

# Connecting REANA and the CERN-VRE: a JupyterLab extension middleware

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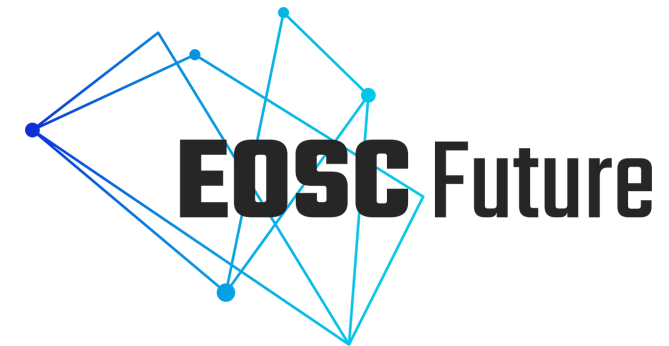
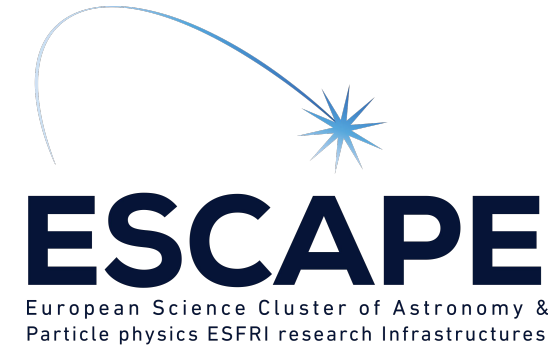
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# Introduction

## The Virtual Research Environment (VRE):

- Collaborative analysis platform where researchers can develop and share end-to-end workflows.
- Adheres to FAIR principles to enhance the usability and impact of scientific data (**F**indable, **A**ccessible, **I**nteroperable, **R**eusable).
- Developed at CERN within the ESCAPE and EOSC (European Open Science Cloud) Future projects.
- Showcases how disciplines ranging from HEP to Astrophysics could benefit from the usage of common technologies.

