

# ACCLAIM Kick-off

DESY-M

Annika Eichler for DESY-M

15.1.2021



# Group

## People involved

### Machine Physics Group

- Ilya Agapov
- Andrei Ivanov (PostDoc from AMALEA)
- + PostDoc

### Machine Beam Control Group

- Annika Eichler
- + PhD Student

# Recent Work

## Modeling and Control: MPY (Andrei Ivanov and Ilya Agapov)

### Modelling using physic-based Neural Networks (TM-PNN)

- Taylor maps for ODEs to deep neural networks
- Application to PETRA III

### Experiments at PETRA with TM-PNN

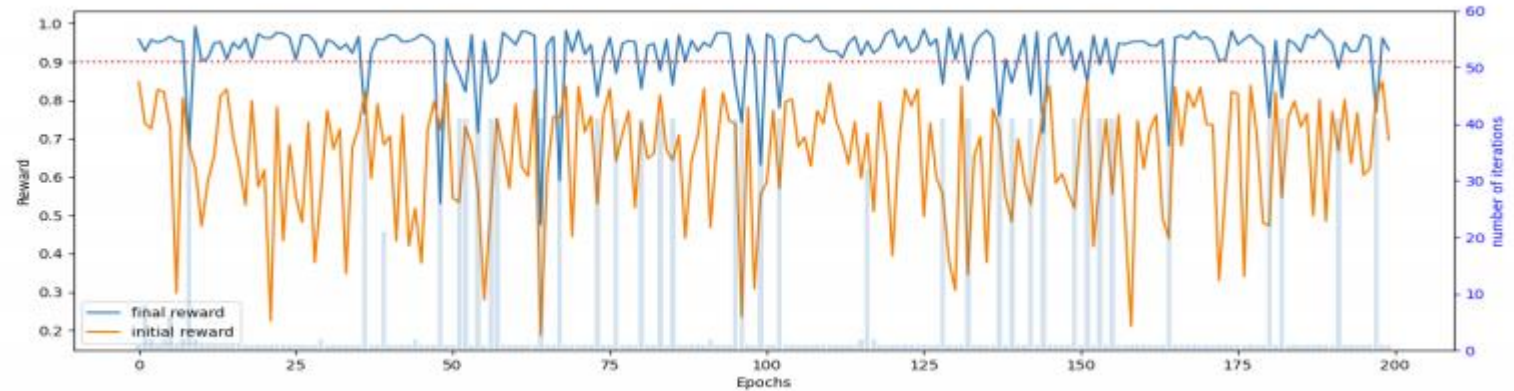
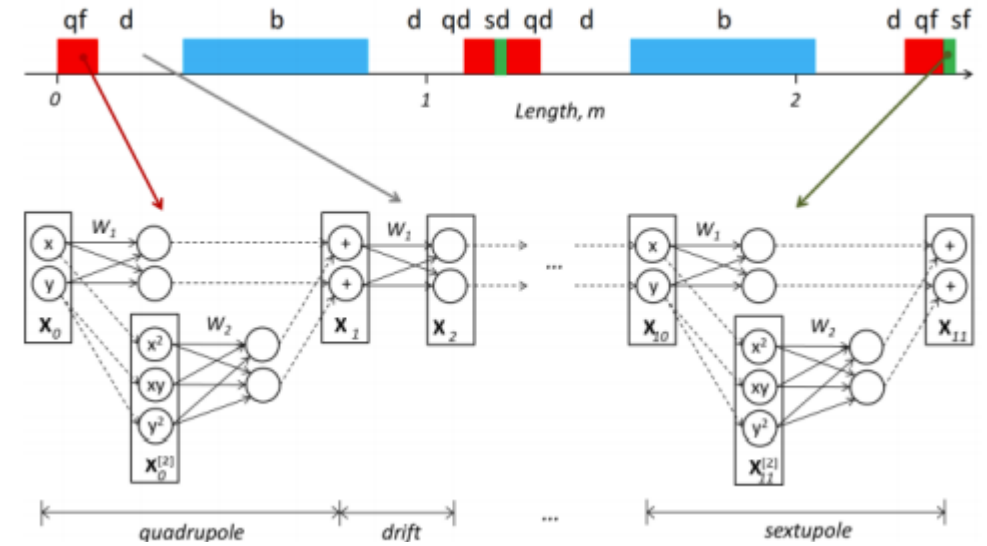
- Orbit correction
- Tune recovering
- Optics measurement

### Exploiting models for control

- Model-based Reinforcement learning using TM-PNN

### Agent-based architecture for experiments and operation

- First tests based on KAFKA

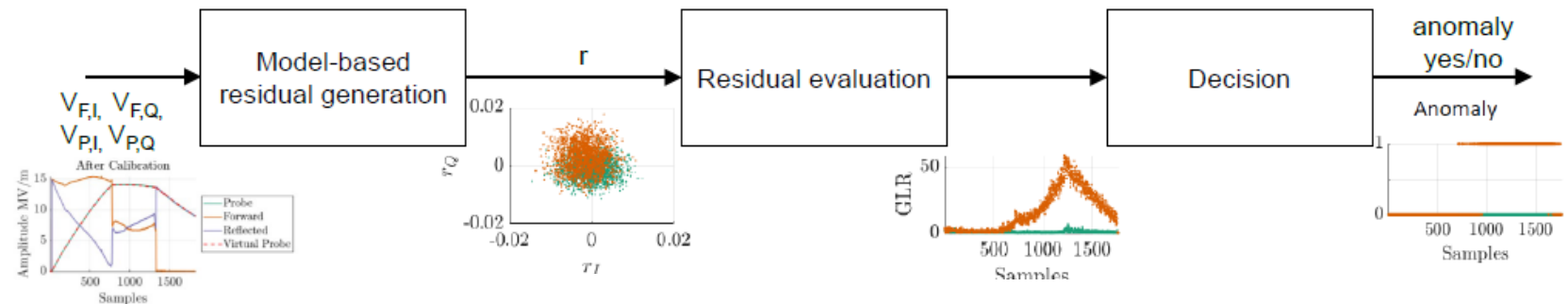


# Recent Work

## Diagnosis and Control: MSK (Ayla Navwaz, Jan Timm, Annika Eichler)

### Hybrid fault diagnosis to detect system failures online

- Application: Quench detection for SRF cavities
- Hybrid: Model-based and data-driven
  - Unscented Kalman filter
  - Stochastic evaluation with generalized likelihood ratio
  - Classification to distinguish faults
- Online implementation
- Data-base of all events in the LLRF system in the last 2 years



# Plans

## And Ideas for ACCLAIM

### ML-assisted Control

- Continue work on control based on the **TM-PNN**
- From TM-PNN-based beam steering to ML-assisted machine start-up and optics adjustment

### ML-assisted Fault Diagnosis

- Detect faults (anomaly detection) with hybrid approaches
- Root-cause analysis of faults (where in the facility is its origin and what is the problem)
- Control strategies in case of a fault



### Common goals (ACCLAIM)

- Transfer of TM-PNN modelling and control from storage rings to FELs
  - Common modelling baseline
- Common agent-based architecture for experiments, operation and diagnosis