Design & Construction

Part 3/3 Computing Infrastructure

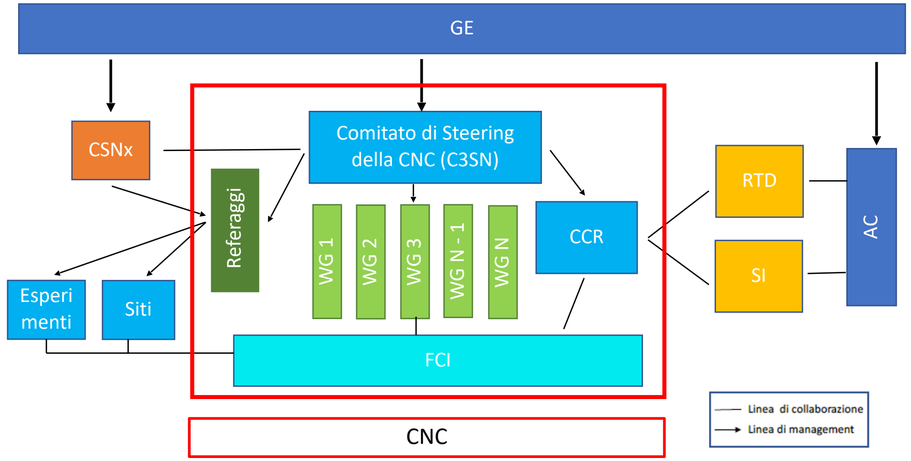
G. Mazzitelli CYGNO annual meeting 19/20-12-2022

CNC steering committee C3SN

INFN computing infrastructure “clean up”…

CSN2
Fisica delle
Astroparticelle

- WG **Infrastruttura** (D. Salomoni);
- WG **Tecnologie informatiche** (A. Chierici);
- WG **Modelli di calcolo** (D. Elia);
- WG **Progetti/Fondi Esterni** (L. Gaido)
- WG **High Performance Computing** (T. Boccali)
- WG **Quantum Computing** (C. Bozzi)
- **FORUM** (C. Grandi)
- **CCR** (A. Brunengo)
- **Referaggi** (G. Carlino



• Dott.	Gianpaolo Carlino	Presidente
• Dott.	Alessandro Brunengo	Presidente della CCR *(ex officio)*
• Dott.	Luca dell’Agnello	Direttore del CNAF *(ex officio)*
• Prof.ssa	Laura Perini	Rappresentante in Italian Computing and Data Infrastructure) ICDI *(ex officio)*
• Dott.	Gianpaolo Carlino *(ad interim)*	Coordinatore dei Referee Calcolo Scientifico *(ex officio)*
• Dott.	Claudio Grandi	Il coordinatore del Forum del Calcolo INFN
• Dott.	Daniele Cesini	Rappresentante del Tier-1
• Dott.	Giacinto Donvito	Rappresentante del Tier-2
• Dott.	Tommaso Boccali	Esperto Architetture calcolo scientifico
• Dott.	Davide Salomoni	Esperto Infrastrutture calcolo distribuito
• Dott.	Concezio Bozzi	Esperto calcolo quantistico
• Prof.	Daniele Bonacorsi	CSN1
• Dott.	Giovanni Mazzitelli	CSN2
• Dott.	Domenico Elia	CSN3
• Prof.ssa	Cecilia Tarantino	CSN4
• Dott.ssa	Alessandra Retico	CSN5

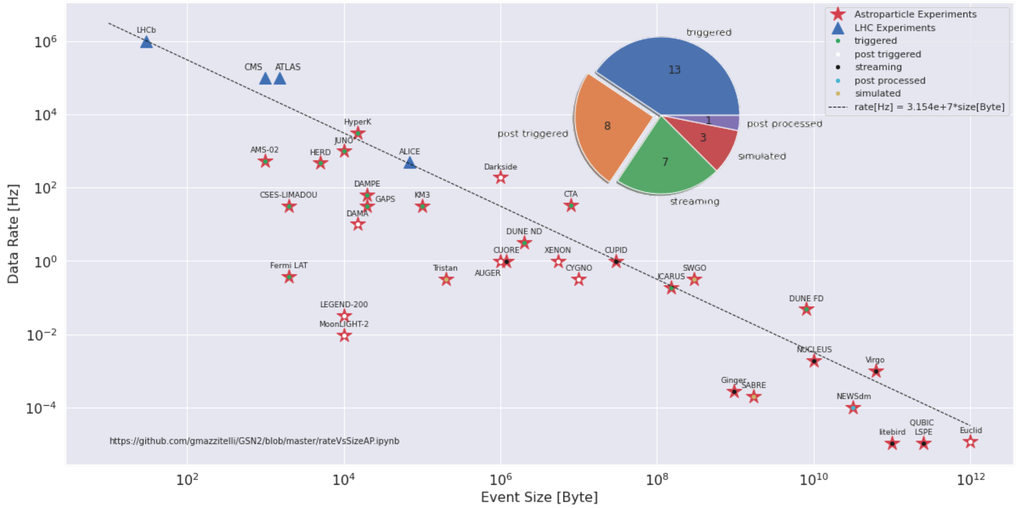
CSN2/INFN WG Computing Models
G. Mazzitelli, M. Duranti, F. Di Pierro , S. Bagnasco, M. Tenti, R. Cerulli