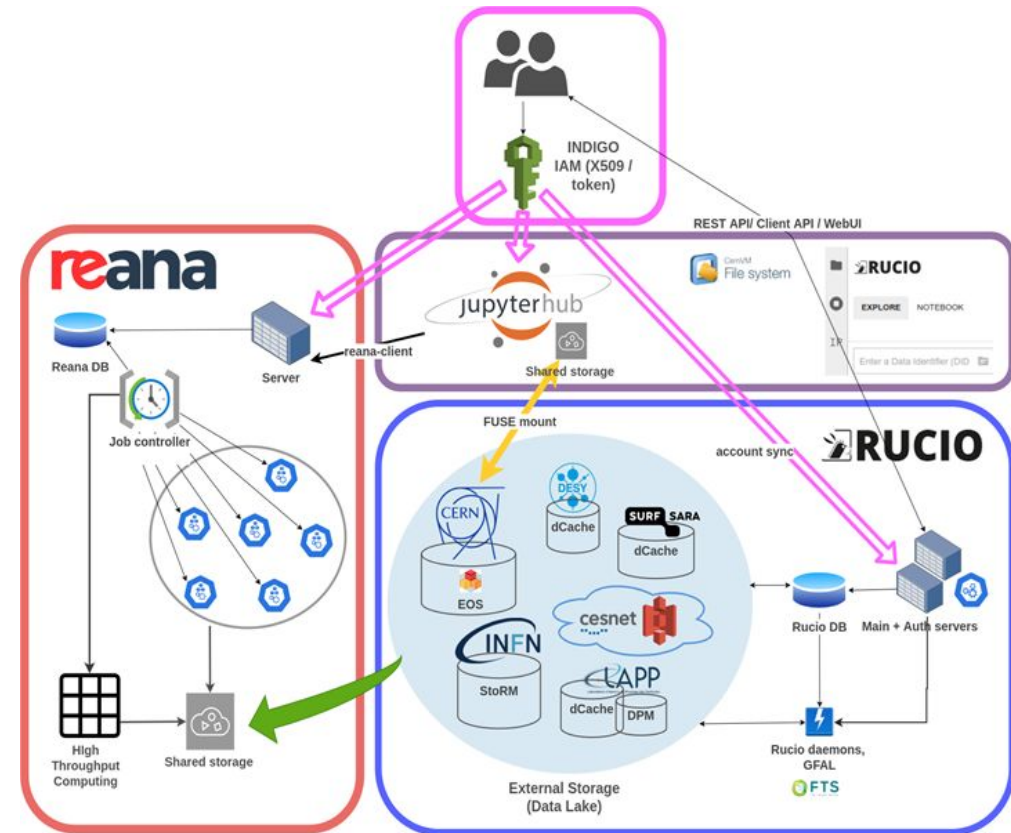


# Introduction

## The Virtual Research Environment (VRE):

- **Main components:**

- A federated Authentication and Authorization layer.
- A federated distributed storage solution (the Data Lake) with a Data Management framework (Rucio).
- An enhanced **notebook interface**.
- A computing cluster with a re-analysis software (**Reana**)



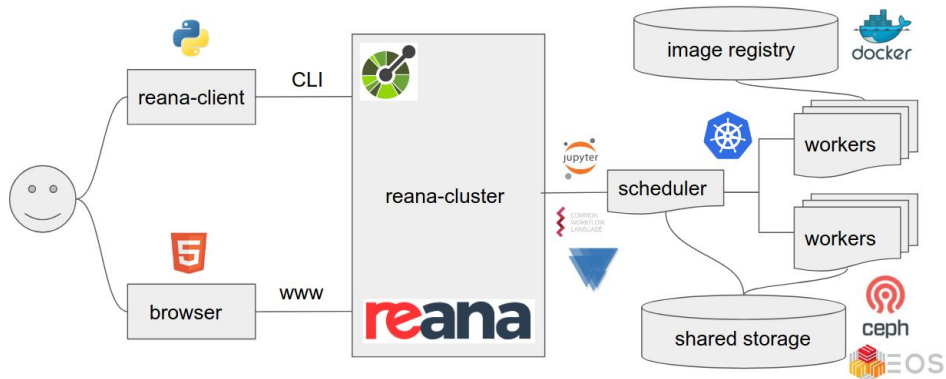
**VRE-hub:** <https://vre-hub.github.io>



# Introduction

## REANA:

- REANA is a **reproducible analysis** platform that allows scientists to run containerised data analysis pipelines on remote compute clouds.
