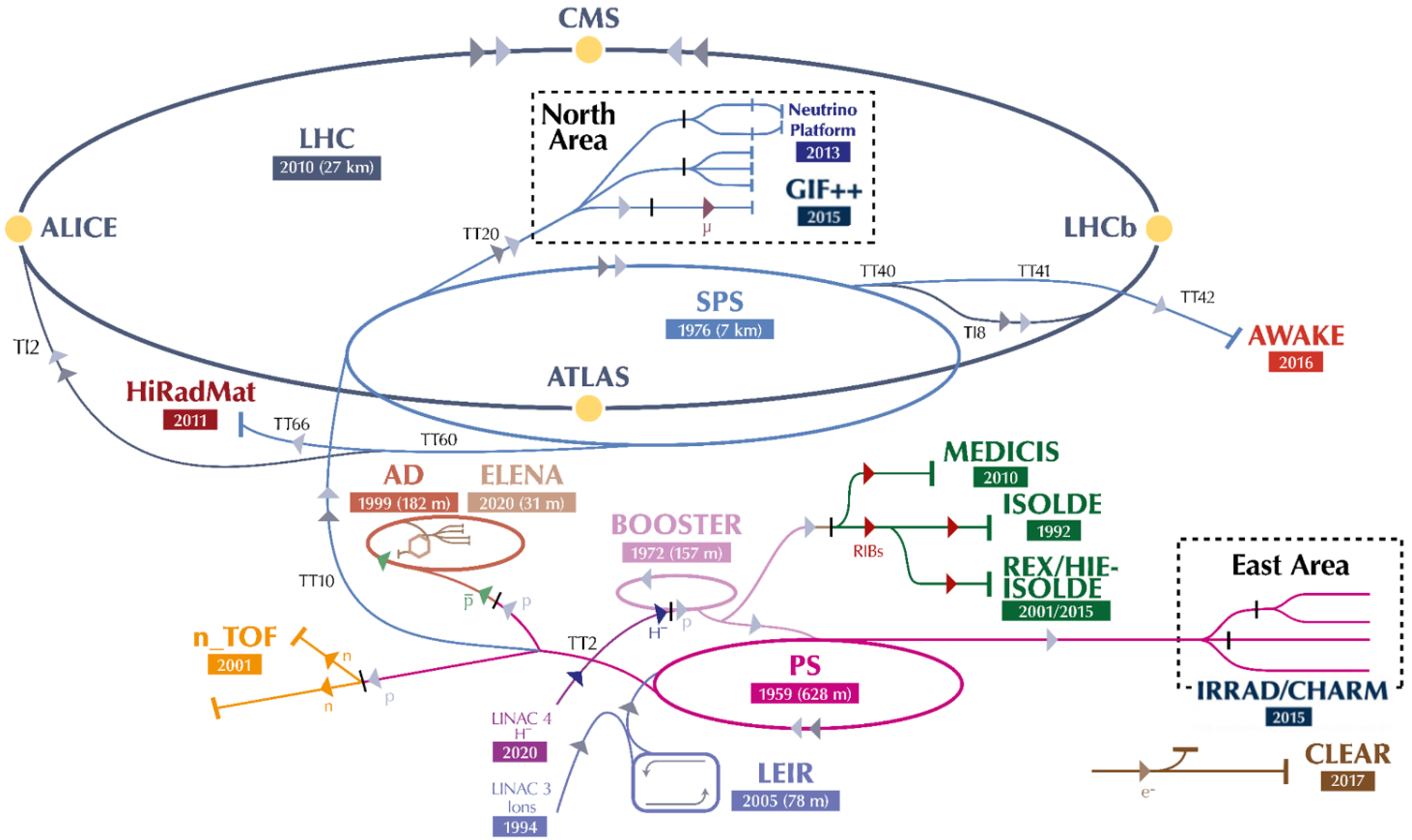
CERN Accelerator Complex



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