

2024

- Prototypes for near real time analysis with feedback



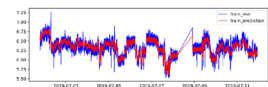
2025

- Operation-critical intelligence on machine & experiment status

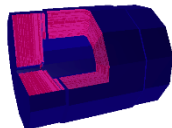


2027

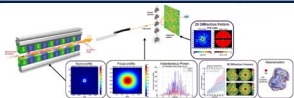
- Complete simulations of systems, experiments & machines



A.I.-optimized injection



Full, generic detector descriptions



Start-to-end workflows



Accelerator optimization

## Exascale Plasma accelerator simulation

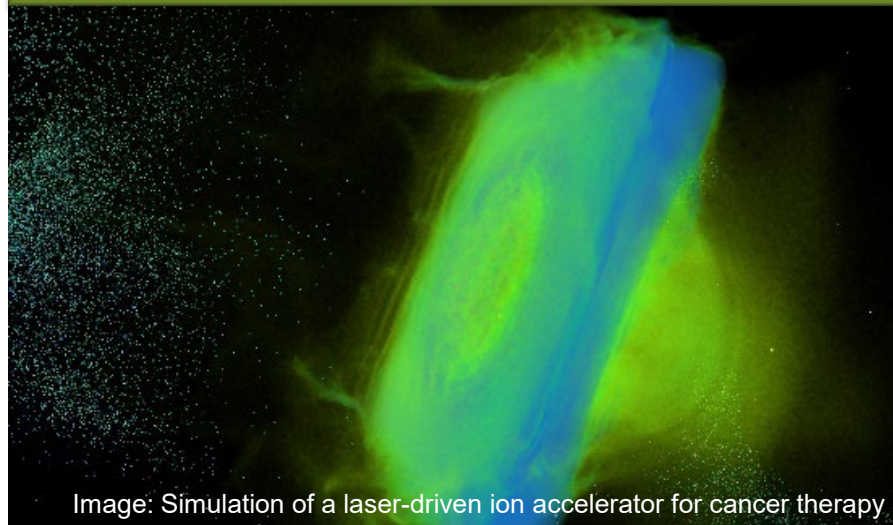


Image: Simulation of a laser-driven ion accelerator for cancer therapy

- Simulation
- In situ Data Analytics
- Near real time feedback
- Machine optimization

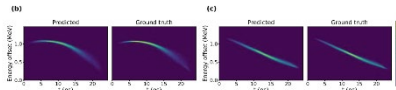
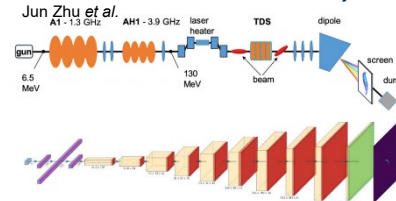
## Do we have everybody “on board”?

- 35 “working” people on the ST3 mailing list, more to come
- Participating centres: DESY, FZJ, HZB, HZDR + x?

## Status of the projects in ST3:

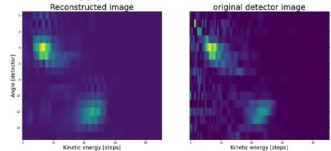
- Projects based on existing MT collaborations have been initiated:

### DL-Autoencoder for an RF Photoinjector



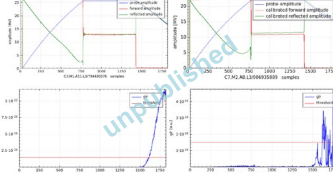
### Noise reduction in Angular Streaking

