

# RDMO at GSI/FAIR

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08.10.24

**Heavy-ion accelerator laboratory** in Darmstadt, Germany with 1350+ employees & 700 external users

## Who we are?

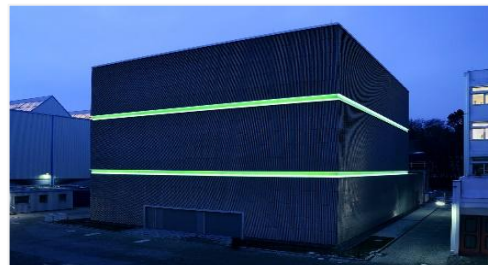
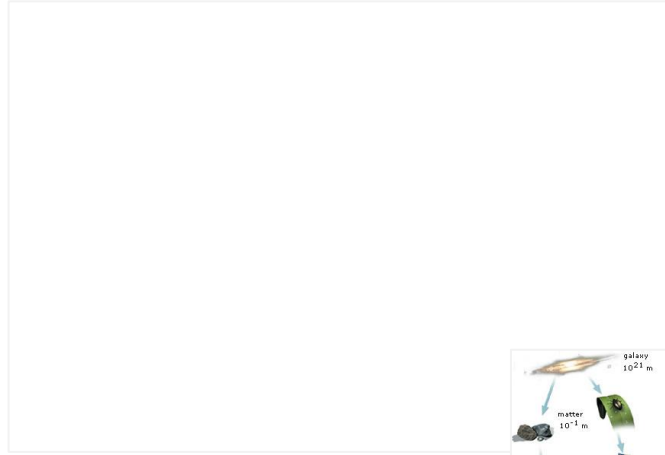
- Founded in **1969**
- **Elements H to U can be accelerated**

## Past Achievements

- Discovering **six new elements, many exotic nuclei**
- Developing a **new cancer treatment**

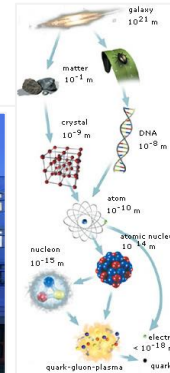
## Our Future

- First stage injector for the **FAIR facility**
- **Experiments continuing** (FAIR Phase-0)



## Research Interests

- Accelerator Physics
- Detector Development
- Atomic Physics
- Nuclear and particle Physics
- Plasma Physics
- Biophysics
- Materials Research
- High-Performance Computing
- Theoretical Physics

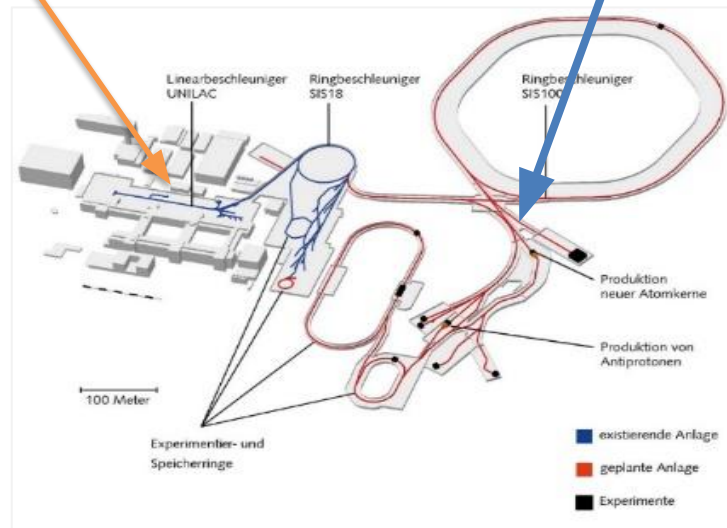
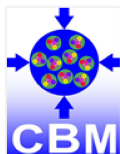


# FAIR (Facility for Antiproton and Ion Research in Europe)



## New accelerator facility

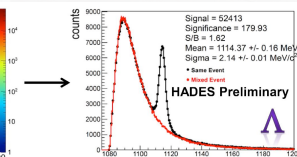
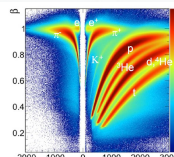
- **Top priority** for European Nuclear Physics Community
- **International:** 50 countries, 3000 researchers
- **Diverse community** from atomic to particle physics
- **'FAIR goes F.A.I.R.': commitment to open science**
- Towards the next generation "data challenge" Volume, Velocity, Veracity, Variety, and Complexity
- **~TB/s data rates**, online processing,  $\sim 5 \times 10^5$  cores
- Data stored to **disk 40+ PB/year**
- **Distributed computing** with a large user community
- **Data preservation and accessibility key to success**



