



EUROPEAN SPALLATION SOURCE



Student Projects in Machine Learning at ESS

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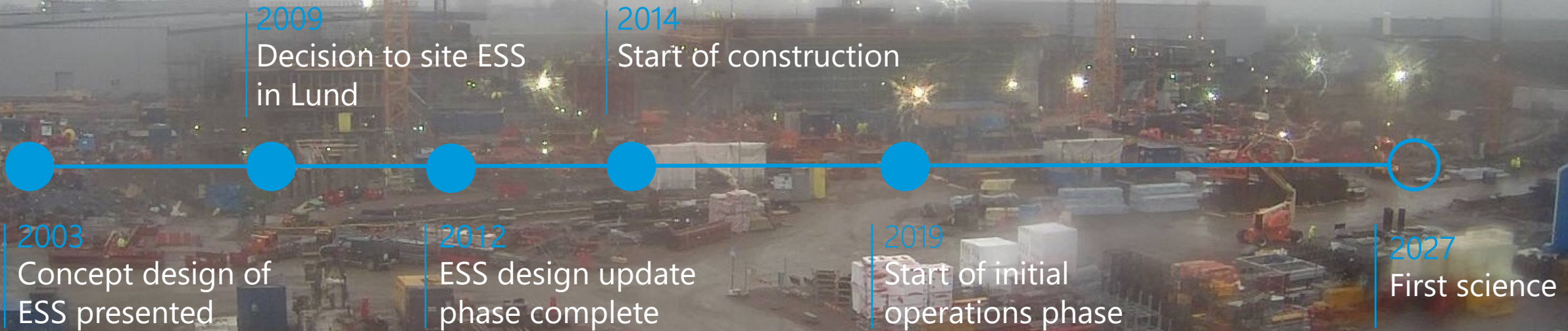
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2024-10-16