David Meier *et al.*



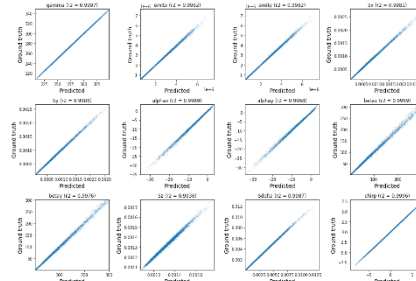
### Model-based Anomaly Detection

Annika Eichler *et al.*



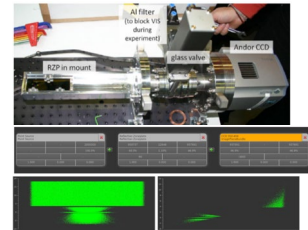
### Surrogate model for EuXFEL injector

Jun Zhu *et al.*



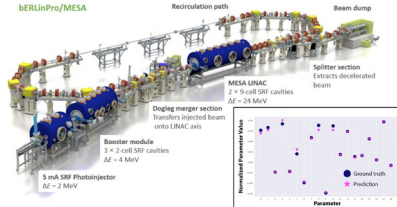
### AI-based Spectrometer Optimization

Peter Feuer-Forsen *et al.*



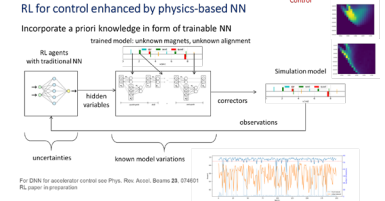
### bERLinPro Offset Finding & Optimization

David Meier *et al.*



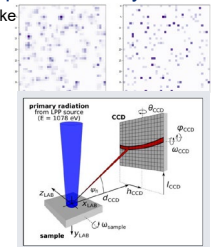
### Towards autonomous accelerator operation

Ilya Agapov *et al.*



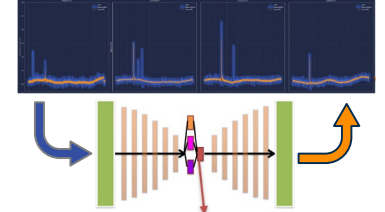
### Fast Multi-pixel Hit-Analysis of 2D-Detectors

Gesa Goetzke *et al.*



### FLASH2 Single-shot Diagnostics with $\beta$ -VAE

Gregor Hartmann *et al.*



## Internationally “state of the art”?

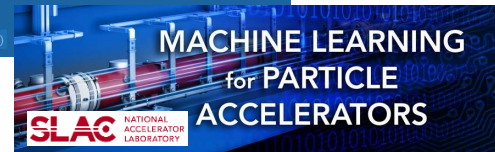
- ICALEPCS (large facility controls)
- Dedicated ML workshop (series) at different facilities, ...
- “DIGITAL LEAPS”, which is ramping up:

ICALEPCS 2019: Data Science and Machine Learning Workshop

Sunday 6 Oct 2019, 08:30 → 18:00 US/Eastern

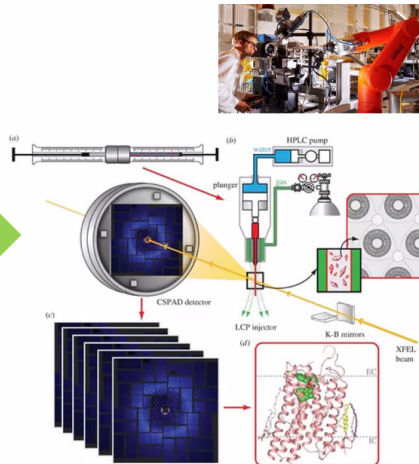
Marriott at The Brooklyn Bridge

Manuel Gonzalez Berges (CERN), Marco Lonza (Elettra - Trieste)



## Digital LEAPS

- **AI-assisted resilient and energy-saving operation of LEAPS Research Infrastructures**  
Autonomous operation of complex accelerators  
Remote operation
- **Digital user operation modes**  
Remote user experiments  
Real-time analysis of data and real-time (exascale) simulations
- **Advanced digital communication**  
Lessons Learnt: new digital forms of communication between labs and between labs and users
- **Digital training concepts**  
New forms of training exploiting Virtual Reality (from schools to universities)
- **AI-assisted molecular infection fight**  
LEAPS facilities prepare for future infection *fight* (virus, bacteria, parasites)
- **Advanced materials for the digital transformation and circular economy**



**LEAPS** League of European Accelerator-based Photon Sources

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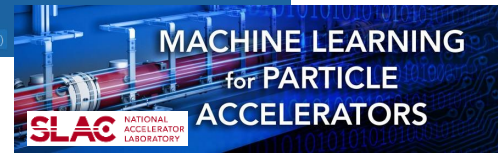
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DIGITAL LEAPS

### DIGITAL LEAPS (DL):

a new Pathway of LEAPS Facilities into the Post-Corona Era

The DL proposal is made up by four projects:

- **ST**andardisation for **R**emote **S**ample Handling (**STARS**)
- **LEAPS** **I**ntegrated **P**latform (**LIP**)
- Reference Design for a Fully Automated User Beamline
- Collaboration Platform for LEAPS Members: From Technology News to “Innovation Mall”

Further LEAPS internal projects related to **Developments of Facilities** and to **Platforms and Networks** are proposed and they may be included in a different time scale.





