How to use distributed storage for your data

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Rucio Introduction

Rucio is an open-source software framework that provides functionality for data management and access in a distributed storage environment.

Rucio provides single namespace, work like file catalogue and provides protocols to get/put files on storages and PFNs of files that registered in Rucio.

Currently, Rucio is used by production systems, but there must be users. It is a good practice to store data using Rucio.

Quick terminology recap

File – the smallest operational unit of data in Rucio.

Dataset – a named set of files.

Container – a named set of datasets or, recursively, containers

DID – rucio LFN for data (file/dataset/container) as combination of a scope and a name.

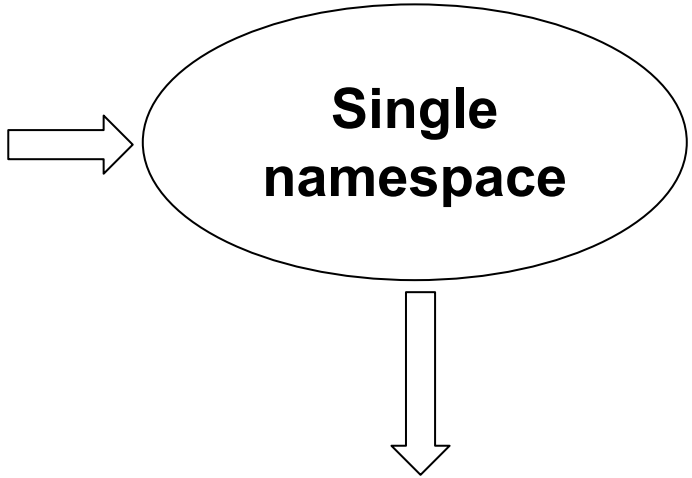
Scope – a scope partitions the namespace into several sub namespaces.

Replica – a managed copy of a file.

RSE – the logical abstraction of a storage system for physical files. It has a unique identifier and a set of meta attributes describing properties.

Storage environment organisation

JINR_EOS2_DATADISK	Production data storages
PNPI_SPD_DATADISK	
JINR_EOS2_USERDISK	User data storage



MC2026_S1	MC2026_S2	user.konak	group.st	…
production scopes		user scope	group scope	…

Start with Rucio

To work with Rucio:
- you need to be registered in SPD IAM (https://spd-iam.jinr.ru),
- you need rucio-client.

We provide common client at cvmfs.
Login via ssh to lxui10.jinr.ru – lxui12.jinr.ru, and activate client

```
source /cvmfs/spd.jinr.ru/sw/ddm/rucio-clients/38.5.1-system-site-packages/bin/activate
```

To get own client, follow this instruction
https://rucio.github.io/documentation/user/setting_up_the_rucio_client
Note: install version 35.8.1, sample of config in backup slides.

Authentication/authorization in Rucio

- with proxy-cert

```
voms-proxy-init --voms spd.nica.jinr:/spd.nica.jinr --cert <cert.pem> --key <key.pem>
```

```
export X509_USER_PROXY=</path/to/proxy>
```

```
export RUCIO_AUTH_TYPE=x509_proxy
```

```
export RUCIO_ACCOUNT=<nickname>
```

- with auth-token

```
export RUCIO_AUTH_TYPE=oidc
```

```
export RUCIO_ACCOUNT=<nickname>
```

use any rucio-client command and follow given instruction

Uploading data

To upload files, use the command **rucio upload </path/to/file>**
with special parameters:
 --rse JINR_EOS2_USERDISK
 --protocol <davs/root>
 --register-after-upload
 --lifetime <time_in_seconds>

For example:

```
rucio upload --rse JINR_EOS2_USERDISK --protocol davs --register-after-upload --lifetime 3600 /home/konak/my_file
```

After uploading

You may have number of files in personal user.scope:
user.scope:file1, user.scope:file2, user.scope:file3

- Create dataset with command
  rucio did add user.scope:dataset
- Attach files to dataset like
  rucio did content add -to user.scope:dataset user.scope:file1 user.scope:file2 user.scope:file3
- Create rule to lock data on the RSE with
  rucio rule add --rses JINR_EOS2_USERDISK --copies 1 user.scope:dataset

Helpful commands on the uploading/after uploading stage

1) List of files (dids of files) in personal scope
   rucio did list --filter 'type=file' user.scope:*
2) List of collections (dids of collections) in personal scope
   rucio did list user.scope:*
3) List of files in collection
   rucio did content list user.scope:dataset
4) List of rules
   rucio rule list --account <nickname> # by account
   rucio rule list --did user.scope:dataset # by DID

Work with data

Rucio does not allow you to work with files directly. It's just a catalog!