## Experimental Data

```

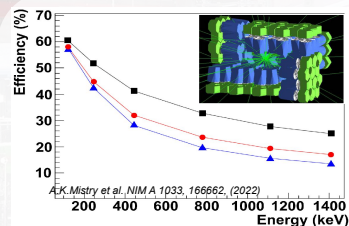
11101001
01010011
00100111
10000111
01101011
11010011
00001111
    
```



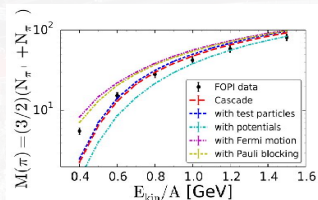
Raw

Pre-processed

Result



Simulation



Theory

```

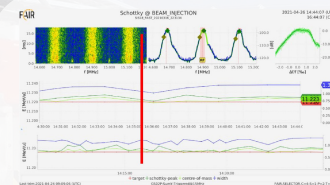
template <typename Modus>
void Experiment<Modus>::run() {
  cast auto &mainlog = logg[Main];
  for (event_ = 0; !is_finished(); event_++) {
    mainlog.info() << "Event " << event_;

    // Sample initial particles, start clock, some prints
    initialize_new_event();

    run_time_evolution(end_time_, {});

    if (force_decays) {
      do_final_decays();
    }
  }
}
    
```

Software








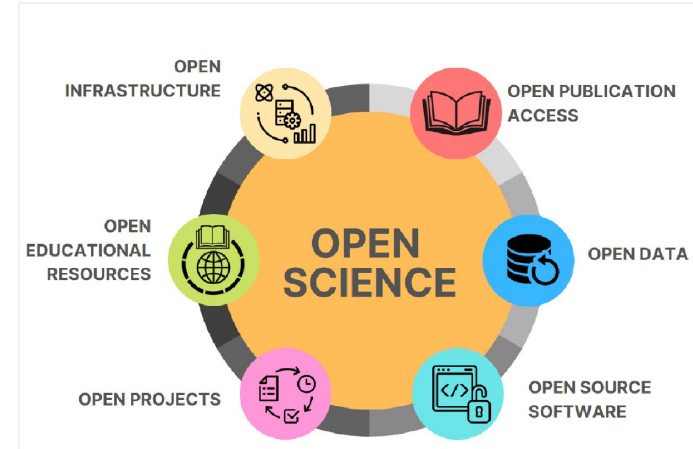
Machine Parameters

Research Area	Exp. Run Time	Raw Data	Calibrated Data	Simulations	Final Datasize
HADES	3 weeks	130TB	300TB	150TB	<1TB
Materials Science	~Minutes	~MB - GB	-	-	10MB
FAIR CBM	2 months	~20PB	-	-	4PB

# Open Science @ GSI/FAIR: What do we want to achieve?



-  **Open Access Publications** : Mandatory publication of Open Access articles
-  **Research Data** : Publish research data in suitable repositories (F.A.I.R. Data)
-  **Open Software** : Make open whenever possible (F.A.I.R. Software)
-  **Open Infrastructure** : Open Projects in research and industry
-  Develop an **Open Science Ecosystem** to combine everything



## Considerations:

- The steps and processes to achieve this are complex... Start smaller and work up
- Do not make it too '*general*', needs finer granularity and use-cases
- Aim to address **all researchers who use GSI/FAIR**: Students, Postdocs, PI's, Group leaders...

*European Science Cluster of Astronomy & Particle Physics ESFRI Research Infrastructures: Open Source Software Repository (OSSR) developer and maintainer*

*Nuclear Physics European Collaboration Committee: Participation and writing Open Science section of the LRP 2024*

*European Open Science Cloud: GSI/FAIR both observer members, contribution and suggestions for EOSC Future*

*EuroLabs: Work Package on Open, diverse and inclusive Science*

*Particles, Universe, NuClei and Hadrons for the NFDI: Two Task areas; Developments on data portal, AAI, data lake and other infrastructure from GSI IT department and Research division*

*Matter and Technology, Data Management and Analysis: IT contributions*

*HGF Open Science: Members of the OS, software and POF IV indicators working groups*

*Helmholtz Metadata Collaboration: Participation in HMC funded projects, links and connections to Matter division*