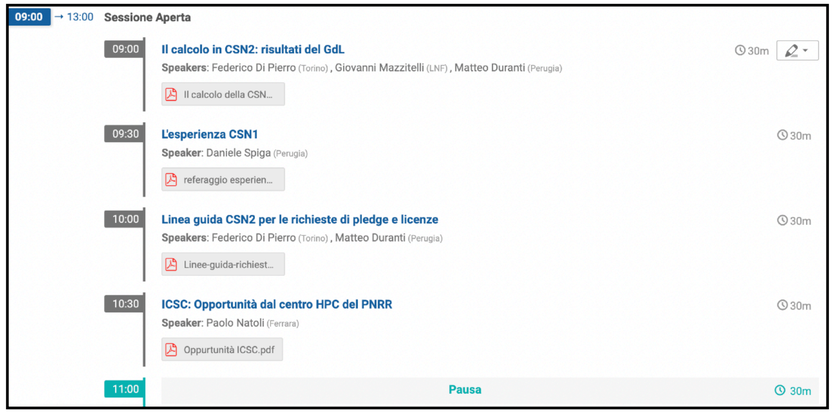
CNC

Budget ordinario 2023 = 2.400 k€
- C3SN = 415 k€
- CCR = 1.985 k€

CSN2 computing models analisys and WG

- since Nov 2021 a WG in CSN2 started to review the computing model of astroparticle experiments in order to provide **guidelines and develop tools** for the community maximising the exploitation of the resources.
- the CSN2 CM **analysis as been presented at last meeting** and has been assumed as seed for the next step in the INFN CM WG.
- The **CYGNO CM** and similar applications under development are in the **main stream of the CSN2/ INFN of the ideas** to how evolve the infrastructure, also due to the **PNRR** where our use case fit very well.





https://agenda.infn.it/event/33086/#1-il-calcolo-in-csn2-risultati

ICSC

XC, Italian Center for Super Computing (1/5 national center)