- Analyses are defined in YAML files, describing the inputs, workflow steps and the outputs.



Reana: <https://docs.reana.io/>

reana



## Your workflows

Refreshed at 14:52:54 UTC

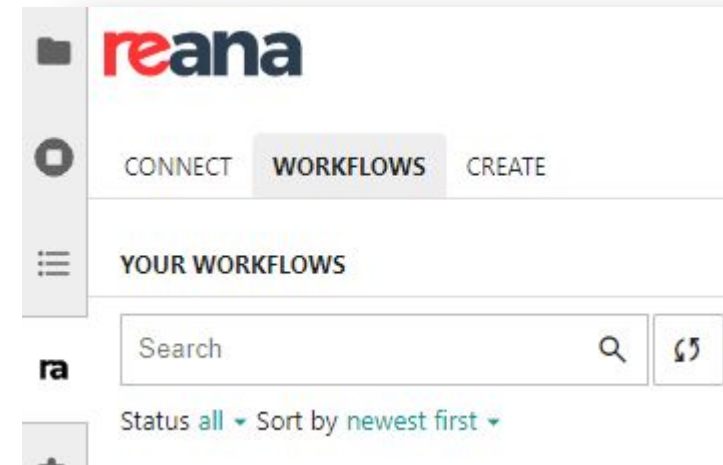
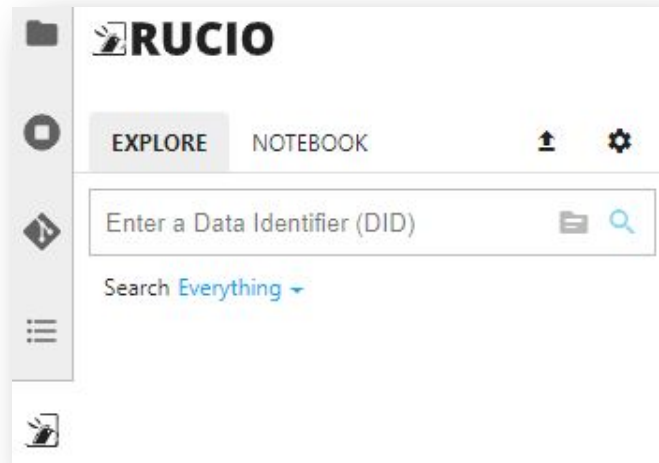
Search...	
Status	Latest first
✔ roofit #26 Finished an hour ago	finished in 22 seconds step 2/2
✔ roofit #25 Finished 3 hours ago	finished in 19 seconds step 2/2
✔ roofit #24 Finished 5 hours ago	finished in 22 seconds step 2/2
✔ roofit #23 Finished 5 hours ago	finished in 22 seconds step 2/2
✔ roofit #22 Finished 5 hours ago	finished in 21 seconds step 2/2

