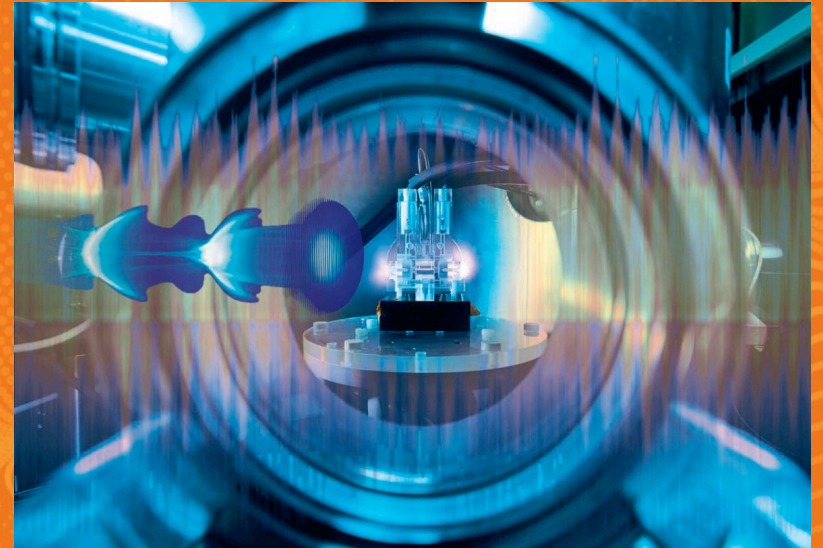
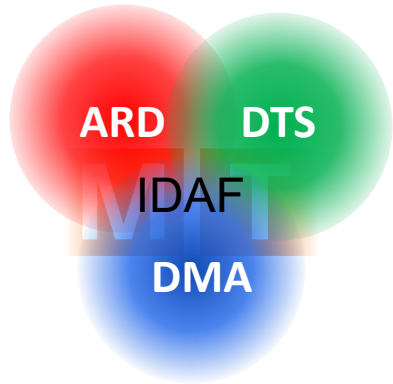
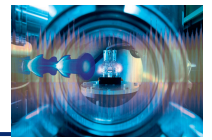


PROGRAM Matter and Technologies



Matter and Technologies

Technologies for Science



Accelerator science
Detector science
Data analytics

- Research in *Matter* is bold and broad
- It relies on people and on advanced technologies

MT is a program for the future of *Matter*
closely intertwined with MML and MU

Matter and Technologies

Other areas
Industry

R&D

- Fundamental R&D
- Research in technologies

Growth

- Prototyping
- Designing systems
- Scalability

Maturity

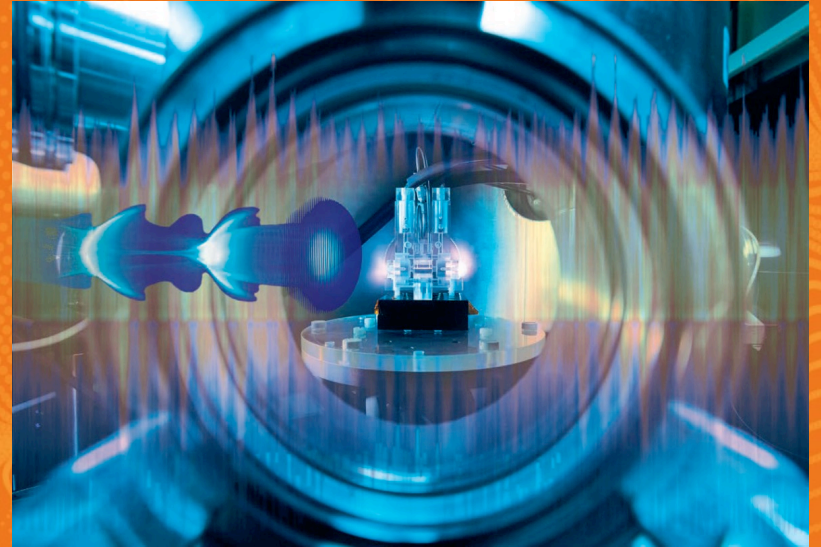
- Developing facilities
- Building infrastructures
- Applications

Decline

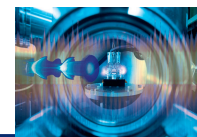
- Decommissioning

User communities

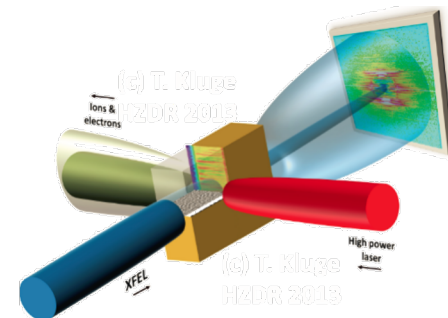
Data Management and Analysis (DMA)