- search with **rucio did list** and **rucio did content list**
- download with **rucio download <DID>**

Deletion process

If you don't need some data:
- update rule that lock some dataset
``` **rucio rule remove <rule_id>** ```

After 24h rule will be removed, and these data marked as **can be deleted**.

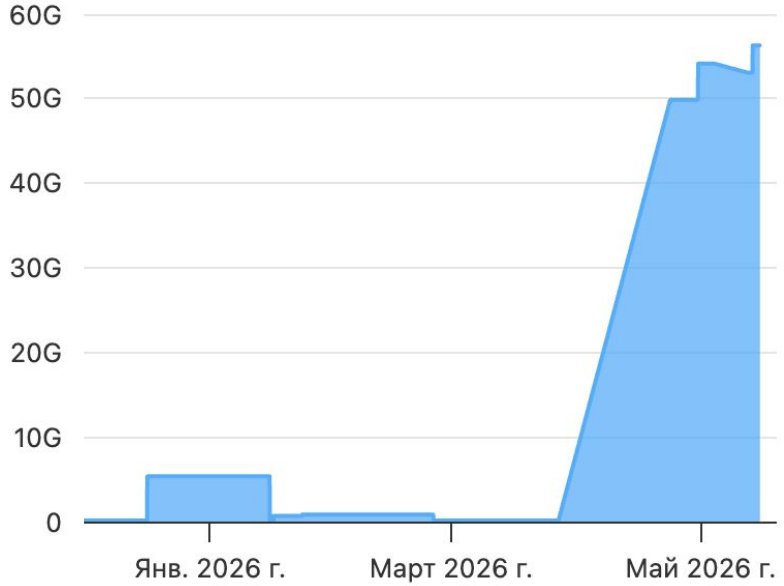
The deletion process is carried out by a set of specific daemons with very complex logic, so do not be surprised if the dataset is immediately deleted and the files are still in place. The files will also be deleted soon.
```

First user

We have our first user, Dmitry Sosnov. He successfully completed the tasks of uploading and registering data using Rucio.

```
[root@665361bc2d0f tmp]# rucio did content list user.sosnov:StrawTracker.testbeam
+-----------------------------------------------------+--------------+
| SCOPE:NAME                                          | [DID TYPE]   |
|-----------------------------------------------------+--------------|
| user.sosnov:StrawTracker.testbeam.2025-July-H4      | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-November-T9  | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-September-SC1000 | CONTAINER    |
+-----------------------------------------------------+--------------+
```

```
[root@665361bc2d0f tmp]# rucio did list user.sosnov:*
+-----------------------------------------------------------------------------+--------------+
| SCOPE:NAME                                                                  | [DID TYPE]   |
|-----------------------------------------------------------------------------+--------------|
| user.sosnov:StrawTracker.testbeam                                           | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-July-H4                              | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-November-T9                          | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-September-SC1000                     | CONTAINER    |
| user.sosnov:StrawTracker.testbeam.2025-September-SC1000.data-caen-dwave-fe55 | DATASET      |
+-----------------------------------------------------------------------------+--------------+
```



Summary

To use Rucio

- Register in SPD IAM
- Use rucio-client on cvmfs or get your own client
- Auth with proxy certificate or oidc token
- Upload files with **rucio upload**
- Don’t forget to add files to datasets and add rules on datasets
- Search/get files with Rucio

Thank you for your attention!