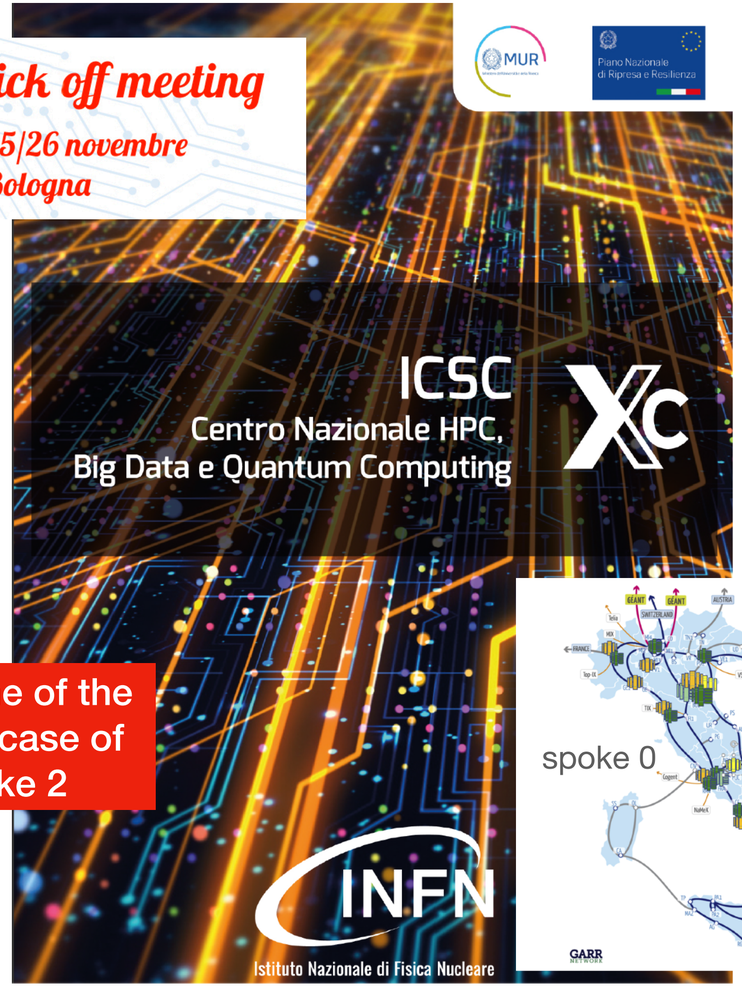
CSN2 Fisica delle Astroparticelle

- Budget ridotto da 400 M€ a 320 M€
- Quota INFN ridotta da 72.2 M€ a 58.2 M€
- Inizio: 1/9/2022
- ~ 250 PhD e 250 LD
- 1 infrastruttura (spoke 0),10 spokes tematici

	0									
	SUPERCOMPUTING CLOUD INFRASTRUCTURE CINECA (Leader), INFN (Co-Leader), GARR (Participant)									
	1	2	3	4	5	6	7	8	9	10
	FUTURE HPC & BIG DATA	FUNDAMENTAL RESEARCH & SPACE ECONOMY	ASTROPHYSICS & COSMOS OBSERVATIONS	EARTH & CLIMATE	ENVIRONMENT & NATURAL DISASTERS	MULTISCALE MODELING & ENGINEERING APPLICATIONS	MATERIALS & MOLECULAR SCIENCES	IN-SILICO MEDICINE & OMICS DATA	DIGITAL SOCIETY & SMART CITIES	QUANTUM COMPUTING
Co-Leader Leader	UNIBO	INFN	INAF	CMCC	UNIBA	SAPIENZA	CNR	IIT	UNINA	POLIMI
Co-Leader Leader	UNITO	INAF	INFN	CNR	UNIAQ	UNIPI	SISSA	UNICT	FBK	UNIPD
Participants	POLIMI POLITO UNIPI UNIPD ROMA TOV UNINA UNICT UNICAL INAF CINECA ENEA IIT UNIFE	UNICT UNICAL UNIBA UNIMIB UNINA SAPIENZA UNITS UNIBO POLIBA UNIFI UNIPD UNIFE UNISALENTO	SISSA UNITO UNITS SNS-PI ROMA TOV UNICT	ENEA FBK UNITN UNISALENTO	ENEA POLIBA UNIFI INGV SAPIENZA CNR	UNIBO POLIMI POLITO UNIPV ROMA TOV UNICAL CNR UNIFI	UNIMIB UNITS POLITO UNITO UNIPI UNIFI UNITN UNICAL ENEA	UNIBO UNITO UNIPD UNIPV POLIBA UNIBA INFN CNR FBK UNIFE	UNICT UNIMIB UNITN UNIAQ POLIBA UNISALENTO CRS4	UNIBO UNIMIB UNIPI UNIPV SAPIENZA UNINA UNIBA
	LEONARDO, ENI, SOGEI, FERROVIE DELLO STATO ITALIANE, FINCANTIERI, AUTOSTRADE PER L'ITALIA, UNIPOLSAI, THALES ALENIA SP IFAB, FONDAZIONE INNOVAZIONE URBANA, HUMANITAS, ENGINEERING, UPMC, INTESA SAN PAOLO, TERNA									
	EDUCATION & TRAINING, ENTREPRENEURSHIP, KNOWLEDGE TRANSFER, POLICY, OUTREACH									
	HUB ONLY, WITHOUT BUDGET: OGS, UNIPR, UNIMORE									
	NETWORK PARTNERS									

ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

Kick off meeting
25/26 novembre
Bologna



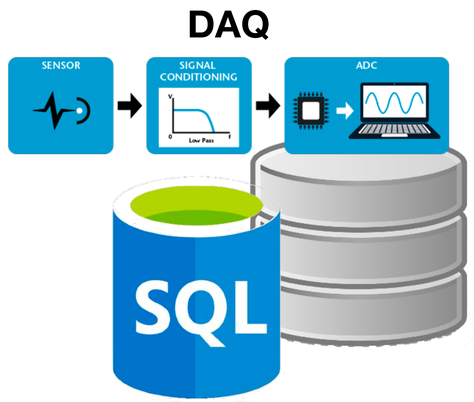
CYGNO is one of the physics use case of WP3 spoke 2

