

# Research Field Matter

**Dr. Michael Bussmann, Prof. Dr. Volker Gülzow**

*Topic Speaker Data Management & Analysis*



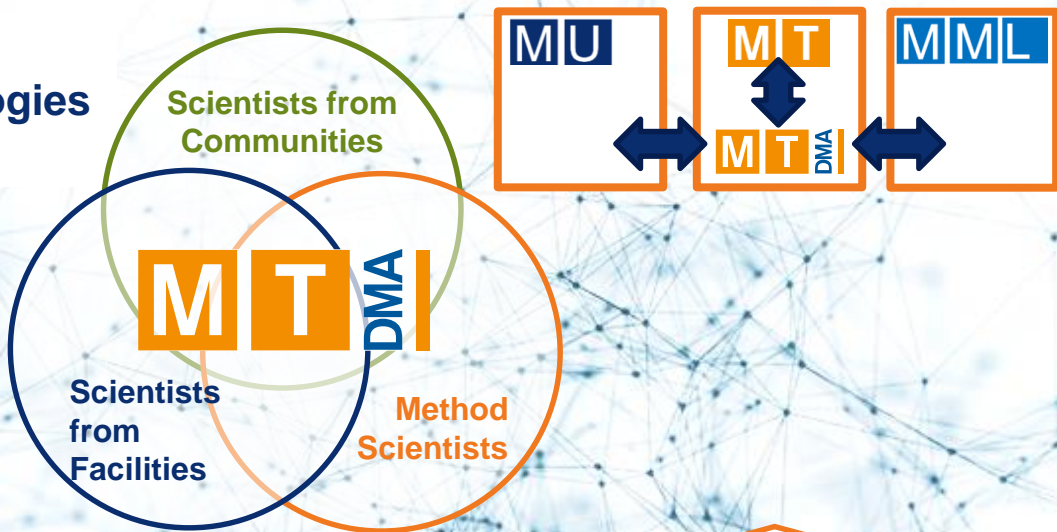
**The topic Data Management & Analysis (DMA)**

# Research Field Matter Data Management & Analysis

## Who we are

### Research Field Matter

- Programm Matter & Technologies
- Topic DMA



### Topic Speakers



M. Bussmann V. Guelzow

### ST1 Speakers



Y. Kemp K. Schwarz

### ST2 Speakers

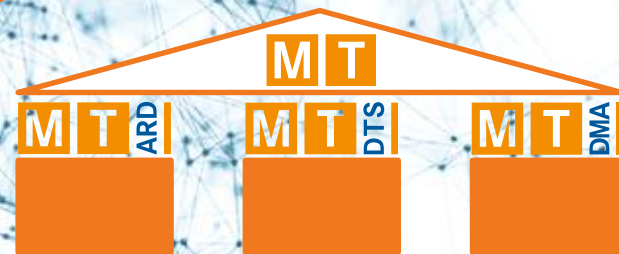


M. Al-Turany G. Juckeland

### ST3 Speakers



J. Viefhaus T. Wilksen



# Research Field Matter

## Digitalisation Strategy



	LK II (User facilities)	International Research Infrastructures	National Research Institutes / Infrastructures
DESY	FLASH PETRA III IDAF	LHC Belle II CTA ( <i>under construction</i> ) IceCube European XFEL ESRF	CFEL CSSB NanoLab DESY Test Beams DAF HIB@European XFEL PITZ
FZJ	JCNS (in MLZ)	ESS ( <i>under construction</i> ) ILL	(FRM-II)
GSI	UNILAC SIS 18 ESR	FAIR ( <i>under construction</i> ) ALICE@LHC	HI Jena HI Mainz
Hereon	GEMS	ESS ( <i>under construction</i> )	EMSC
HZB	BESSY II		SupraLab EMIL
HZDR	ELBE HLD IBC	European XFEL EMFL ESRF	HIB@European XFEL DRESDYN
KIT	GridKa	KATRIN Auger IceCube	ATP FLUTE TLK SR Beamlines

- Unique Research Facilities
- Many scientific domains and a diverse user community from university, research institutes and industry
- Digitalisation is important for
  - Efficient and sustainable operation
  - Optimum use of research infrastructures
  - Knowledge extraction from research data
  - Frontier science as a driver of innovation
- Topic DMA established in POF IV