*Exploring the Universe from Microscopic to Macroscopic Scales: Supporting Open Science area of the project (as well as other direct research areas)*

## Research Data Management...

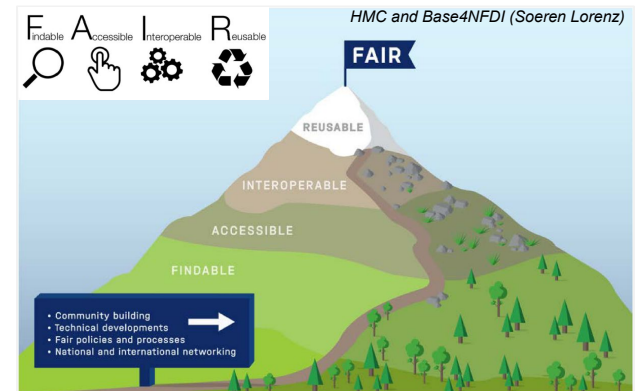
...encompasses all aspects of handling research data, from planning, its generation and processing to publication, long-term archiving, and eventual deletion, while adhering to the principles of good scientific practice.

## Goals

- to ensure good RDM practices at GSI/FAIR;
- promote and assist researchers in publishing data;
- to aim (as best as reasonably possible) that data is published according to the Findable Accessible Interoperable and Reusable principles;
- develop the tools and infrastructure needed to do this.

### ***FAIR Data is not an end goal***

- continual process of improving practices and adapting research resources with technology innovations



**Living document** • Prepared at the start and follows the research data (RD) lifecycle throughout

**Data management plans**

- Communication tool for researchers
- Aids RDM project internal management
- Supports F.A.I.R.'ness of Research Data
- Useful for IT/Resource Cost estimates
- Funding body requirements

**Contents include**

- General data (Project name/PI, start and end of data taking...)
- RD information (Data type, size, scope, and generation method...)
- Overhead (Data protection, costs, project planning...)
- Achieving and reuse (repository selection, data to be published, metadata schema...)

✓ **Goal : Make it easy for the users and encourage them to use it**



# Data Management Plan Tool Evaluation

- **DMP tool:** e.g., DMPonline, DMPtool... but testers and own criteria tended towards...
- **RDMO (Research Data Management Organiser):**
  - Can be dynamic and versioned along life cycle
  - Offers multilingual support
  - Used by many other Uni's and centres
  - Can be locally installed



# Project Steps: Starting out

- Basic local version installed on VM
- Accessible on GSI LAN

RDMO testing: To Do



- Please fill issues on [GitLab](#), *in particular on the GSI Data management plan questions*  
<https://rdmo.test.gsi.de/>  
<https://git.gsi.de/oswg/gsi-rdmo-testing>
- Please also check and comment on my example answers (in the .views' section)
- Always available for a chat if you need help and I'd be happy to sit down and go through the DMP with you!



1 **Thanks for your assistance**

GSI RDMO

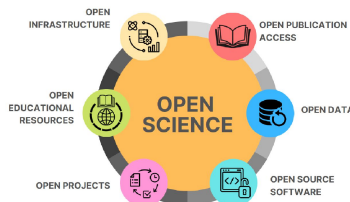


A tool to support the planning, implementation, and organisation of research data management at GSI. Funded by the Deutsche Forschungsgemeinschaft (DFG).

Welcome to GSI Research Data Management Tool

The aim of this website is to provide a tool to organise data management plans in an easy way. This is a prototype and is based on the software RDMO. The aim of the RDMO project is to deliver a web application to assist structured planning, implementation and administration of the data in a scientific project. Additionally, the gathered information can be cast into textual forms suitable for

## GSI/FAIR Open Science Working Group testing and feedback



# Project Steps: Feedback

- Basic local version installed on VM (<https://rdmo.test.gsi.de>)
- Accessed on GSI networked computer
- GitLab, Feedback, Reporting

## RDMO Report

### General Question / Remarks:

- When has this RDMO has to be filled? I think a lot of these questions require that one has already had contact to GSI members.
- It is not possible to see what questions still have to be answered or which entry has to be fully edited. I only see the progress bar showing that something is missing.

### Responsibilities:

- For me, "Responsible department" sounds a bit strong. Maybe one could "weaken" it a little bit by changing it to "Related GSI / FAIR department" or "Local contact department"? Of course, this is just a personal preference.