CYGNO/QUAX/CSN2 … model

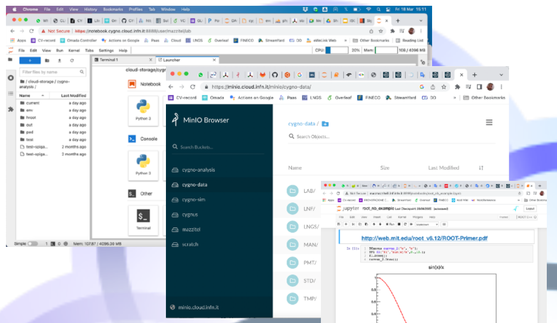
CSN2
Fisica delle
Astroparticelle

LNGS/LNF/…

DAQ



WEB GUI

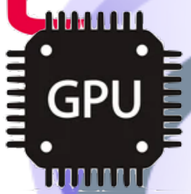


BACH

ANALISYS

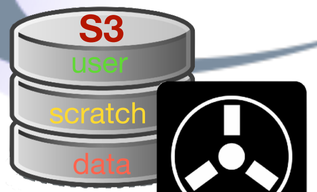
HPC

RESOURCES



INFN

SIMULATION



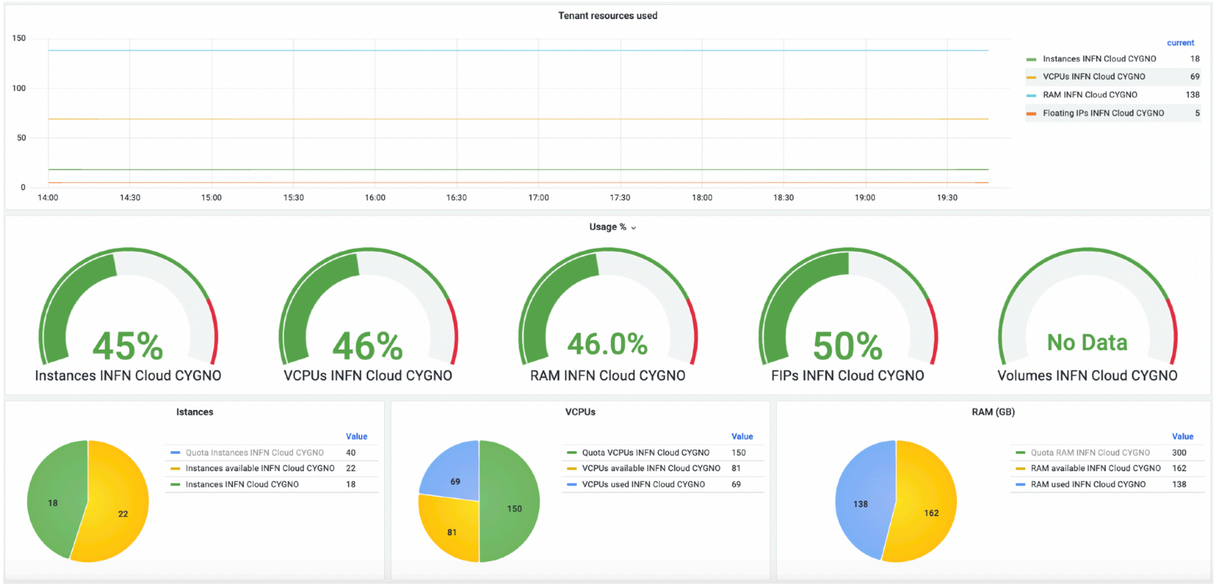
STORAGE/BACKUP

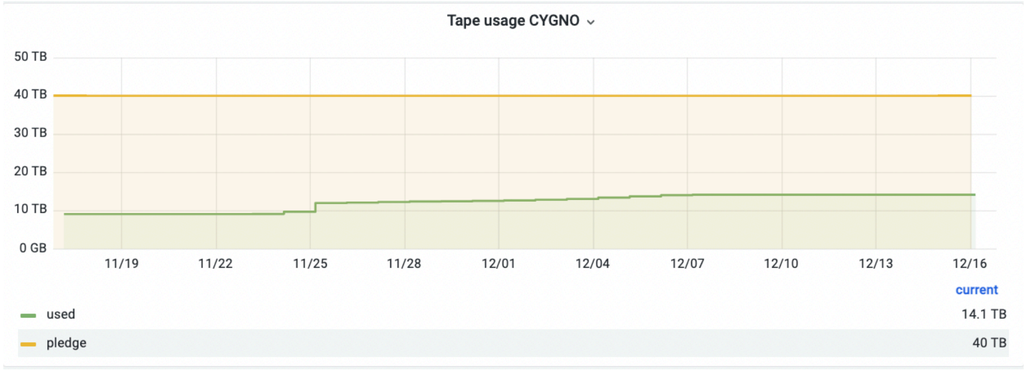
METADATA &
SLOW CONTROL

CYGNO resources

https://github.com/CYGNUS-RD/cygno/blob/main/infrastructure.md

- pledge: **150 CPUs 300 GB** conferable on demand
- **40 TB of S3 + 40 TB of TAPE storage** (estimating 40TB/year the overall final pledge will be around 100/250 TB)
- **2 notebook** configure with 16 CPUs/32 GB
- **2 HTCondor** (production/test) queue configurable on demand (24 pods * 4 core/ 2GB)
- 50% of pledges are configured, about 40/50% average load.
- an experiment orchestrator/service provider is under development