European Spallation Source





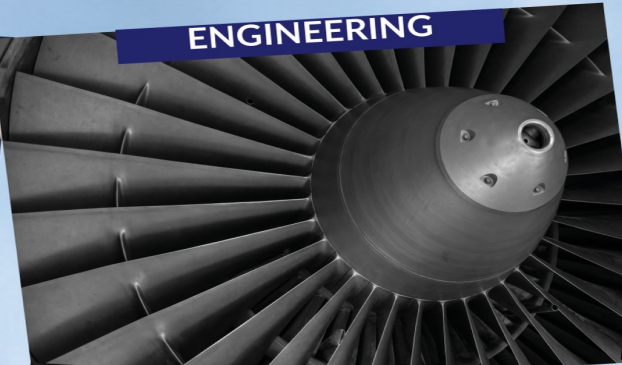
MEDICINE & HEALTH



ENERGY



ENGINEERING



WORLD AROUND US



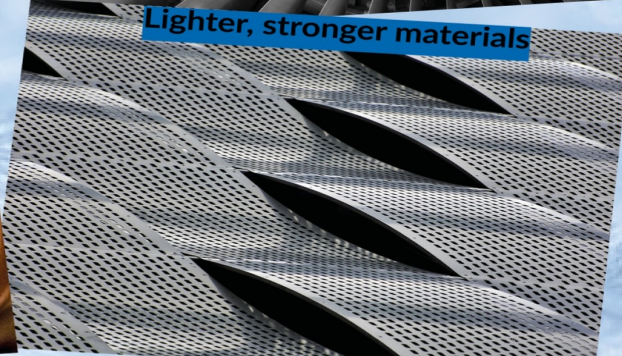
Drug development



Better batteries



Lighter, stronger materials



Advanced data storage



New generation MRI



Green fuel



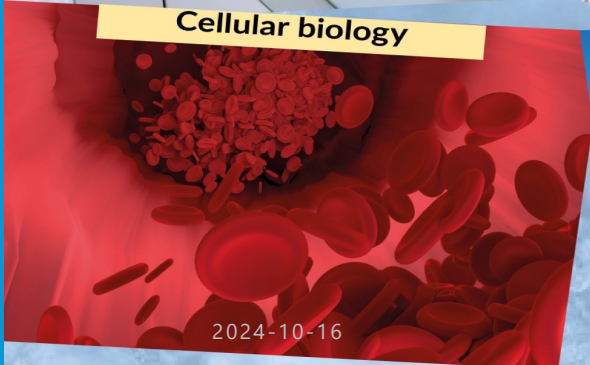
Superconductivity



Disease resistant crops



Cellular biology



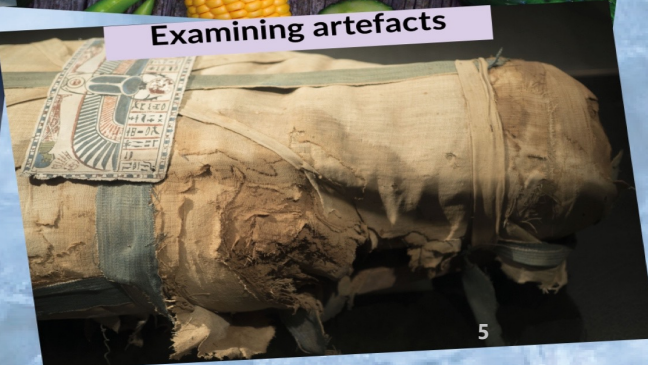
Improved solar cells



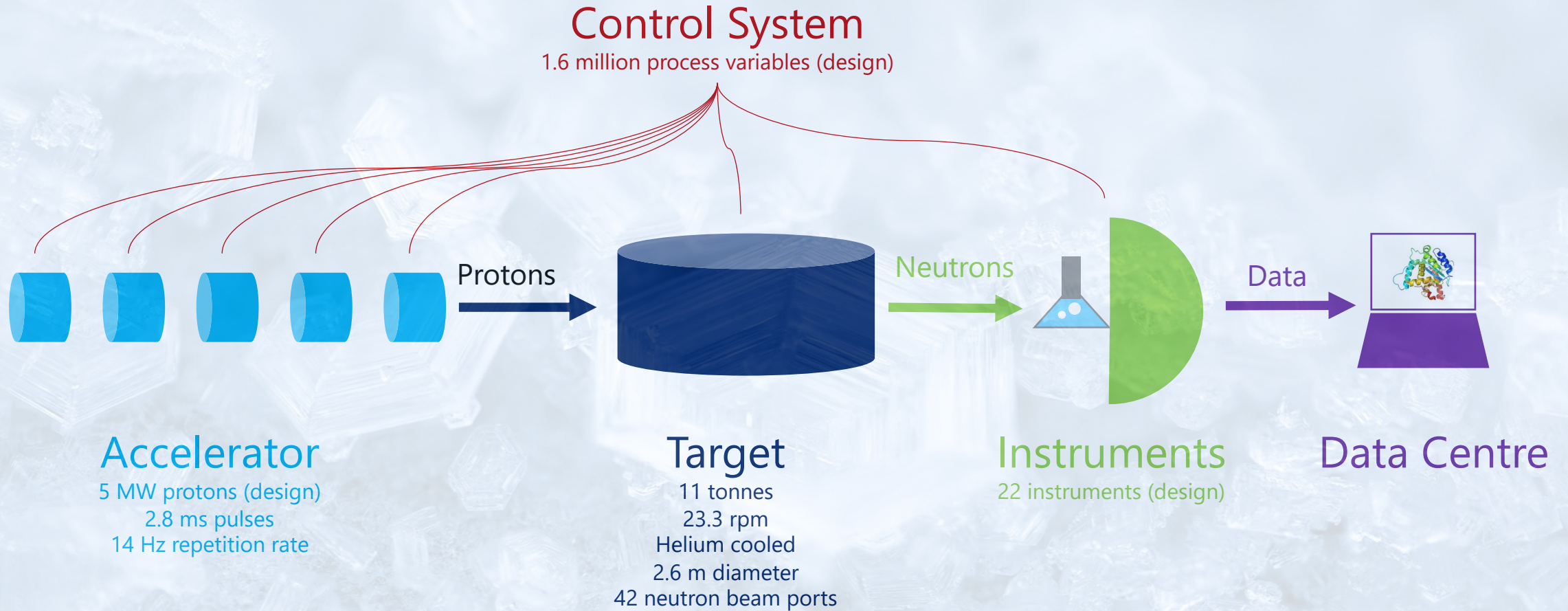
Better catalytic systems



Examining artefacts



The ESS Machine





Main Control Room

Target

Instruments

Accelerator

ESS is a *user facility*.

Scientists from all over the world will be welcomed to ESS with their specimens to do experiments.