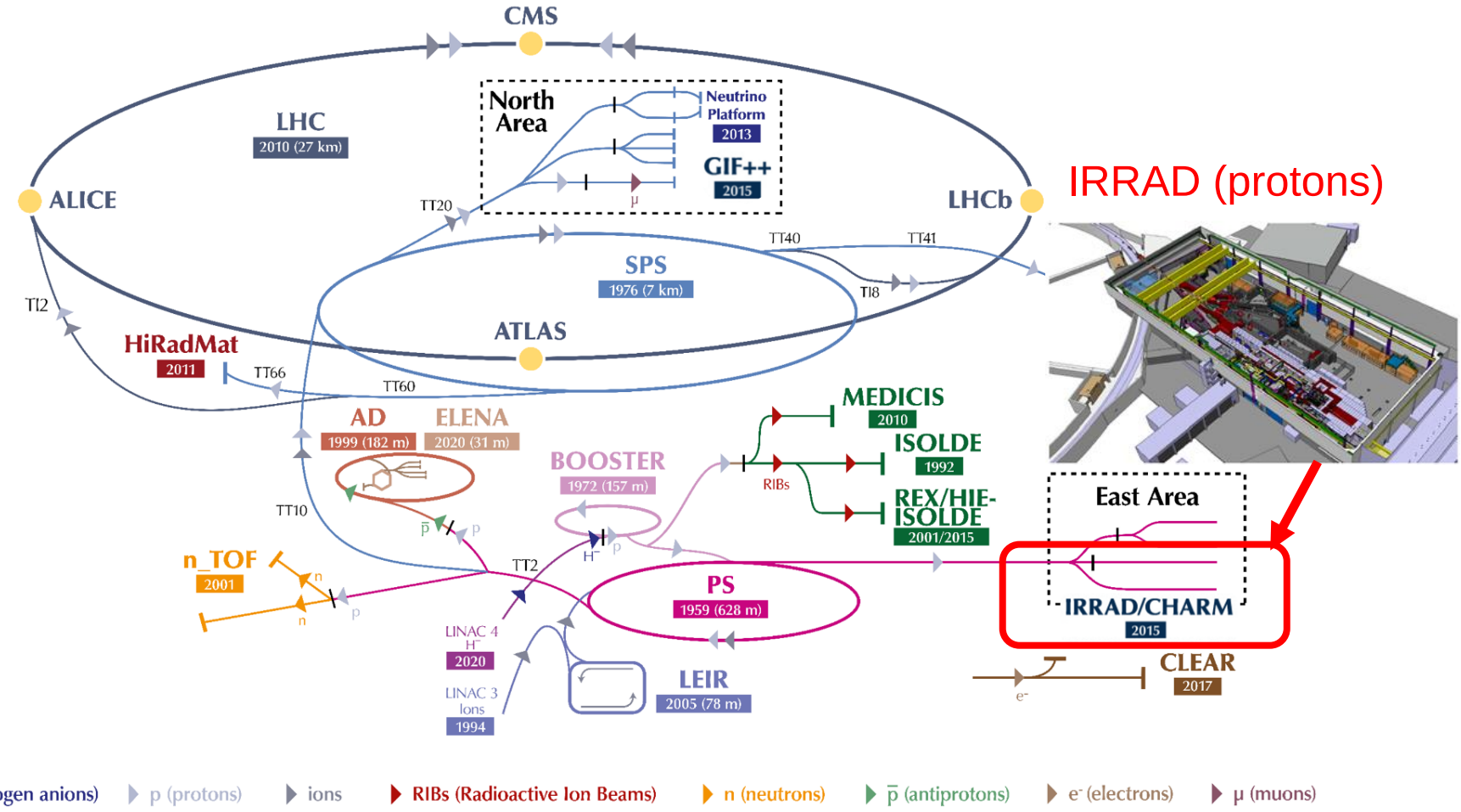
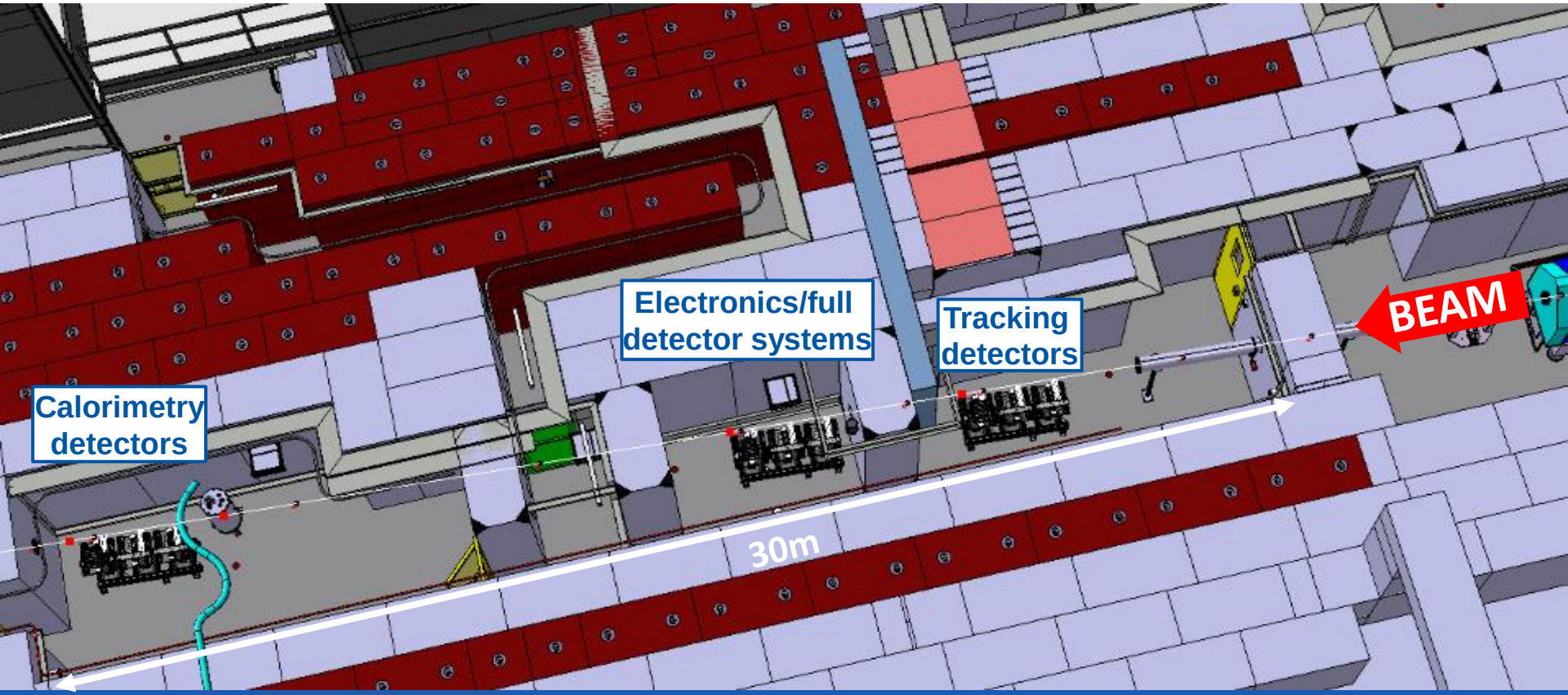