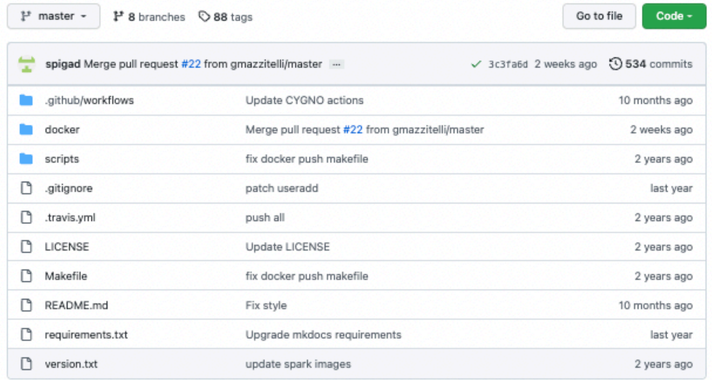


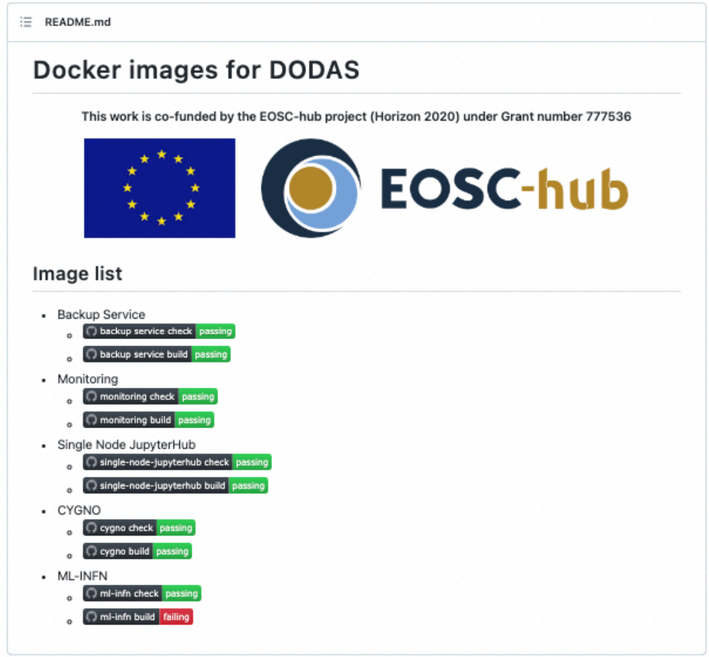


Dynamic On Demand Analysis Service (DODAS)

https://github.com/DODAS-TS/dodas-docker-images

- services on demand:
  - composition of two services
  - composition of a new service with an existing one
  - customisation of existing services
  - **Integration of Cloud storage INFN for persistence services (INFN-ML and CYGNO)**
- the cloud (but also any system today, eg the LNGS machine) is based on virtual machine (PaaS) where process called container are develop to provide software needed (SaaS) by users (—> safety, scalability, uniformity, resources and cost saving);
- DODAS is the INFN project of which CYGNO use case is part and where we can develop our specific applications for the experiment;
- we have the full control of the resources and the application we want to develop.