« < 1 2 3 4 5 ... 8 > »

Reana-UI: <https://github.com/reanahub/reana-ui>

# Motivation

- In order to use Reana in our virtual environment we need to know how to use **reana-client**. If we want to use **reana-ui**, we have to open a new browser tab, separated from the JupyterLab interface.
- As we did for Rucio, we aim to integrate REANA and its functionalities into the JupyterLab environment.



# Reana JupyterLab extension

## Main features

Connect to any Reana server

List workflows

Interact with a workflow

Create workflow from the environment

## UI Requirements

Responsive

User-friendly

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The screenshot shows the Reana JupyterLab extension interface. At the top, there is a navigation bar with the Reana logo and three buttons: 'CONNECT', 'WORKFLOWS', and 'CREATE'. Below this, a section titled 'CONNECT TO REANA' contains a form. The form has two input fields: 'Server Name' with the value 'https://reana-vre.cern.ch' and 'Access Token' with a masked value '.....'. A 'Connect' button is located below the 'Access Token' field.



# Reana JupyterLab extension

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List workflows ✓

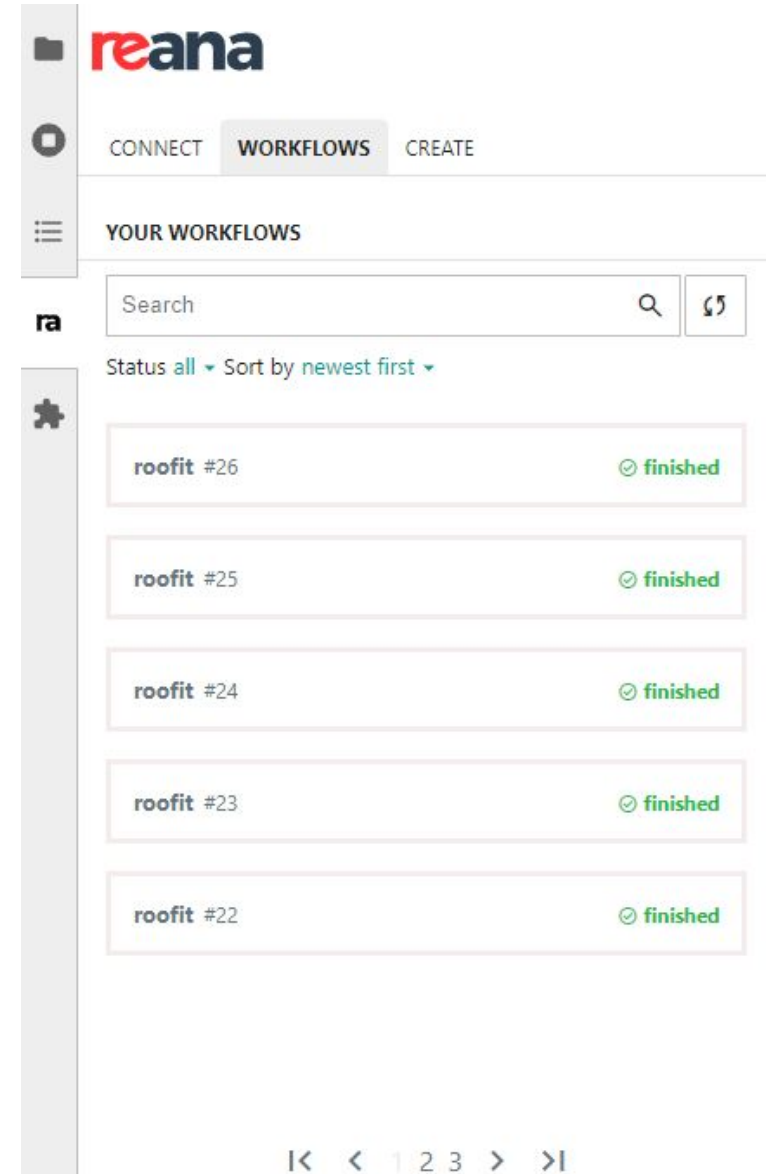
Interact with a workflow

Create workflow from the environment

## UI Requirements

Responsive

User-friendly



The screenshot shows the Reana web interface. At the top, there is a navigation bar with the Reana logo and buttons for 'CONNECT', 'WORKFLOWS', and 'CREATE'. Below this is a section titled 'YOUR WORKFLOWS' with a search bar and a refresh button. The main content area displays a list of workflows, each with a status indicator and the word 'finished' in green. The workflows are numbered from #22 to #26. At the bottom, there is a pagination control showing '1 2 3' and navigation arrows.

Workflow ID	Status
roofit #26	finished
roofit #25	finished
roofit #24	finished
roofit #23	finished
roofit #22	finished

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reana

CONNECT WORKFLOWS CREATE

←

roofit #26 finished in 22 seconds  
Finished: 5/8/2024, 13:41:50 step 2/2

ENGINE LOGS JOB LOGS WORKSPACE SPECIFICATION

Step gendata

finished in 5 seconds Kubernetes docker.io/reanahub/reana-env-root6:6.18.04

```
$ mkdir -p results && root -b -q 'code/gendata.C(20000,\"results/data.root\")'
```

job: :

```
| Welcome to ROOT 6.18/04 https://root.cern |  
| (c) 1995-2019, The ROOT Team |  
| Built for linuxx8664gcc on Jan 08 2020, 14:10:00 |  
| From tags/v6-18-04@v6-18-04 |  
| Try '.help', '.demo', '.license', '.credits', '.quit'/.q' |
```

Processing code/gendata.C(20000,\"results/data.root\")...

```
@[1mRooFit v3.60 -- Developed by Wouter Verkerke and David Kirkby@[0m  
Copyright (C) 2000-2013 NIKHEF, University of California &  
All rights reserved, please read http://roofit.sourceforge.
```

```
[#1] INFO:ObjectHandling -- RooWorkspace::import(w) importing RooAddPdf::mc  
[#1] INFO:ObjectHandling -- RooWorkspace::import(w) importing RooChebychev:  
[#1] INFO:ObjectHandling -- RooWorkspace::import(w) importing RooRealVar::>  
[#1] INFO:ObjectHandling -- RooWorkspace::import(w) importing RooRealVar::e  
[#1] INFO:ObjectHandling -- RooWorkspace::import(w) importing RooRealVar::e
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The screenshot displays the Reana JupyterLab extension interface. At the top, the 'reana' logo is visible, followed by navigation tabs for 'CONNECT', 'WORKFLOWS', and 'CREATE'. Below these, a section titled 'CREATE A REANA WORKFLOW' contains a 'Workflow Name' input field with the value 'roofit' and a 'YAML File' input field with the value 'reana-demo-root6-roofit/reana.yaml'. There are 'Validate' and 'Create & Run' buttons. The 'OUTPUT' section shows a terminal window with the following text:

```
==> Verifying REANA specification file.. /home/ruben/UGR/jupyterlab-extension-tutoria
-> SUCCESS: Valid REANA specification file.
==> Verifying REANA specification parameters...
-> SUCCESS: REANA specification parameters appear valid.
==> Verifying workflow parameters and commands...
-> SUCCESS: Workflow parameters and commands appear valid.
==> Verifying dangerous workflow operations...
-> SUCCESS: Workflow operations appear valid.
```

# Reana JupyterLab extension

## Main features

Connect to any Reana server ✓

List workflows ✓

Interact with a workflow ✓

Create workflow from the environment ✓

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User-friendly

reana

CONNECT WORKFLOWS CREATE

CREATE A REANA WORKFLOW

Workflow Name  
roofit

YAML File  
reana-demo-root6-roofit/reana.yaml

Validate Create & Run

OUTPUT

```
==> Verifying REANA specification file.. /home/ruben/UGR/jupyterlab-extension-tutoria
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reana

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Workflow Name  
roofit

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Validate Create & Run

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# Reana JupyterLab extension

- **Frontend:**
  - Jupyter lab extension
  - Based on [jupyterlab/extension-template](#)
  - React, Typescript, CSS, HTML
- **Backend:**
  - Jupyter server extension
  - Python
- **Connection to REANA API:**
  - reana-client in Python
  - reana-client in CLI
  - Reana REST API

## Docker image and Python package available!

```
docker pull ghcr.io/vre-hub/reana-jupyterlab-extension:latest  
pip install reana-jupyterlab
```

The extension is already installed in the VRE platform: <https://jhub-vre.cern.ch/>.





# Reana JupyterLab extension

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# Conclusions

- **reana-jupyterlab-extension** integrates all the basic functionalities of **reana-client** and **reana-ui** in the notebook interface.
- Positive feedback from the REANA team.
- **Future work:**
  - Use the Python methods provided by **reana-client** to make the requests to the server.
  - Maintenance.

# DEMO

# Thank you!

Questions? Suggestions?



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[github.com/vre-hub/reana-jupyterlab-extension](https://github.com/vre-hub/reana-jupyterlab-extension)



# Bibliography

1. Gazzarrini, E., Garcia, E., Gosein, D., Moya, A. V., Kounelis, A., & Espinal, X. (2023). The Virtual Research Environment: towards a comprehensive analysis platform. *arXiv preprint arXiv:2305.10166*.
2. Gazzarrini, E., Garcia, E. G., Gosein, D., & Espinal, X. (2024). The Virtual Research Environment: A multi-science analysis platform. In EPJ Web of Conferences (Vol. 295, p. 08023). EDP Sciences.
3. Šimko, T., Heinrich, L., Hirvonsalo, H., Kousidis, D., & Rodríguez, D. (2019). REANA: A system for reusable research data analyses. In EPJ Web of Conferences (Vol. 214, p. 06034). EDP Sciences.