# Research Field Matter

## The 10 Goals of the Matter Digitalisation Strategy

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1. **Enabling frontier science** through federated compute, data and service infrastructures across centres and communities
2. **Sustaining technological leadership** in scientific simulation, data analytics and machine/experiment control through cutting edge technologies such as AI, Exascale and Quantum Computing
3. **Providing an integrated support infrastructure** for the diverse user communities of our research infrastructure
4. **Supporting user communities** in disseminating and using scientific data in an open, sustainable and F.A.I.R. way (Open Science!)
5. **Developing and building large-scale research infrastructures** using modern IT technologies
6. **Developing and using intelligent and autonomous systems** for maintenance/operation of machines, instruments & experiments
7. **Using resources sustainably**, from energy to materials, from data to software
8. **Fostering the careers of young researchers** in computer, information and data science
9. **Cooperating with industry partners** on applied research
10. **Growing transfer of knowledge and technologies** to industry and society both nationally and internationally

# Research Field Matter

## Digitalisation Strategy



- A digitalisation strategy aligned with all Helmholtz centers in Matter for the whole Research Field.
- Set up for cross research field collaboration
- Fitting to the strategic position paper “Digitalisierungsstrategie der Helmholtzgemeinschaft”
- Concrete measures to reach the goals of the strategy

# Research Field Matter Data Management & Analysis Subtopics

## Overview over the 3 DMA Subtopics



### ST1 – The Matter Information Fabric

- Exascale Data Management
- F.A.I.R. Data & Meta Data
- Long-term preservation



### ST2 – The Digital Scientific Method

- Artificial Intelligence
- Exascale Computing
- Near-realtime analysis
- Quantum Computing



### ST3 – The Digital Experiment and Machine

- Exascale Simulations
- In-situ Data Analytics
- Near-realtime feedback
- Machine optimization

regular exchange &  
common projects

# Research Field Matter Data Management & Analysis Subtopics

## ST1 – The Matter Information Fabric



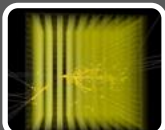
2022

- Community needs identified. High performance data intake demonstrated



2024

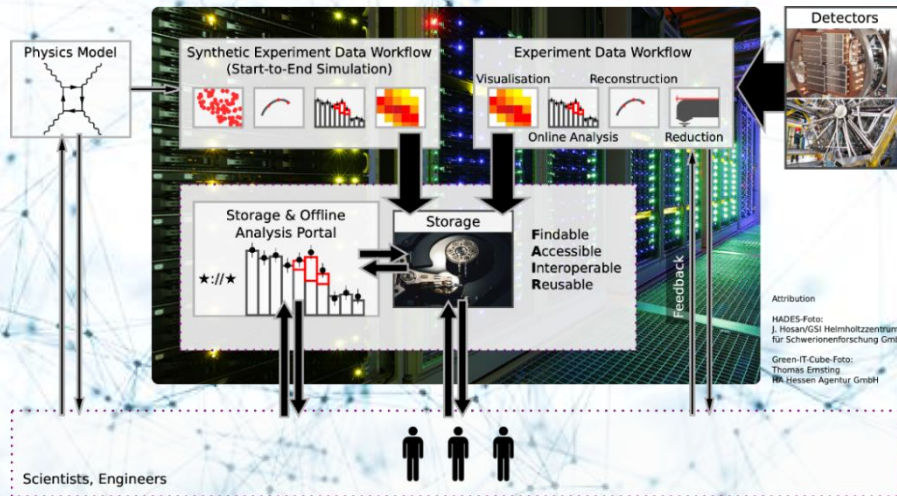
- Cross-community, modular prototype designs following F.A.I.R. principles



2027

- Review & “lessons learned” of prototypes implemented

### Exascale Data Management

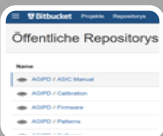


- Exascale Data Management
- F.A.I.R. Data & Meta Data
- Long-term preservation



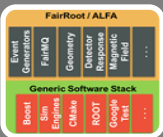
# Research Field Matter Data Management & Analysis Subtopics