Expectations:

- 800 experiments per year
- 3 000 guest scientists per year

Challenges

- Accelerator – based facilities are some of the worlds most complex systems
- ESS is a user facility with a 95% availability goal
 - High availability requirements on equipment
 - The control system plays a key role for the availability of the facility



Control System Machine Learning Project



Objective: Explore if machine learning can be used to

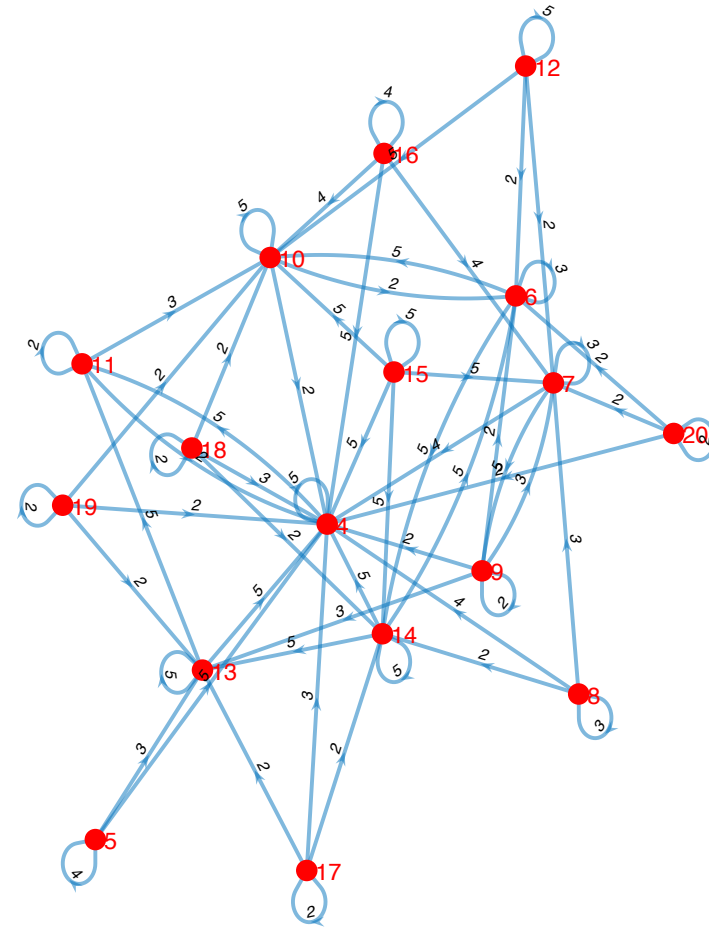
- Increase facility availability.
- Increase efficiency of operation
- Enhance process understanding
- Lower operational and maintenance costs
- Decrease commissioning time



Master project on alarm cascades

2023

- **Title:** Causal event processes and alarm analysis at ESS
- **Student:**
- **Department:** Automatic controls, Lund University.
- **Degree:** MsC in Machine Learning, Systems and Control
- **ESS Supervisor:**
- **Thesis:** To be published.





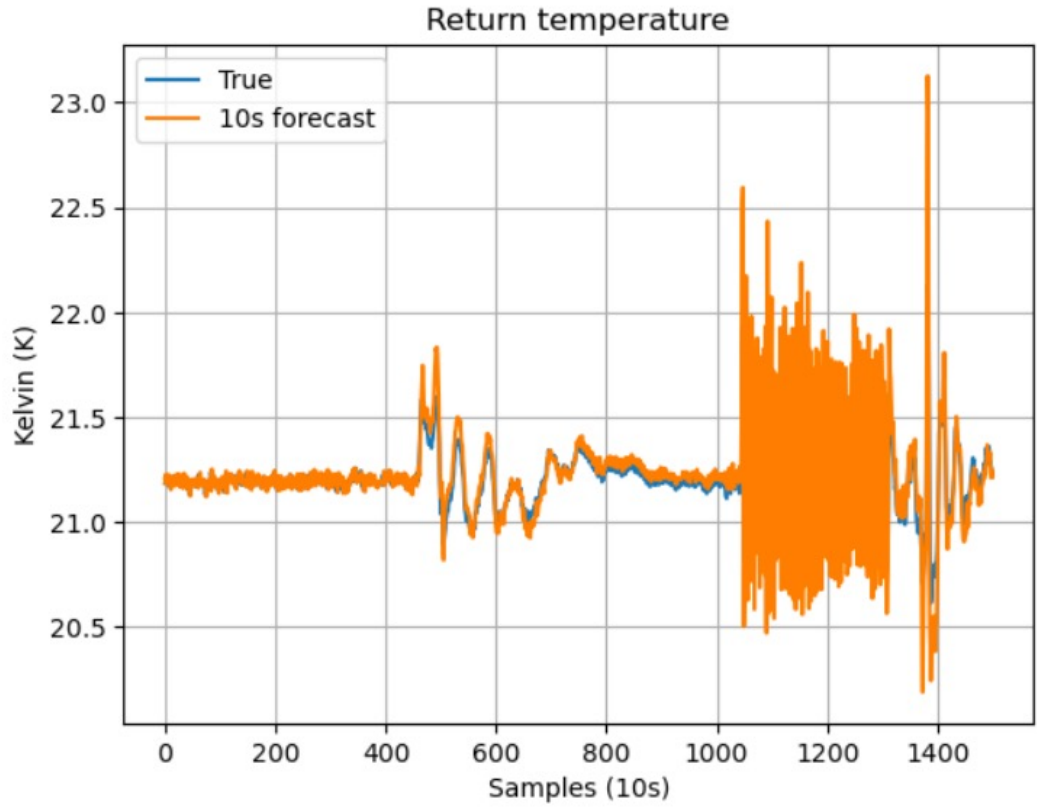
PID tuning (summer work)