# BACKUP SLIDES

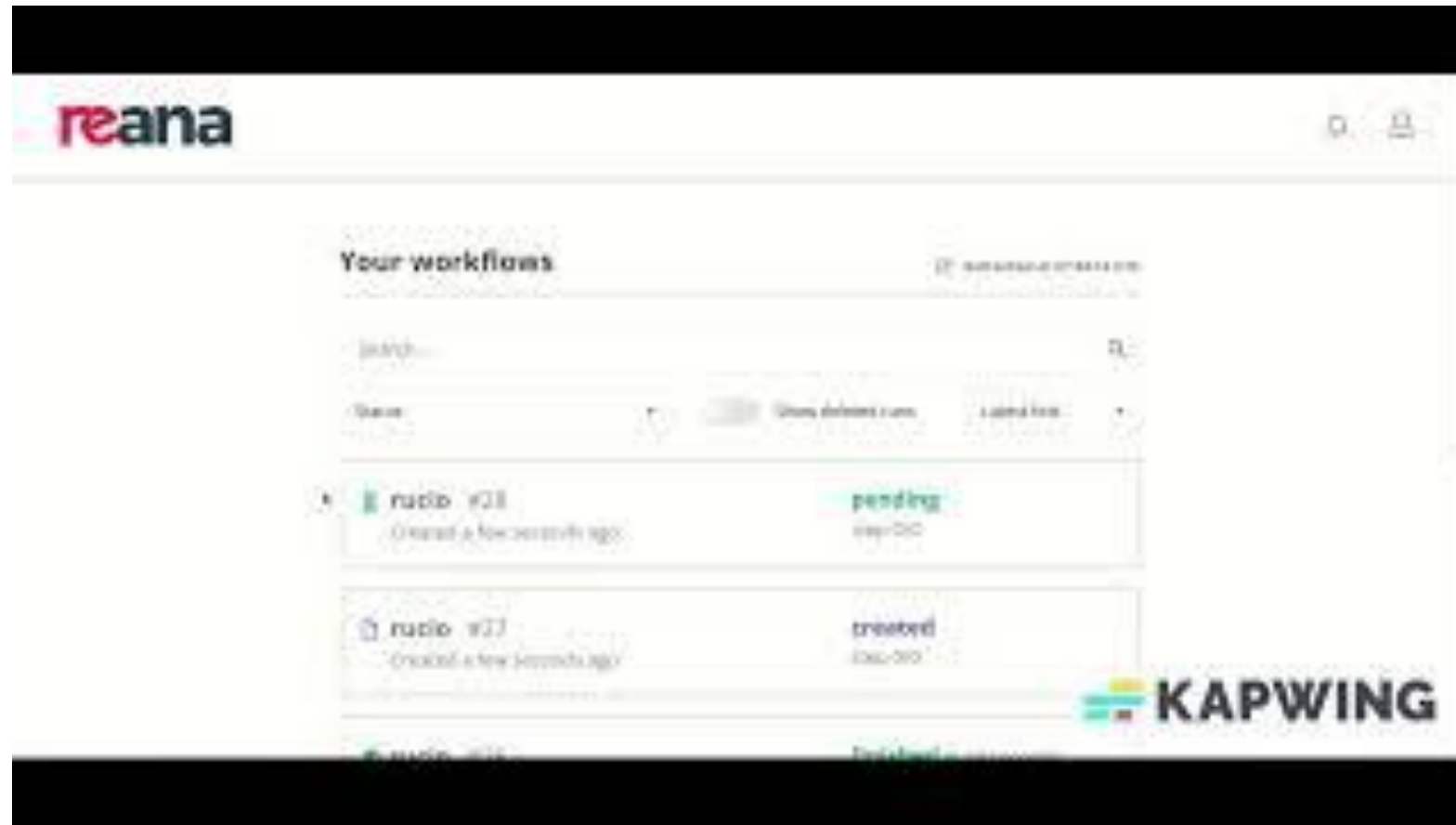


# Interaction with REANA

- We started using **reana-client** on this project, but we faced a few problems along the way. Some of them:
  - **jsonschema** incompatibility (<https://github.com/reanahub/reana-commons/issues/461>).
  - Server URL issue (<https://github.com/reanahub/reana-client/issues/722>).
  - No *sort* parameter in **get\_workflows**.
  - No information about navigation in **get\_workflows** (needed to paginate the results).
  - No **run** shortcut for creating the workflow, uploading the files and starting the workflow.
- We are using the **reana-server REST API** instead.
- Problem: Workflow creation is complex. We need to use the commands in **reana-client**.  
**reana-client run**  
**reana-client validate**

# How Reana is being used in the VRE without the extension?

Elena Gazzarini. ATLAS Dark Matter Dilepton Resonance on the Virtual Research Environment.



# How Reana will be used in the VRE with the extension?

The screenshot displays the Reana JupyterLab interface. On the left, the 'CONNECT' tab is active, showing the 'CONNECT TO REANA' section. The 'Server Name' field contains 'https://reana-vre.cern.ch' and the 'Access Token' field is masked with dots. A 'Connect' button is located below these fields. The main area on the right is a terminal window with the title 'ruben@LEGION: ~/UGR/jupyX'. The terminal shows the prompt 'ruben@LEGION:~/UGR/jupyterlab-extension-tutorial\$' and a cursor. The bottom status bar indicates 'Simple' mode, '1' session, '0' tabs, and the terminal path 'ruben@LEGION: ~/UGR/jupyterlab-extension-tutorial'.