CERN Proton Irradiation Facility (IRRAD)

- Testing components of HEP experiments
- 24 GeV/c, Gaussian 12×12 mm^2 FWHM
- Spills of 400 ms every ~10 s
- Fluence of 1×10^{16} p/cm^2 in ~14 days

cern.ch/ps-irrad



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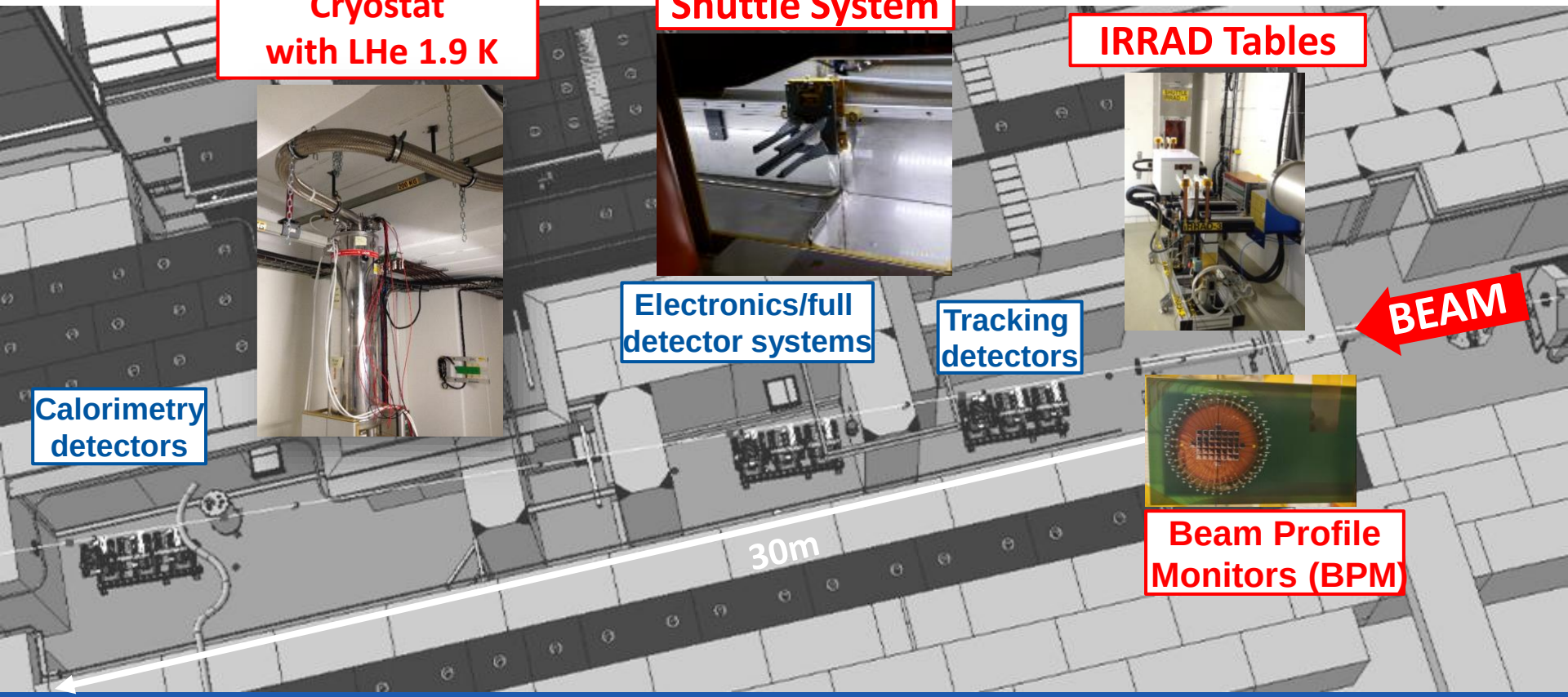