## ST2 — The Digital Scientific Method



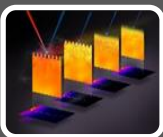
2023

- DMA repository of interconnectable, modular software in full operation



2025

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

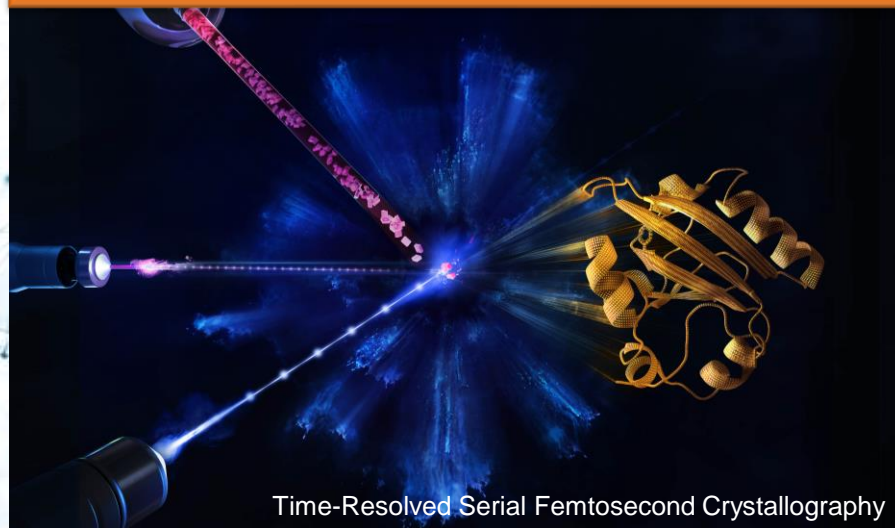


2027

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

- Artificial Intelligence
- Exascale Computing
- Near-realtime analysis
- Quantum Computing

A.I.-driven, real-time analysis of complex systems

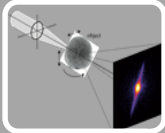


Time-Resolved Serial Femtosecond Crystallography



# Research Field Matter Data Management & Analysis Subtopics

## ST3 – The Digital Experiment and Machine



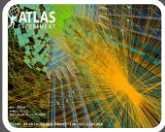
2024

- Prototypes for near-realtime analysis with feedback



2025

- Operation-critical intelligence on machine & experiment status

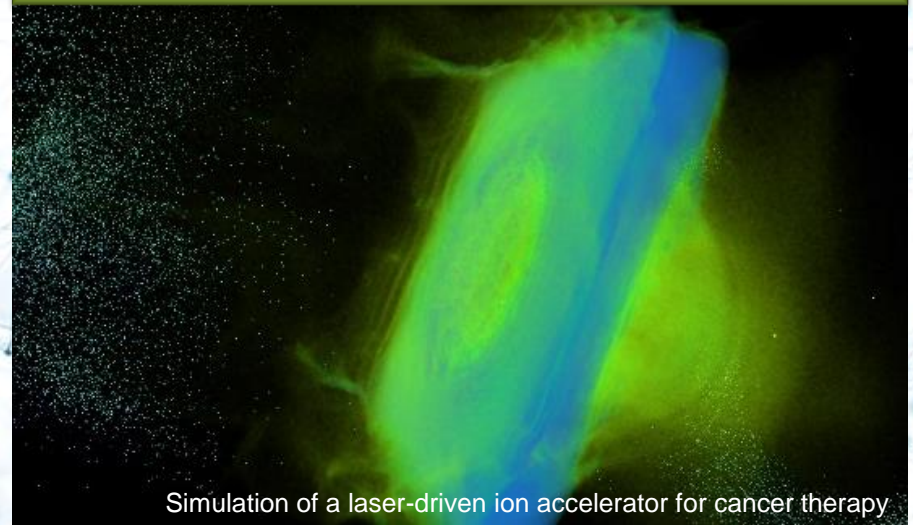


2027

- Complete digital twins of systems, experiments & machines

- Simulation
- In-situ Data Analytics
- Near-realtime feedback
- Machine optimization

### Exascale Plasma accelerator simulation



Simulation of a laser-driven ion accelerator for cancer therapy

# DMA creates interfaces nationally and internationally

DMA connects to many different initiatives

HELMHOLTZ-INKUBATOR  
INFORMATION & DATA SCIENCE

HELMHOLTZAI



HIFIS <HMC>

HELMHOLTZ  
IMAGING

HiDA

nfdi  
Nationale  
Forschungsdaten  
Infrastruktur

DAPHNE  
4NFDI

PUNCH  
4NFDI

ErUM-Data  
IDT



EUROPEAN OPEN  
SCIENCE CLOUD

ExpANDS  
European Open Science Cloud Photon  
and Neutron Data Services

panosc  
photon and neutron  
open science cloud

ESCAPE  
European Science Cluster of Astronomy &  
Particle physics (ESCAP) research infrastructures

WLCG  
Worldwide LHC Computing Grid

LEAPS

LENS  
LEAGUE OF ADVANCED  
EUROPEAN NEUTRON  
SOURCES



EuroHPC  
Joint Undertaking

RDA  
RESEARCH DATA ALLIANCE

HSF  
HPC Software Federation

# Computational and data science for fundamental research

DMA, NFDI & ErUM

**nfdi** Nationale  
Forschungsdaten  
Infrastruktur

**Infrastructures  
Communities  
Talents  
Interfaces  
Standards  
Data Lifecycle  
Research Software  
Sustainability**

ErUM-Data