2024

PID tuning: Use LSTM to tune PIDs for the CMS subsystem

Student:

ESS Supervisors:



Master project: Tuning of the DTL

2022

Title: Tuning of the ESS Drift Tube Linac using Machine Learning

Student:

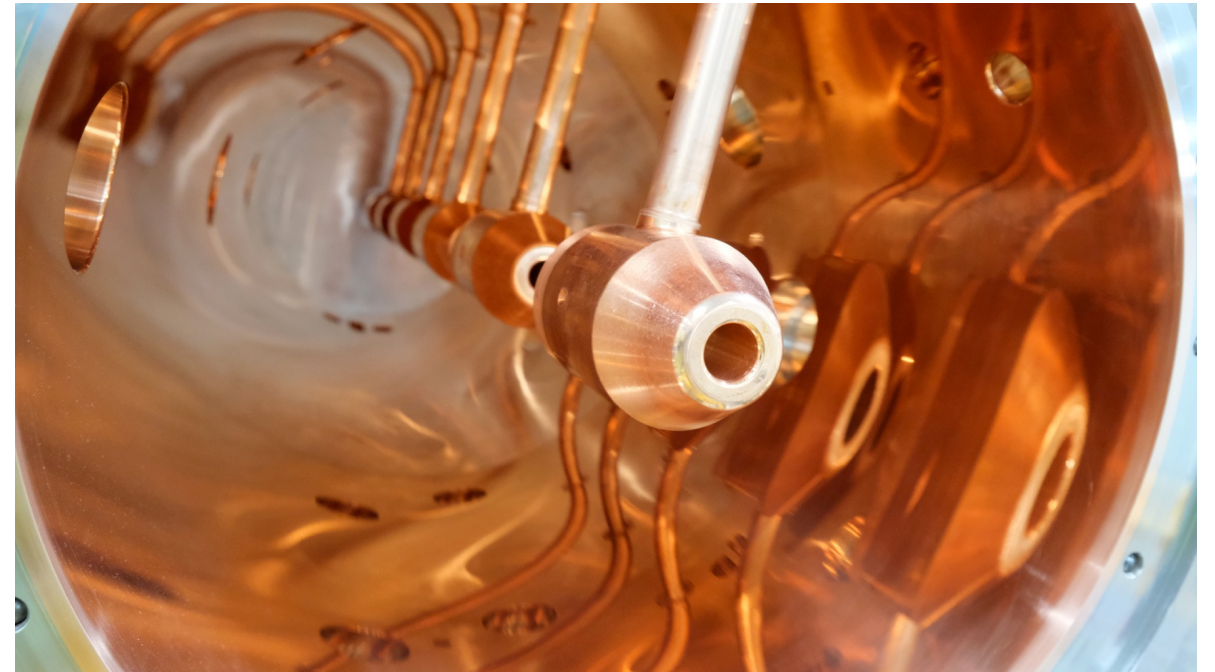
Thesis:

<https://lup.lub.lu.se/luur/download?func=downloadFile&recordId=9075906&fileId=9075910>