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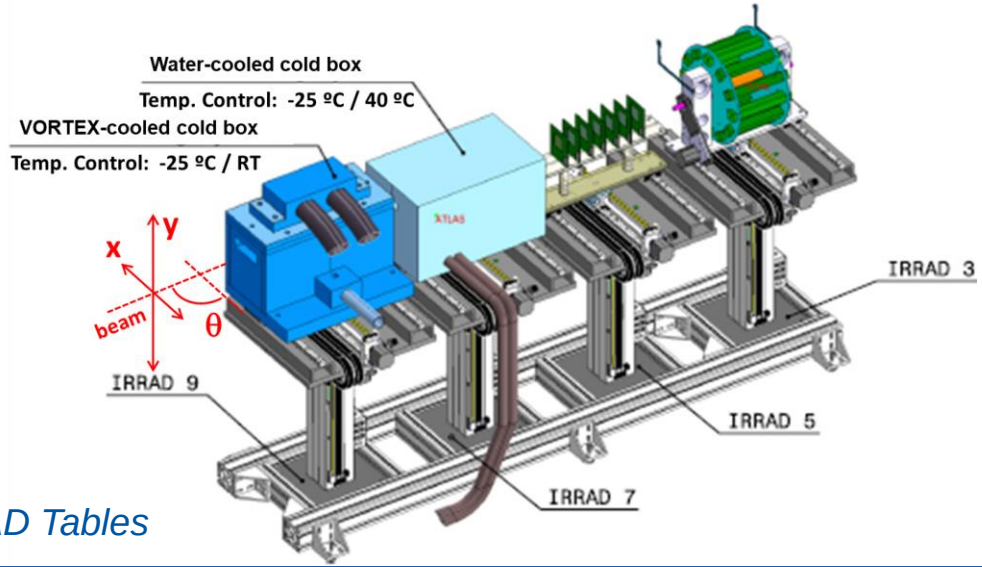
IRRAD Tables

Remotely controlled moveable stages

- **2 stepper motors** for **horizontal move** and **rotation**
- **1 AC motor** for **vertical move**
- **9 IRRAD Tables in total**
  - 6x at room temperature
    - Vmax = 20×20×50 cm^3
    - Scan over 10-20 cm (X-axis)
  - 2x with cold boxes (-25°C)
    - Vmax = 12×4×38 cm^3
  - 1x cryogenic setup (1.9K)
    - Vmax = 5×5×20 cm^3



IRRAD Tables

IRRAD Tables Control System: Hardware Components & Communication

Brainboxes (Ethernet to Serial)

RS232

M300

Manual control

Motor Control Unit

IRRAD Table

Ethernet

Graphical User Interface (GUI)

Software Technologies

Old GUIs:

- Limited to specific operating system;
- Proprietary software;
- Additional functionalities required (no database in the backend)

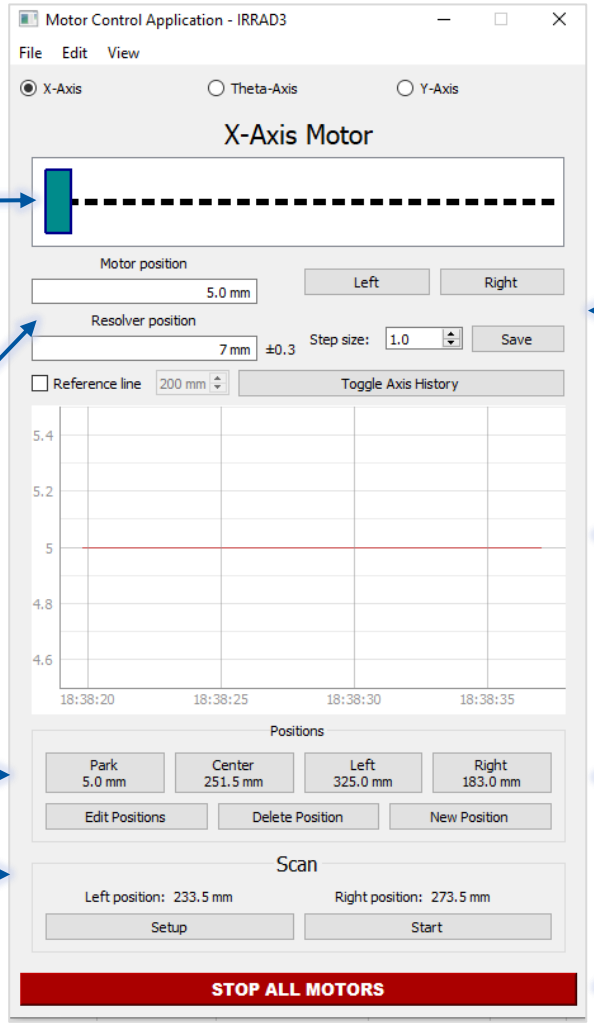
→ Need for free, open-license cross-platform technologies and implementation of additional functionalities