### Research Data Management and Policies

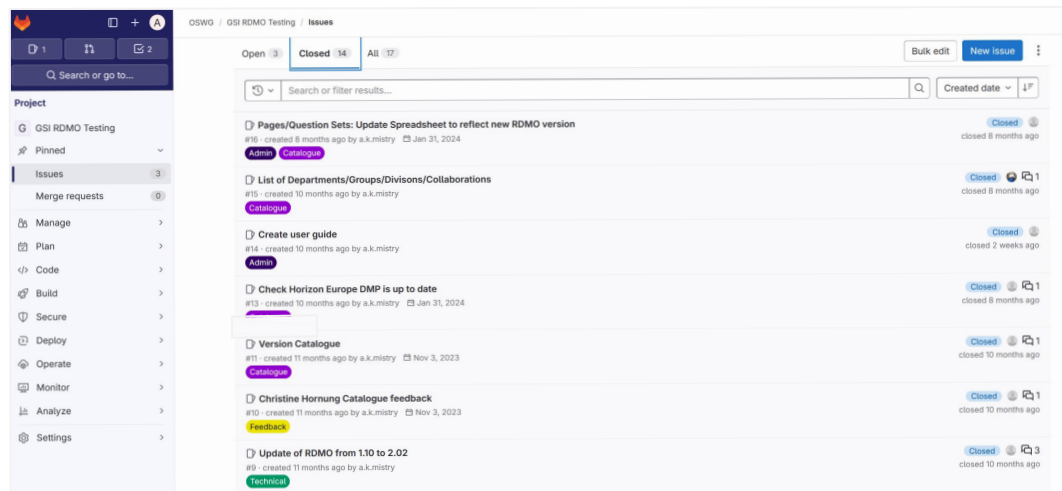
- The link for Data Policy of AGATA does not work.
- Data Policy of Collaboration: Does this require a link? Otherwise, the text field might be a little bit to small.

### Data Set Collection

- Is it up to the user to define what a data set is, or is it sort of pre-defined? E.g. is it a set of data from one detector, and only one? Or is it a sum of the whole project or sub-project? Setting up a data set for 10+ different detectors that maybe sometimes store different data types at once can be a little bit tedious.

### Data Storage and Archiving

- Is there some information for all external users on how long data will be stored at GSI? If yes, maybe a link would be helpful. This is



The screenshot shows the GitLab Issues interface for the project 'GSI RDMO Testing'. The left sidebar contains navigation options: Pinned, Issues (3), Merge requests (0), Manage, Plan, Code, Build, Secure, Deploy, Operate, Monitor, Analyze, and Settings. The main content area displays a list of issues with the following details:

- Issue #16: Pages/Question Sets: Update Spreadsheet to reflect new RDMO version. Status: Closed. Created 8 months ago by a.k.mistry. Labels: Admin, Catalogue.
- Issue #15: List of Departments/Groups/Divisions/Collaborations. Status: Closed. Created 8 months ago by a.k.mistry. Label: Catalogue.
- Issue #14: Create user guide. Status: Closed. Created 2 weeks ago by a.k.mistry. Label: Admin.
- Issue #13: Check Horizon Europe DMP is up to date. Status: Closed. Created 10 months ago by a.k.mistry. Labels: Admin, Catalogue.
- Issue #11: Version Catalogue. Status: Closed. Created 11 months ago by a.k.mistry. Label: Catalogue.
- Issue #10: Christine Horning Catalogue feedback. Status: Closed. Created 10 months ago by a.k.mistry. Labels: Feedback, Catalogue.
- Issue #9: Update of RDMO from 1.10 to 2.02. Status: Closed. Created 11 months ago by a.k.mistry. Label: Technical.

## General Project Information

A Data Management Plan (DMP) is a comprehensive document that outlines how data are to be handled both during a research project and after the project is completed. This includes how research data will be collected, processed, stored, and shared during and after a research project. The plan typically includes information on the types of data to be collected, data storage, data security and access protocols, and plans for sharing and preserving the data. The goal of a data management plan is to ensure that the data is well-organised, properly documented, and accessible to the research team and other authorised users, while also protecting the privacy and confidentiality of any sensitive information. As far as possible, research data should follow the Findable, Accessible, Interoperable and Reusable (FAIR) principles, and this should be reflected in the Data Management Planning phases. The document can be updated throughout the project, and completed by one or more parties. Further information on research data publication can be found on the GSI Open Science Webpage, and in the GSI Instructions for Data/Software Uploads.