DMA – Mission & Goals



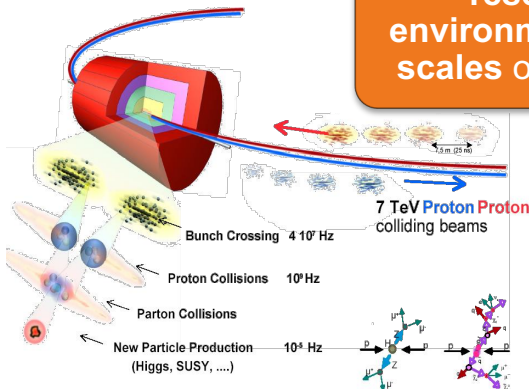
Boosting science in Matter through application-driven, leading edge research in Computer and Data Science



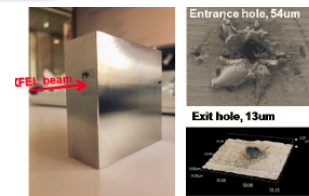
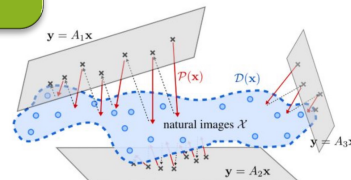
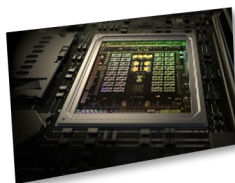
Create a sophisticated research environment on all scales of research

Develop and apply new digital methods and disruptive technologies to push science to the limits

Digital scientific workflows for experiments and machines to maximize scientific gain

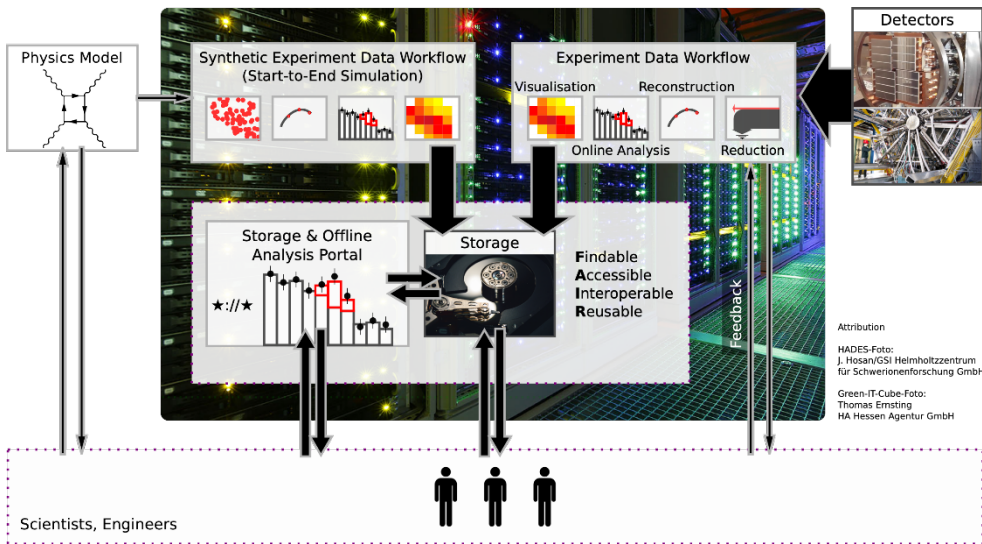
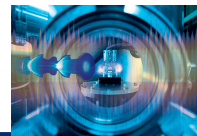


Selection of 1 event in 10,000,000,000,000



50 mm drilled in 26sec
~ 6% of max beam

I. Focus – ST 1 / The Matter Information Fabric



Design & implement **high performance hard- & software infrastructures** for the scientific data lifecycle and machine operation for facilities in Matter

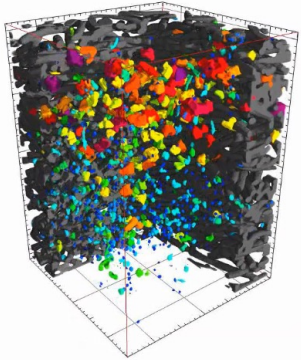
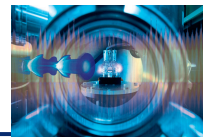
- **Exascale** data ingest, transport, compression, reduction & analysis
- **Meta Data & F.A.I.R.** principles
- **Long term** archiving & preservation
- **Portable & modular** solutions