Development

Serial Communication

Data Storage

IRRAD Tables Control System: GUIs and Functionalities



Position visualisation

Indication from position sensors

Fixed buttons

Scanning setting

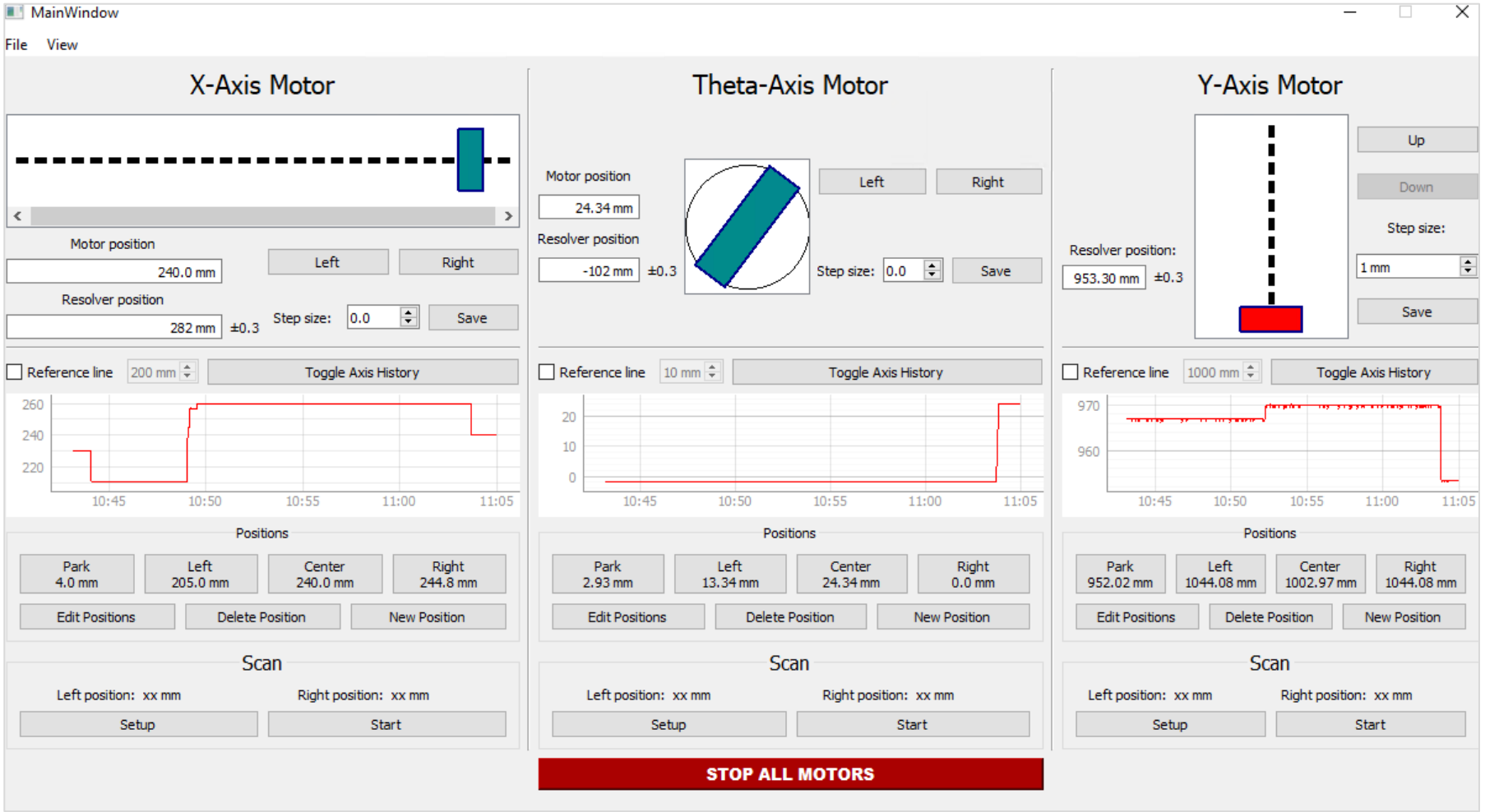
Movement in steps

Movement in time

Additional custom positions

Emergency stop

IRRAD Tables Control System: GUI Full View

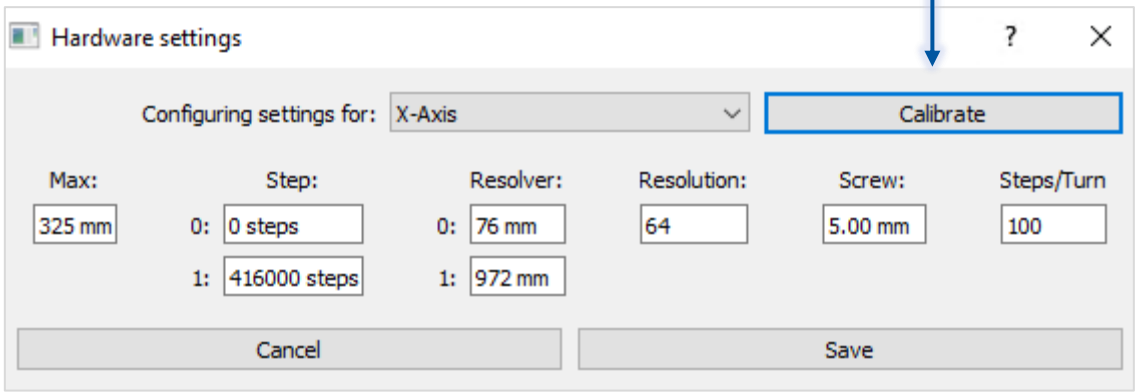