For further information, please see the [GSI/FAIR Policy on Research Data Management](#) and the [GSI/FAIR Open Science Webpage](#)

For comments, questions, and support please contact the Research Data Management Team [open-science@gsi.de](mailto:open-science@gsi.de)

### Data Management Plan Version

Please give the version number of the DMP. e.g. v1

### Principal Investigator(s)

Name of the Principal Investigator(s) of the project

Please enter your entries line by line. You can add lines using the green button and remove them using the blue cross (x).

+ Additional PI

### Please provide your name

As the person filling out this plan

### Project Name

Give the name of the project. Can be e.g. experiment name

Project ID (optional)

## Overview

Project: [GSI Data Management Plan](#)

Template: [Example Case 1\\_1 Beginning of Project](#)

Catalog: [GSI/FAIR Data Management Plan](#)

[Reload page](#)

[Back to my projects](#)

## Progress

58 of 58

[Back](#)

[Proceed](#)

## Navigation

Using the navigation will save your input.

Grey entries will be conditionally skipped based on your input.

### General

→ [General Project Information](#)

[Responsibilities](#)

[Data Set Description](#)

[Data Publication and Access](#)

[Data Findability and Metadata](#)

[Data Interoperability](#)

[Data Resuability](#)

[Ethics and Legal issues](#)

[Associated Costs](#)

[Additional Notes, Comments and/or Inf...](#)

### processed and result

- List mode data (.lmd)
- Hierarchical Data Format version 5 (.hdf5)
- ROOT (.root)
- ASCII (.dat.csv.txt)
- Spreadsheet (.xls.ods ...)
- Image files (.png.jpeg... other (please specify))
- LabVIEW Measurement (.lvm)
- Other

### Storage location for raw data

Refers to storing datasets normally during generation for easy access. Data stored may not necessarily be backed-up

- Lustre
- Centrally managed Microsoft Windows storage
- Locally managed storage (please specify):
- External storage solution (please specify):
- Other storage solution (please specify):

### Raw data set size (approximate)

Raw Data (in this instance) refers to unrefined data generated or collected in its base form. E.g. an .lmd file or unmanipulated image. This also includes calibration data taken before/after the experiment

- MB:
- GB:
- TB: 15
- PB:
- Other:

### Storage location for pre-processed(semi-derived) data (optional)

Refers to storing datasets normally during generation for easy access. Data stored may not necessarily be backed-up

- Lustre
- Centrally managed Microsoft Windows storage
- Locally managed storage (please specify):
- External storage solution (please specify):

### Overview

Project: [GSI Data Management Plan](#)  
Template: [Example Case 1\\_1 Beginning of Project](#)  
Catalog: [GSI/FAIR Data Management Plan](#)

[Reload page](#)  
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### Progress

58 of 58

[Back](#) [Proceed](#)

### Navigation

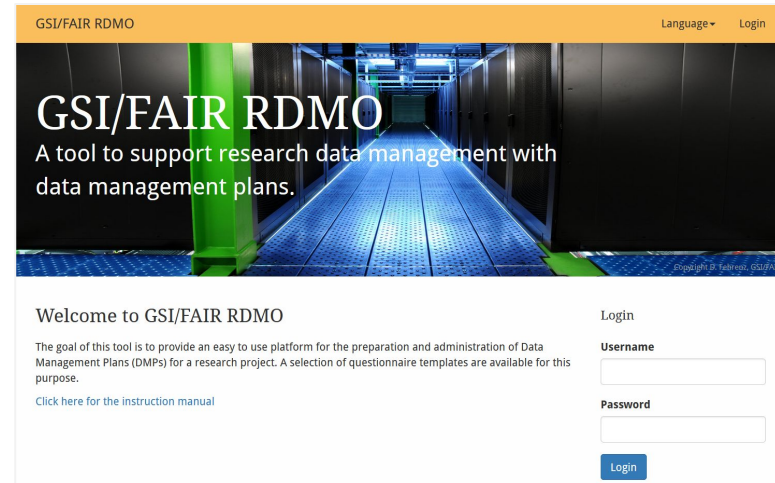
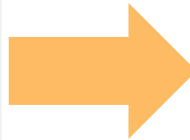
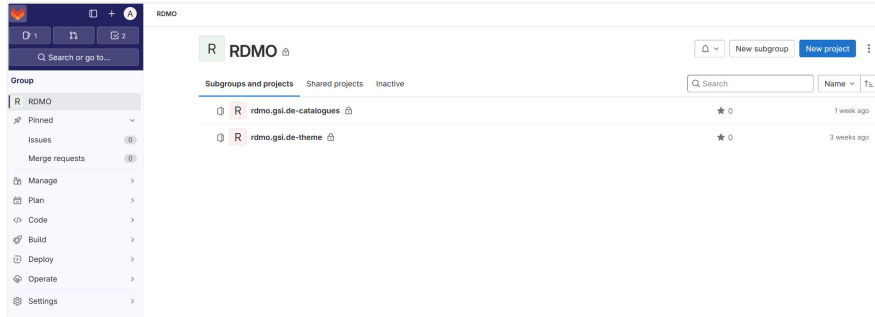
Using the navigation will save your input.  
Grey entries will be conditionally skipped based on your input.