2022: Define needs of the communities

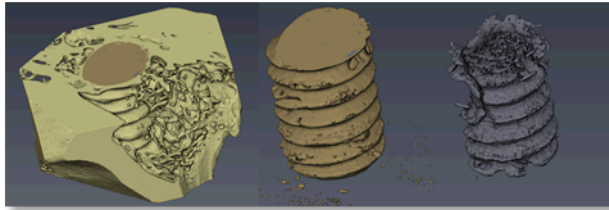
2024: Design infrastructure prototype

2027: Review prototype implemented

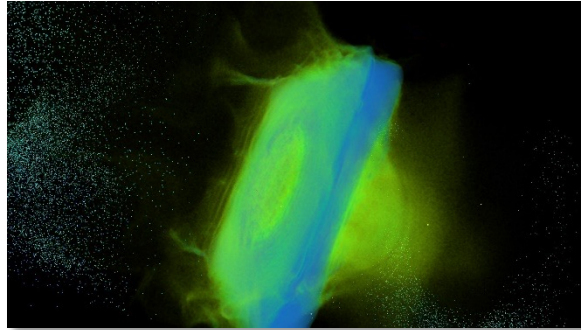
I. Focus – ST 2 / The Digital Scientific Method



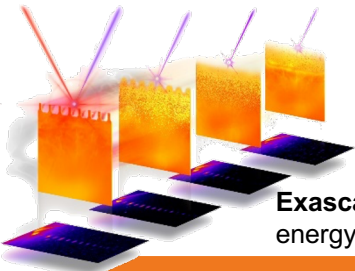
Near real-time **segmentation** of battery electrode data by AI



Near real-time **segmentation** of bone implant data by AI



Exascale simulations of laser-driven ion acceleration



Exascale simulations of high energy density plasmas

Develop, apply and share **cutting edge digital methods and frontier technologies** for research in Matter.

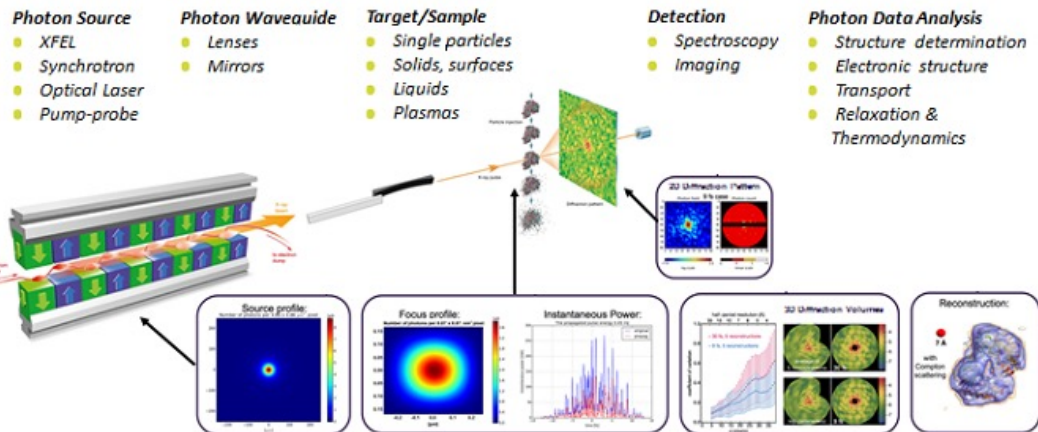
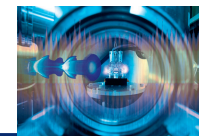
- Artificial Intelligence
- Exascale Computing
- High Throughput Computing
- Quantum Computing
- Near real-time analysis

2023: DMA Open Solutions Toolbox

2025: Near real-time capabilities

2027: Surrogate modelling

I. Focus – ST 3 / The Digital Experiment & Machine



Full digitalisation of experiments with feedback and machine control

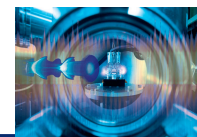
- Near real-time analysis
- Start-to-end simulations
- Digital Twins of experiments
- Fast feedback
- Machine / experiment optimization
- In-situ / in-operando Visual Analytics
- Open data standards

2024: Near-realtime analysis prototype

2025: Operation-critical intelligence

2027: Digital Twins

II. Share – Synergies, Open Science & Education



DMA creates synergies in Matter between

- Helmholtz Centers & Facilities
- Research Programs (MU,MML,MT)
- Science Domains