IRRAD Tables Control System: Database Data and Hardware Settings

Data stored in the database:

- Stepper-motor hardware settings
- AC motor hardware settings
- Motor
- Movements
- Custom positions

Automated calibration process



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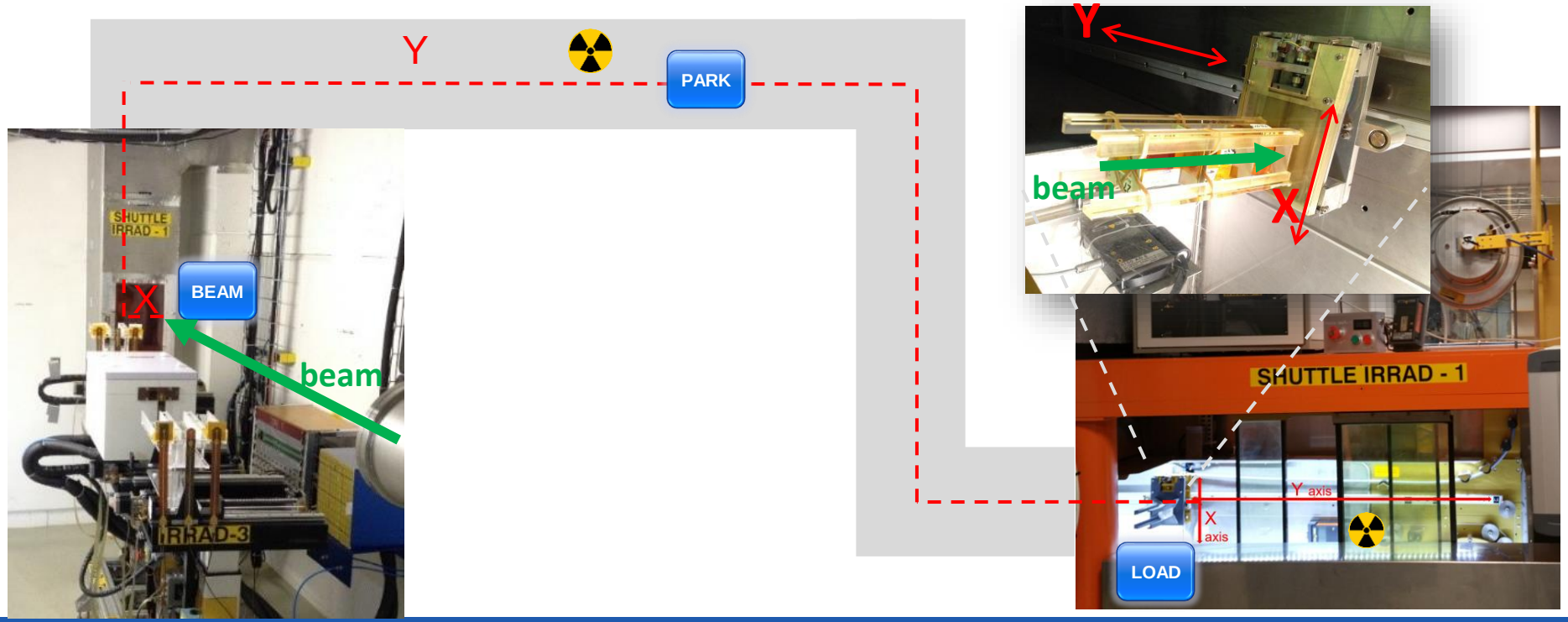
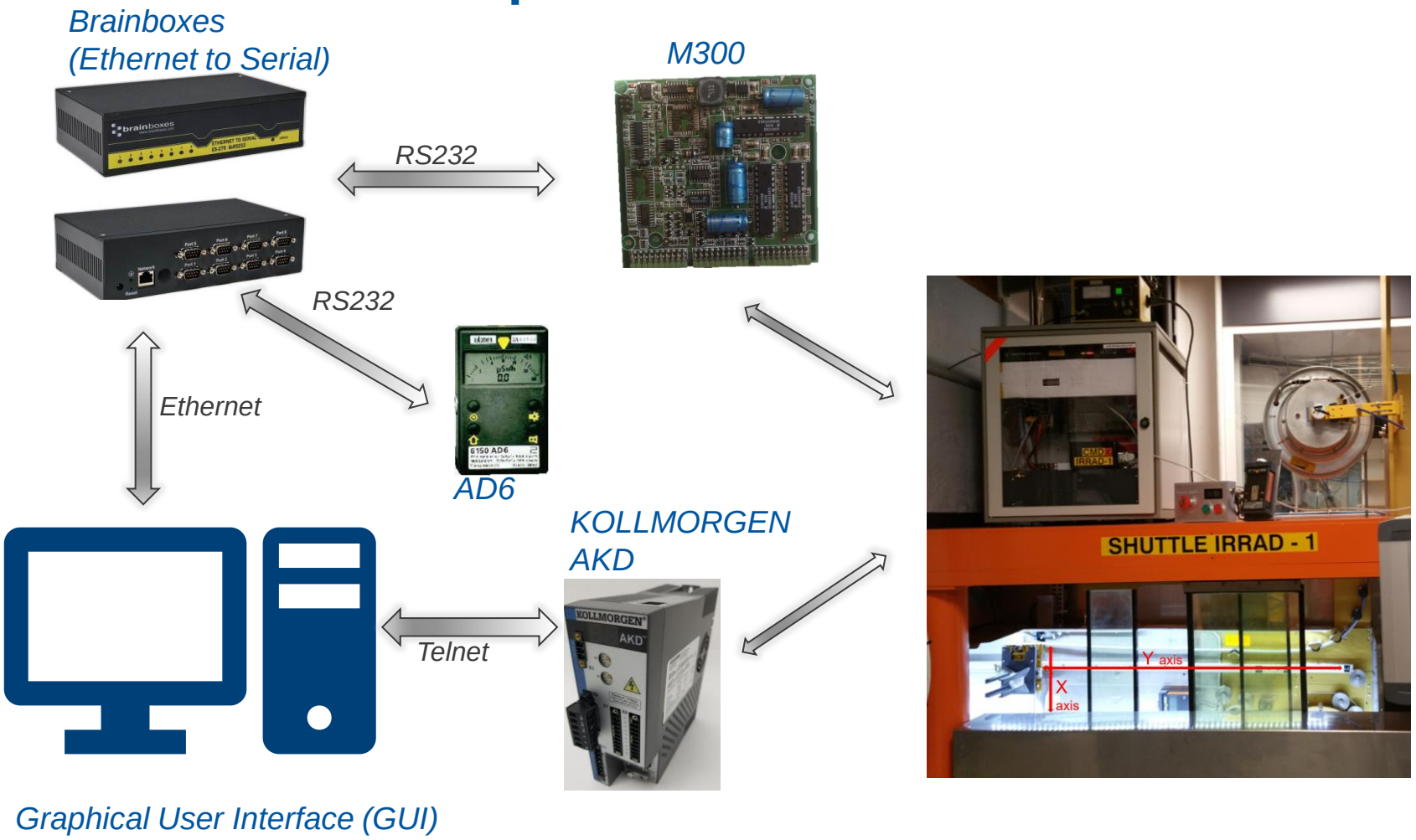
IRRAD Shuttle Control System