General

- [Data Set Description](#)
- [Data Set Collection and Storage](#)
- [Data set Archiving](#)
- [Data Publication and Access](#)
- [Data Findability and Metadata](#)
- [Data Interoperability](#)
- [Data Resuability](#)
- [Ethics and Legal issues](#)
- [Associated Costs](#)
- [Additional Notes, Comments and/or Inf...](#)

# Project Steps: Implementation and Management

- Currently running two versions: **production and testing**
- Connected to GitLab for automatic updating of themes
- Went live Feb 2024: Aimed at users of GSI/FAIR (AAI LDAP connection)
- GSI/FAIR tailored DMP catalogue available



# Project Steps: Uptake and feedback



- Now requested for all **accepted experimental proposals** to prepare a DMP via RDMO
- Work with researchers to **refine the catalogue** and encourage continuous usage

## GSI Proposal management system

## RDMO Catalogue Questions

### ■ Important next steps

#### 1.1-S

##### Beamtime

Your experiment has been scheduled in accordance with the Beamtime Coordinator Scientist and the Beamtime Coordinator ASAP.

##### Experimental team

Please appoint your experimental team coming on site as soon as possible submitted in time. Further information on accessing our campus is also given in the "next".

##### Beamtime preparation

For an optimal preparation of a successful beamtime your Link Scientist can be contacted. Contacting him/her early in advance of the beamtime is highly recommended.

If you need any host lab resources, please contact the respective department (Indication in the submitted proposal is not sufficient.)

##### Safety regulations

Consent of the department Safety and Radiation Protection is required before the start of the experiment. A safety evaluation of the exp. area (STV) when required should be done ideally months before the experiment.

##### Research Data Management Plan (DMP)

Currently, a RDMP is not mandatory, but you are asked to plan ahead of time and think about its possible later publication. This also helps in formulating a DMP for accepted proposals at GSI/FAIR

##### Publications

For correct acknowledgement of GSI/FAIR and FAIR Phase-0 see our publication

## GSI/FAIR RDMO Instructions

v. 1.0 February 2024

**Research Data Management Organiser (RDMO)** is a tool designed to assist researchers in the planning and management of their research data generated during a research project. The software is open source (<https://rdmorganiser.github.io>) and maintained by a community of users. GSI/FAIR hosts its own instance of RDMO for users of the facility.

GSI/FAIR RDMO can be reached via <https://rdmo.gsi.de>

RDMO contains a series of questionnaires about how data will be treated over the course of the project that can be filled out and exported as a **Data Management Plan (DMP)**. GSI/FAIR strongly encourages the preparation of the DMP, and in addition it is now a requirement of many funding agencies. The DMP should be prepared at the start of the project and updated throughout to reflect any changes. Further information about Research Data Management can be found in the [GSI/FAIR Research Data Management Policy](#) and [GSI/FAIR Research Data Management Guidelines](#).

This document is a basic guide to support the use of GSI/FAIR RDMO. Further help can be found through [rdmo-help@gsi.de](mailto:rdmo-help@gsi.de)

Save and process here (optional)

Back

Complete questionnaire

## Examples

Example 1: DMP given in the project and can then be exported in various formats. Initially, all views are empty, starting with Answer Questions (at the top of the sidebar).

Example 2: DMP

Example 3: Data Management Plan prepared at the start of an experimental project.

Example 4: Data Management Plan prepared after the data generation period of an experimental project

# Next steps: Formatting and development

## PDF templates formatting

### Answers for *My first project*

#### General

##### General Project Information

##### Data Management Plan Version

v1

##### Principal Investigator(s)

Jane Doe

##### Please provide your name

Andrew Mistry

##### Project Name

My Experiment

##### Project ID

G-22-0123

##### Project Stage

Beginning

##### Project Start Date

Jan. 4, 2025

##### Project End Date

Oct. 4, 2026

##### Data Management Plan version date

Oct. 1, 2024

Does an external data management plan already exist for this project?