DMA develops open, shareable solutions for Matter

- **Open Source, modular** solutions, open standards
- Professional, industry-grade software development
- **F.A.I.R.** Data
- **S4M: S**hared, **s**calable **s**olutions for **s**cience in **M**atter

DMA educates scientists & fosters talents

- **New Formats:** Hackathons, Datathons, Hands-on
- **New Career Paths:** Data Scientist, Software Engineer
- **New Indicators:** Software & Data Citation

FairShip http://ship.web.cern.ch/ship/	AliceO2 http://alice-o2.web.cern.ch/
BNMRoot http://mpd.jinr.ru	MPDRoot http://mpd.jinr.ru
ExpertRoot http://er.jinr.ru/	R3BRoot https://www.gsl.de/r3b
PandaRoot https://panda.gsl.de/	CbmRoot https://cbm-wiki.gsl.de

FairRoot / ALFA

Event Generators	FairMQ	Geometry	Detector Response	Magnetic Field	...
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Generic Software Stack

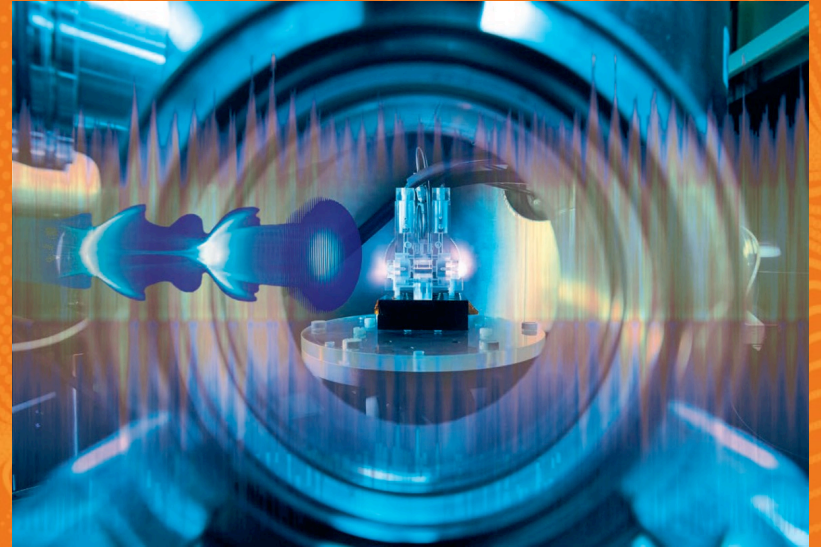
Boost	Sim Engines	CMake	ROOT	Google Test	...
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DATA SCIENTIST
The Sexiest Job of the 21st Century

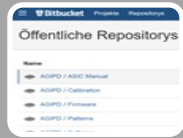
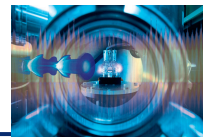
DMA ST 2 – The Digital Scientific Method

M. Al-Turany (GSI)

G. Juckland. (HZDR)

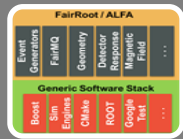


Milestones:



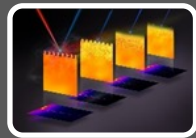
2023

- DMA repository of interconnectable, modular software in full operation



2025

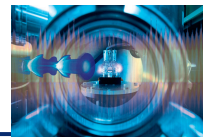
- Toolbox for near-realtime data analysis at extreme scales available



2027

- Surrogate models of multi-source, multi-modal experiments

Cooperation with EOSC



2023

- DMA repository of interconnectable, modular software in full operation



02/2019 - 08/2022



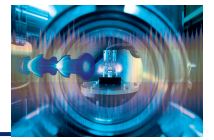
ESCAPE

OSSR

Open-source Scientific Software
and Service Repository

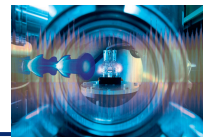
A sustainable open-access repository to share scientific software and services to the science community and enable open science

General Requirement on HGF side



- **Open Source, modular** solutions, open standards
- **F.A.I.R.** principles
- **S4M: S**hared, **s**calable **s**olutions for **s**cience in **M**atter

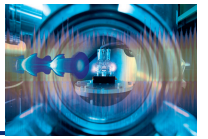
General requirement on HGF side



- **Open Source, modular** solutions, open standards
- **F.A.I.R.** principles
- **S4M: S**hared, **s**calable **s**olutions for **s**cience in **M**atter

The same requirement as in ESCAPE WP3

Open Questions:



- Interoperability with data repos in the future (testing, validating, AI models, etc)
- Catalogue: Central, federated or hierarchical approach ?
- Technical details:
 - Helmholtz AAI
 - Metadata details