- Movements between irradiation zone and out
- 2 movements:
  - Y axis 9-m-long path
  - X axis 63 mm
- Irradiations room temperature
  - V_{max} = 5×5×15 cm^3
  - mainly passive samples
- Radiation levels monitored



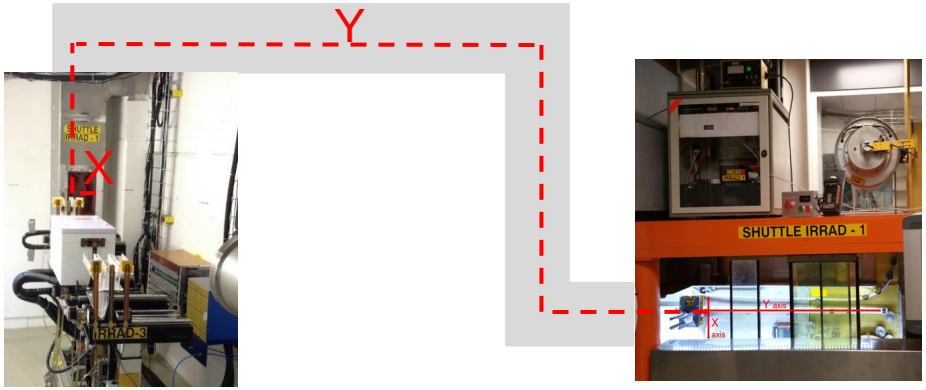
IRRAD Shuttle Control System: Hardware Components & Communication