No

If an external data management plan already exists for this project, please upload here

Is there a collaboration based research data management policy for the project? If so please give details.

Yes

Provide a short description of the project

#### Responsibilities

##### Responsible GSI/FAIR department(s)

Responsibilities during the course of the project

Responsibilities after project completion

#### Data Set Description

##### Data Set Collection and Storage

Generated data category

##### Data format(s)

Storage location for raw data

Raw data set size (approximate)

### Local RDMO instance:

- *Modified utils.py -> pandoc*
- *Added latex template*



### Data Management Plan for *My first project*

#### General

##### General Project Information

##### Data Management Plan Version

v1

##### Principal Investigator(s)

Jane Doe

##### Please provide your name

Andrew Mistry

##### Project Name

My Experiment

##### Project ID

G-22-0123

##### Project Stage

Beginning

##### Project Start Date

Jan. 4, 2025

##### Project End Date

Oct. 4, 2026

##### Data Management Plan version date

Oct. 1, 2024

Does an external data management plan already exist for this project?

No

If an external data management plan already exists for this project, please upload here

Is there a collaboration based research data management policy for the project? If so please give details.

Yes: HISPEC/DESPEC Collaboration agreement

Possible to do this in an easier fashion (i.e. with an in-built latex template?)

# Next Steps: Instrument Records

- Assigning **PIDs for Instruments/Infrastructure** currently hot topic
- Instrument record generation via RDMO?
- Possible to include **images/attachments in exported documents?**

Information | Files | History

Physical Object GSI-2024-00534

**FRS Ion Catcher**

Dickel, T. (Corresponding author) · Pfab, W.<sup>1</sup>

2024  
GSI Darmstadt

Darmstadt : GSI (2024) [10.15120/GSI-2024-00534](https://nbn-resolving.org/urn:nbn:de:gsi:2024-00534)

Please use a persistent ID in citations: doi:10.15120/GSI-2024-00534 or 10.15120/GSI-2024-00534

**Abstract:** The FRS Ion Catcher is a set up which slows down exotic nuclei produced with high energies to perform high precision measurements almost at rest. The properties of the exotic isotopes help to study the internal structure of the nuclei at the origin of the elements in the universe. The setup is located at the Fragment Separator (FRS) of the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany. The setup has been designed in collaboration with international partners, e.g. KVI-CART Groningen, Justus-Liebig-University Gießen, Germany. The FRS Ion Catcher consist of a cryogenic detector wall, an RFQ based beamline with in-variant capabilities and a Multiple-Reflection-Ion-Optic Flight Mass Spectrometer (MR-TOF-MS). More details can be found in [1], [2], 1. WIR, Pfab et al. NIMB 317, 457-462 (2013); <https://www.windows.gsi.de/frs-ion-catcher/>

**Note:** 2010

**Contributing institute(s):**

1. FRS / SFRS Experimente (FRS)

**Research Program(s):**

1. 612 - Cosmic Matter in the Laboratory (POF4-612) (POF4-612)

**Experiment(s):**

1. S482 - Mean range bunches for experiments with steeped beams (POF3-612; HFS)
2. S468 - Search for new neutron-rich isotopes and exploratory studies in the element range from terbium to mercury (POF3-612; HFS)
3. S411 - commissioning of the first-generation cryogenic stopping cell for the Low-Energy Branch of the Super-FRS (POF3-612; HFS)
4. S530 - Fission isomer studies with the FRS (station-FRS)

**Appears in the scientific report 2024**

**Database coverage:**

The record appears in these collections:

- Private institute collections > >WGF > >RED > FRS
- Document types > Other Resources > Physical Objects
- Workflow collections > Public records
- NUSSTAR/MU > FRS/SFRS
- Publications database
- Open Access

**Linked articles:**

Contribution to a book

Eibel, J., Dickel, T., Pfab, W., B., Ayst, S., Dendooven, P., Dunsch, M., Estrade, A., Farion, E., Geisel, M., Greiner, E., Haidner, E., Joch, C., Kalchauer-Javetski, N., Knebel, R., Kurczewski, J., Lang, J., Moore, J., Mutha, I., Nodding, C., Patrick, M., Pfitzner, M., Pletzi, S., Prochaska, A., Purushothaman, S., Reiter, M. P., Reik, A.-K., Scheibenberger, C., Tabuchi, M., Wink, H., Wirthlich, J., Yavor, M. I.