Backup slides

Contact information and additional resources

For all question contact:
- konak@jinr.ru

Official Rucio documentation:
- https://rucio.cern.ch/documentation/

Previous guide:
- https://git.jinr.ru/nica/spdroot/-/wikis/Rucio%20basics

New rucio guide:
- https://git.jinr.ru/spd/spd-dc/rucio/ddm-utils/-/blob/dev/userguide/README.md

Rucio-client config

By default config need to be placed in /opt/rucio/etc/rucio.cfg
If config file in another place ``` export RUCIO_CONFIG=</path/to/config> ```

Sample of config file
```
[client]
rucio_host = https://spd-rucio.jinr.ru:443
auth_host = https://spd-rucio.jinr.ru:443
auth_type = <x509_proxy/oidc>
ca_cert = </path/to/ca_bundle>
client_x509_proxy = </path/to/proxy>
oidc_scope = openid profile offline_access wlcg.groups
account = <nickname>
request_retries = 3
```

Using the rucio-client at cvmfs

1) Enter at lxui.jinr.ru using ssh. Run command at CLI:
   ssh <sso_nickname>@lxui.jinr.ru

```
alex@alex-konak573:~$ ssh konak@lxui.jinr.ru
konak@lxui.jinr.ru's password:
Last login: Tue Mar 11 15:06:43 2025 from bk081.jinr.ru
```

2) Activate rucio client. Run command:
   source /cvmfs/spd.jinr.ru/sw/ddm/rucio-clients/latest/bin/activate

```
lxui04:~ > source /cvmfs/spd.jinr.ru/sw/ddm/rucio-clients/latest/bin/activate
(1.31.7) lxui04:~ >
```

3) Authenticate in rucio. You can use any rucio-client command. For example: **rucio whoami**

```
(1.31.7) lxui04:~ > rucio whoami
account_type : USER
status       : ACTIVE
suspended_at : None
created_at   : 2024-08-01T12:19:41
email        : konak@jinr.ru
account      : konak
deleted_at   : None
updated_at   : 2024-08-01T12:19:41
```

How to authenticate

We offer two flow of authentication in rucio-client.

Using proxy-certificate	Using SPD-IAM
You need to have user certificate issued by **Russian Data Intensive Grid** (https://ca.grid.kiae.ru/RDIG/) or **JINR Grid Certification Authority** (https://ca.jinr.ru/)	With authentication command need to specify parameter "**-S=oidc**" or export this - **export RUCIO_AUTH_TYPE=oidc**
Usercert and userkey in ".pem" format need to be placed in **<home_dir>/.globus** with access mode 600 and 400	You need using browser to authenticate
You need to register user certificate in SPD-IAM	
Generate proxy-certificate with command `voms-proxy-init -voms spd.nica.jinr:/spd.nica.jinr</Role>`	
export proxy-cert with command `export X509_USER_PROXY=/tmp/<proxy_cert>`	
rucio-client at cvmfs use auth method with proxy by default	

Auth with proxy-certificate

1) Create proxy-certificate using command **voms-proxy-init -voms <VO:VO-role>**

```
lxui03:~ > voms-proxy-init -voms spd.nica.jinr:/spd.nica.jinr/Role=production
Contacting spd-voms.jinr.ru:15000 [/C=RU/O=JINR/OU=GRID/OU=hosts/CN=spd-voms.jinr.ru] "spd.nica.jinr"
Remote VOMS server contacted succesfully.


Created proxy in /tmp/x509up_u8102.

Your proxy is valid until Tue Apr 01 02:34:53 MSK 2025
```

2) Export created proxy-certificate

```
lxui03:~ > export X509_USER_PROXY=/tmp/x509up_u8102
```

3) Authenticate with activated rucio-client

```
(1.31.7) lxui04:~ > rucio whoami
account_type : USER
status       : ACTIVE
suspended_at : None
created_at   : 2024-08-01T12:19:41
email        : konak@jinr.ru
account      : konak
```

Auth with SPD-IAM [1]

1) **export RUCIO_AUTH_TYPE=oidc**

```
lxui03:~ > export RUCIO_AUTH_TYPE=oidc
```