Department: Physics Department Lund University

Degree: Master's Program in Physics

ESS Supervisors:



Master project: Tuning of the DTL

2023

Title: Developing an ML-based model for RF tuning of DTL machine at ESS

Student:

Thesis: <https://lup.lub.lu.se/student-papers/search/publication/9141984>

Department: Automatic Controls LU

Degree: Master's Program in Machine Learning, Systems and Control

ESS Supervisors:





Internship

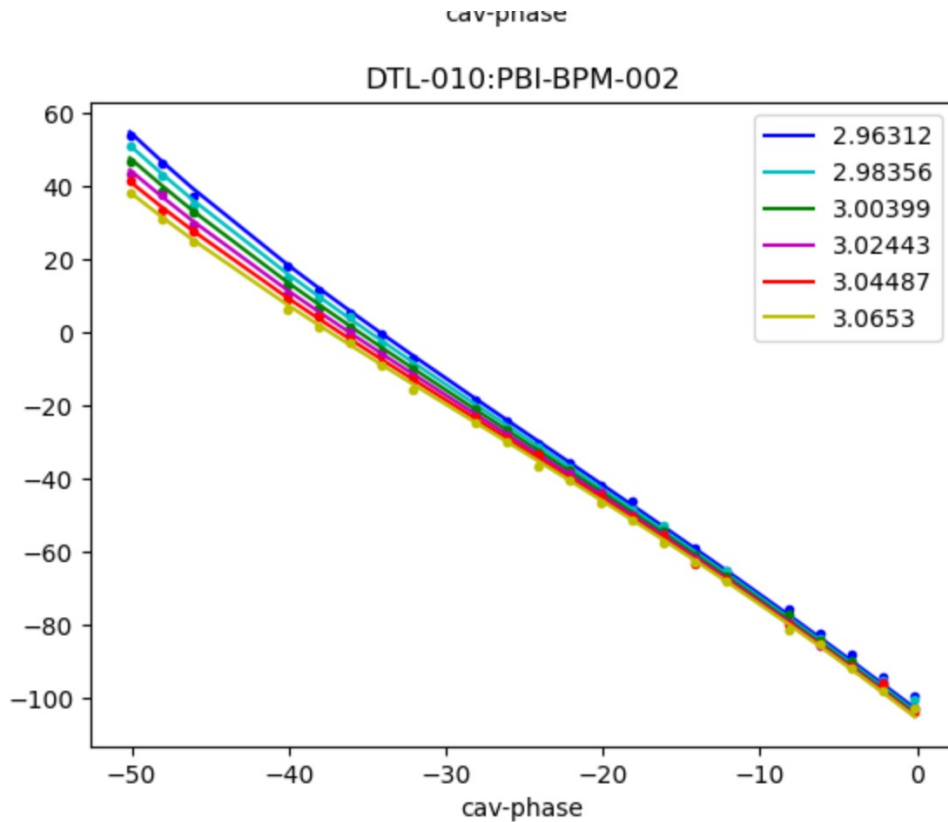
2024

Description: Develop/improve data for operation of the Linac, by using statistics, machine learning and computational methods.

Student:

Department: Math department, University of Bayreuth.

ESS Supervisors:



Target Wheel

2023

Title: Software Process Workflow for Smart Anomaly Detection Systems

Degree: BSc Software Engineering and Management

University: Chalmers and Göteborg University

ESS Supervisor:

Thesis:

<https://gupea.ub.gu.se/handle/2077/78206>



Master project: Rototics

2024

- **Title:** Flexible Computer Vision based Sample Switching System using a Robotic Arm
- **Students:**
- **Department:** Automatic controls, Lund University.
- **Degree:** MsC in Machine Learning, Systems and Control
- **ESS Supervisor:**
- **Thesis:** <http://lup.lub.lu.se/student-papers/record/9171814>



Upcoming Master project

2025

- **Title:** Adaptive science with Robot.
- **Students:** TBD
- **Department:** Automatic controls, Lund University.
- **Degree:** MsC in Machine Learning, Systems and Control
- **ESS Supervisor:**





Other upcoming master projects

2025

- **Data Science:** Control systems data investigation.
- **Software Science:** Workflow and software ecosystem for Machine Learning in control system.
- **Physics:** Simulator and physics informed neural networks.
- **Image processing:** Extract information relevant for operations from images of the proton beam density.



Thank you!