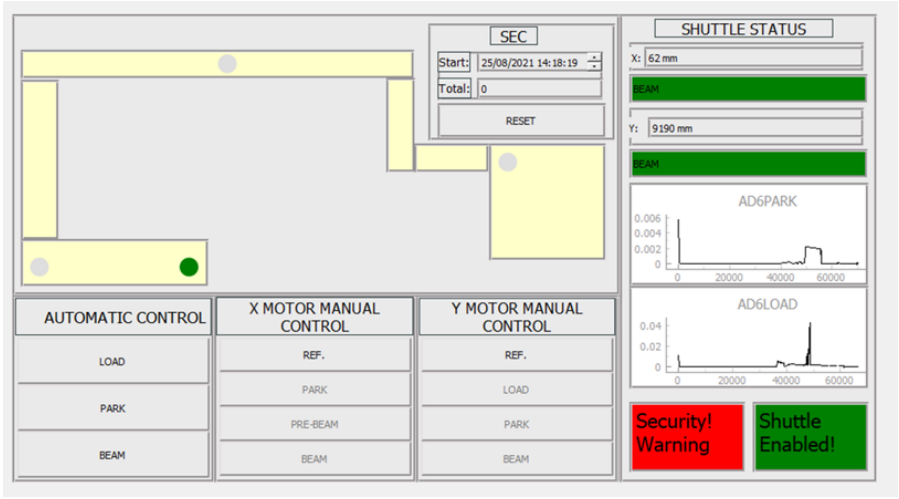


IRRAD Shuttle Control System: GUIs and functionalities

Same software technologies as IRRAD Table Control System GUIs

- Moving positions Load, Park, Beam
- Monitoring and visualising activity
- Software interlocks
- Position visualisation
- Cumulated proton intensity monitored when shuttle in beam





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Lessons Learned

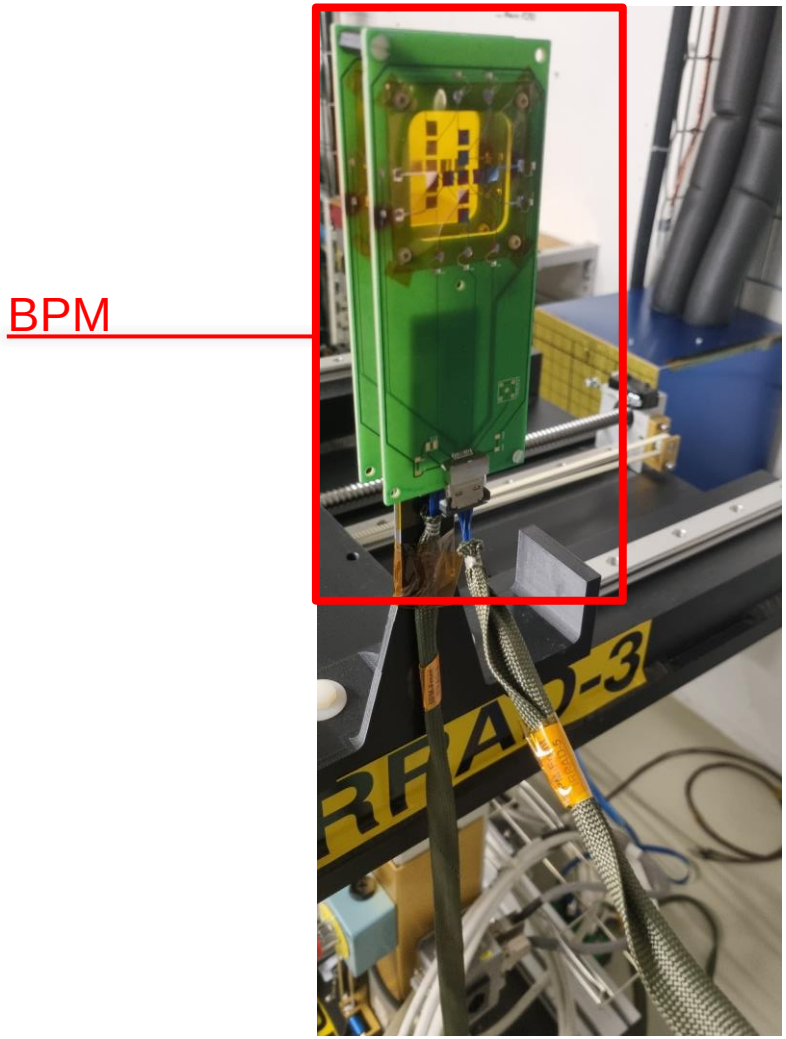
- **Common programming languages** like **Python** can improve:
  - ✓ **scalability**
  - ✓ **maintainability**

  for a small-scale infrastructure
- **Open-source** and **free-license** software:
  - ✓ can **save development time** in the future
  - ✓ find **easily solutions** from **documentation** and large-scale **community**
- **Cross-platform** technologies:
  - ✓ can improve **portability**
  - ✓ **Remove constraints on operating system**

Future Work

1. Beam Position Monitors (BPM) positioned on IRRAD table → Automatic movement of tables in and out of beam

2. Web interfaces for the software control system



Summary

- IRRAD Control systems overview
- IRRAD Control System GUIs upgraded:
  - Open-license and cross-platform technologies used
  - New functionalities
- This upgrade improved:
  - Scalability
  - Maintainability
  - Portability
- Future Work:
  - New developments (BPMs) can be integrated
  - Web interfaces under discussed