2) Authenticate with activated rucio-client

```
(1.31.7) lxui03:~ > rucio whoami

Please use your internet browser, go to:

    https://spd-rucio.jinr.ru/auth/oidc_redirect?mz6Chd3grZtm57vrYcLWKQv

and authenticate with your Identity Provider.
Copy paste the code from the browser to the terminal and press enter:
```

3) Use your internet browser to authenticate in SPD-IAM with following link

Auth with SPD-IAM [2]

4) Allow authorization through the client

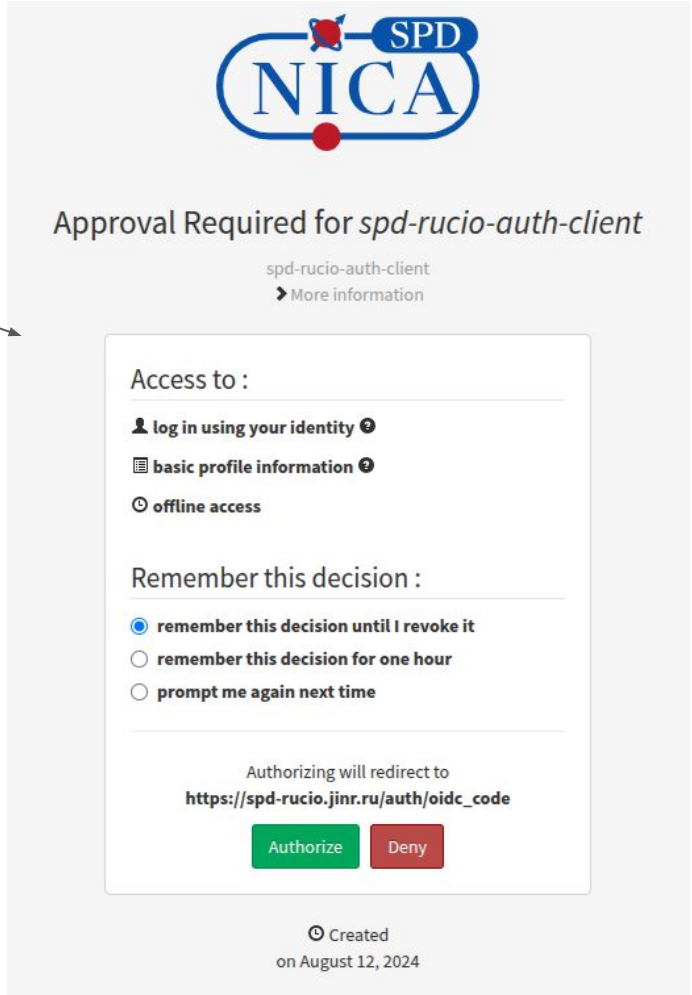
5) Copy special code from Rucio Web UI and paste it to the terminal

RUCIO

SCIENTIFIC DATA MANAGEMENT

Please copy-paste the following code to the open terminal session with Rucio Client in order to get your access token:

ehY3NT9VhozkugICpGx4wUIEA9ZyfBaJaRGMvt133mZ9RBYolo



Auth with SPD-IAM [3]

6) Paste special code to the terminal

```
(1.31.7) lxui03:~ > rucio whoami

Please use your internet browser, go to:

    https://spd-rucio.jinr.ru/auth/oidc_redirect?mz6Chd3grZtm57vrYcLWKQv

and authenticate with your Identity Provider.
Copy paste the code from the browser to the terminal and press enter:
ehY3NT9VhozkuglCpGx4wUIEA9ZyfBaJaRGMvt133mZ9RBYolo
account_type : USER
status       : ACTIVE
suspended_at : None
created_at   : 2024-08-01T12:19:41
email        : konak@jinr.ru
account      : konak
deleted_at   : None
updated_at   : 2024-08-01T12:19:41
```

How to explore data [1]