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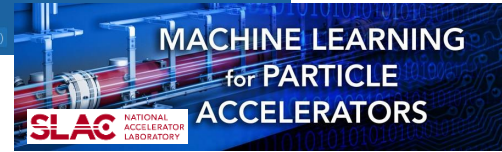
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DIGITAL  
LEAPS

## LIP will enable faster and synchronized progress for intelligent & resilient operation of facilities

### Work packages

- WP 1: LEAPS Integrated Platform (LIP)
- WP 2: Scientific Computing (SC)
- WP 3: Machine Learning (ML)
- WP 4: Virtual Diagnostic (VD)
- WP 5: Androids for Remote Access (ARA)
- WP 6: Remote Training (RT)

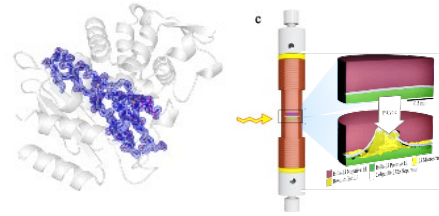
### Role of LIP

*Coordination between centres (we are stronger together), facilitate information exchange and fellowship programme, define interfaces, be inclusive, integration with existing work that is already being done at facilities.*



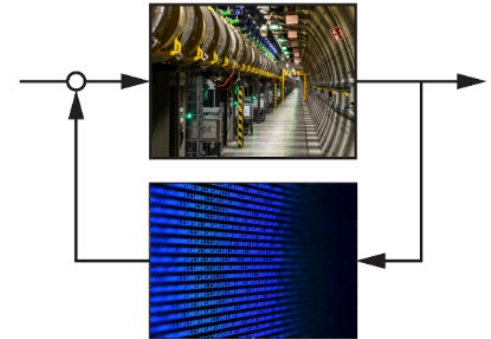
## Challenges for the next two years?

- Establish „network“,
- Get the „users“ engaged
- Define „hot topics“ / adopt / re-define strategy (“remote”!)
- Recruiting talents, ...



## Concentrate during the next two years on:

- Define „pilots“, start implementing the first ones...
- „Outreach“: workshop(s) annually (interleaved with MT meeting)
- Hackathon, graduate schools (HIDSS, DASHH, ...), CDCS



# DMA ST3



## Cross-center activities

- Further centres?

## Interaction with ST1/ST2

- Discuss requirements for the next two years (data management, data handling / methods)

## Interaction with ARD/DTS

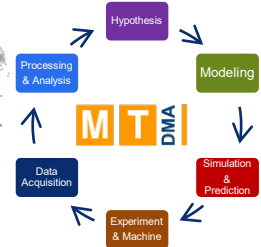
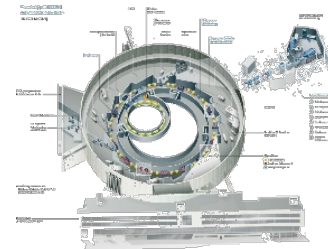
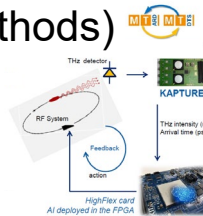
- Both on MT level as well as within the facilities? (push towards DMA?)

## Interaction with MU/MML

- “Start-to-end simulations” would be a joint topic (w. ARD/DTS),
- Users from MML, else?

## Further interaction with

- Innopool (AMALEA/ACCLAIM, Data-X, ...), Helmholtz.AI, HMC, HIP, HIR^3X, ...



DMA ST3 discussion board:

[https://miro.com/app/board/o9J\\_1WSrfxE=/  
/](https://miro.com/app/board/o9J_1WSrfxE=/)

HELMHOLTZAI | ARTIFICIAL INTELLIGENCE COOPERATION UNIT

HiP | HELMHOLTZ IMAGING PLATFORM

<HMC> | HELMHOLTZ METADATA COLLABORATION