**First Mass Measurements of Projectile Fragments with a Multiple-Reflection-Time-of-Flight Mass Spectrometer at the FRS Ion Catcher**

Scientific Report 2012 Darmstadt : GSI Helmholtzzentrum für Schwerionenforschung, GSI Report 2013-1, 162 p. (2013)

GSI/2024-00534-001

**FRS Ion Catcher**

**Document version:** v1

**PID:** [10.15120/GSI-2024-00534](https://nbn-resolving.org/urn:nbn:de:gsi:2024-00534)

**Author:**

Timo Dickel [ORCID <https://orcid.org/0000-0002-5965-8689>]

**Collaboration:**

Mainly, but not exclusively Super-FRS EC

**Host Laboratory/Laboratories:**

GSI Helmholtz Centre for Heavy Ion Research [ROR: <https://ror.org/02k8cbn47>]

**Years active:**

2010 – present

**Diagram/Photo/CAD:**

*Left: schematic of the setup. Right: Photograph of system at the final focal plane of the FRS, in the photo degrader system and downstream detectors before the CSG are missing, they also belong to the setup.*

**Station(s) of device during primary usage:**

FRS HFS S4

**Linked infrastructure:**

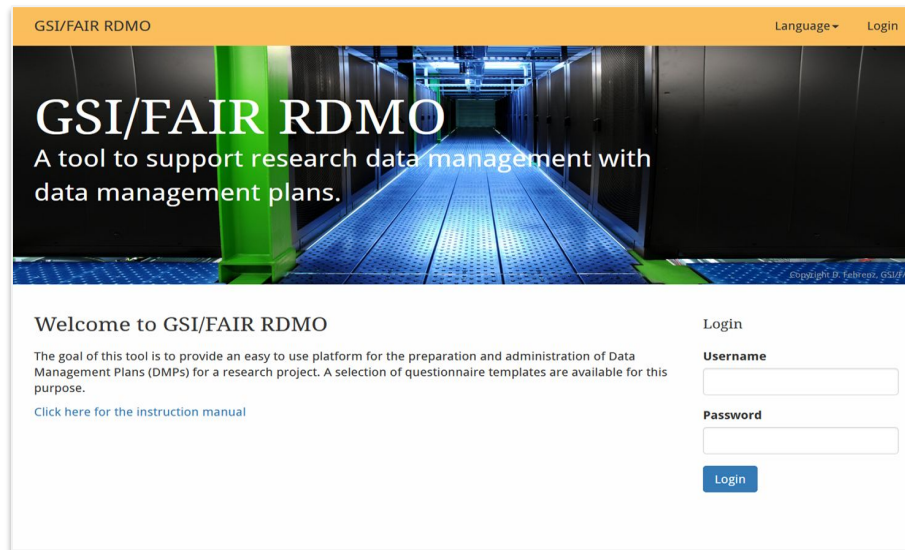
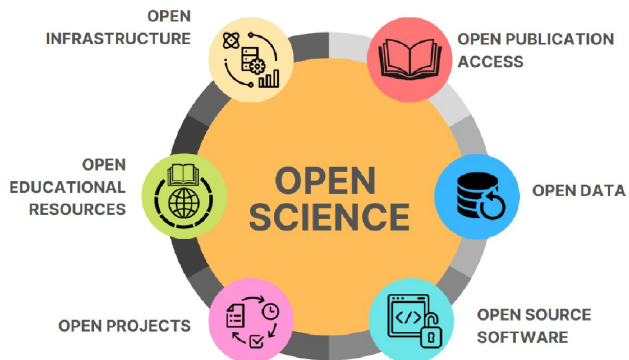
SIS18, FRS

**Device Webpage:**

<https://www.windows.gsi.de/frs-ion-catcher/>



- Next steps: Researcher Testing and Feedback
- Inclusion into the next round of proposal submissions
- Connection to other software/ ecosystems



The screenshot shows the GSI/FAIR RDMO website. The header includes 'GSI/FAIR RDMO' and 'Language Login'. The main banner features a server room image with the text 'GSI/FAIR RDMO A tool to support research data management with data management plans.' Below the banner, there is a 'Welcome to GSI/FAIR RDMO' section with a description of the tool's purpose and a link to the instruction manual. On the right side, there is a login form with fields for 'Username' and 'Password', and a 'Login' button.