- To view the list of DIDs, use the command **rucio list-dids <did_pattern>** (shows a list of dids match given pattern)

```
(1.31.7) lxui03:~ > rucio list-dids MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001*
+-------------------------------------------------------------------------------------+--------------+
| SCOPE:NAME                                                                          | [DID TYPE]   |
|-------------------------------------------------------------------------------------+--------------|
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.2.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.2.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.R        | DATASET      |
+-------------------------------------------------------------------------------------+--------------+
```

```
(1.31.7) lxui03:~ > rucio list-dids MC2025_S1:MC2025_S1.minbias-FTF*
+-----------------------------------------------------------------------------------+--------------+
| SCOPE:NAME                                                                        | [DID TYPE]   |
|-----------------------------------------------------------------------------------+--------------|
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.S      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.P      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.R     | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.log   | DATASET      |
+-----------------------------------------------------------------------------------+--------------+
```

```
(1.31.7) lxui03:~ > rucio list-dids MC2025_S1:*RECO*
+-----------------------------------------------------------------------------------+--------------+
| SCOPE:NAME                                                                        | [DID TYPE]   |
|-----------------------------------------------------------------------------------+--------------|
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.R      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.1.R      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.RECO.1.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.R     | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.2.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.2.R      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.RECO.1.R      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.RECO.1.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.1.log    | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.RECO.1.R      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.log   | DATASET      |
+-----------------------------------------------------------------------------------+--------------+
```

```
(1.31.7) lxui03:~ > rucio list-dids MC2025_S1:*
+-------------------------------------------------------------------------------------+--------------+
| SCOPE:NAME                                                                          | [DID TYPE]   |
|-------------------------------------------------------------------------------------+--------------|
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.2.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.2.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.5.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.1.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.SIM.3.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-001.RECO.1.R        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.1.R        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.2.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.2.R        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.SIM.1.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.SIM.1.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.SIM.1.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.SIM.1.P         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.log     | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.RECO.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.SIM.1.log       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.SIM.1.S         | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.S        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.NA.PROD2025-004.SIM.331               | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.SIM.1.P        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-FTF-spdroot4171-dev.5GeV-UU.PROD2025-005.RECO.1.R       | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.RECO.1.R        | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-003.RECO.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.RECO.1.log      | DATASET      |
| MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-004.RECO.1.R        | DATASET      |
+-------------------------------------------------------------------------------------+--------------+
```

We do not recommend searching all over the production scope! This loads the system and may take a long time to complete.

How to explore data [2]

- To get content from dataset/container use **rucio list-files <did>**

```
(1.31.7) lxui03:~ > rucio list-files MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.P | head -n 8
+-------------------------------------------------------------------------------------------+--------------------------------------+-------------+------------+----------+
| SCOPE:NAME                                                                                | GUID                                 | ADLER32     | FILESIZE   | EVENTS   |
|-------------------------------------------------------------------------------------------+--------------------------------------+-------------+------------+----------|
| MC2025_S1:p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000001.root.1 | 61BBC477-7554-45BE-948C-BBFEED0419E1 | ad:76e05c6b | 1.422 MB   |          |
| MC2025_S1:p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000002.root.1 | E5B745C7-E285-4D84-ABDA-0252CA694D45 | ad:53cc796a | 1.422 MB   |          |
| MC2025_S1:p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000003.root.1 | BC9D8822-466B-4491-8831-723AB58C3482 | ad:71da4ed5 | 1.422 MB   |          |
| MC2025_S1:p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000004.root.1 | BC830E72-AC7C-47B3-9363-552953AE3603 | ad:054aac17 | 1.422 MB   |          |
| MC2025_S1:p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000005.root.1 | E752A5F4-410C-4A4F-A022-92B4F64EF709 | ad:e6cfaba0 | 1.422 MB   |          |
```

- To get PFNs use **rucio list-file-replicas <did> --pfns**

```
(1.31.7) lxui03:~ > rucio list-file-replicas MC2025_S1:MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.P --pfns | head -n 8
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/49/cf/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000001.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/5b/c1/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000002.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/ae/24/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000003.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/79/8e/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000004.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/9e/41/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000005.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/89/d5/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000006.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/08/ce/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000007.root.1
root://eos.jinr.ru:1094//eos/nica/spd/datadisk/rucio/MC2025_S1/7a/0a/p.MC2025_S1.minbias-P8-spdroot417-dev.10GeV-UU.PROD2025-002.SIM.1.000008.root.1
```

TBD!!!

To be continued…