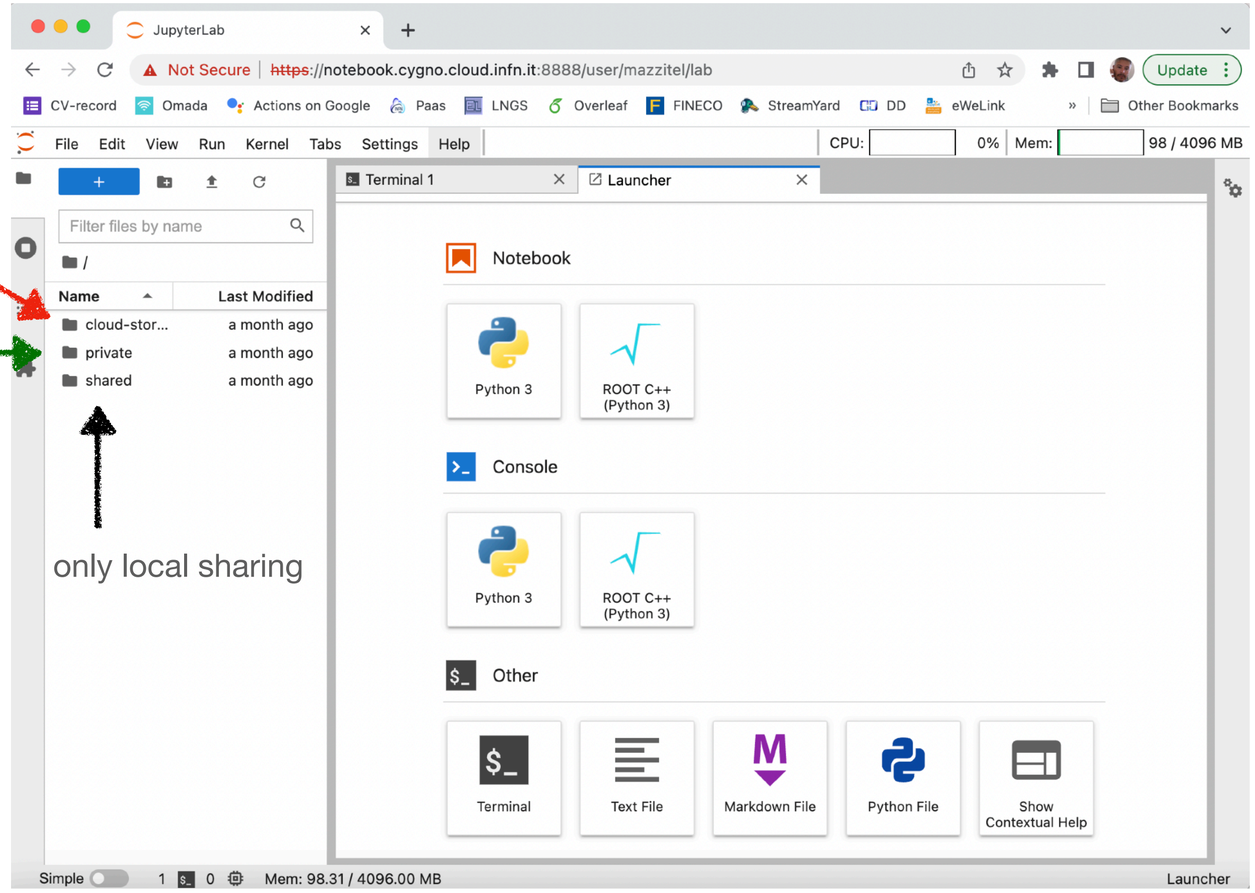




web interface

2 notebooks 16/32

- **notebooks** for scripting in python and root
- root and python **consoles** (ex https://root.cern/doc/master/group_tutorial_graphs.html)
- **terminals**
- **editor** and markdown
- **file system** tolls
- running V17: python 3.9.10 (not deafult), emacs, screen, root_numpy, uproot, pydot, tensorflow, opencv-python, graphviz https://github.com/CYGNUS-RD/cygno/blob/main/infrastructure.md#tag-v1017
- **tips**: any notebook have local **private/shared and S3 storage**. use private for better software performance but **share file on S3 (cloud-storage)** so that you can reach from any notebook/application (example HTcondor)



storage & tape

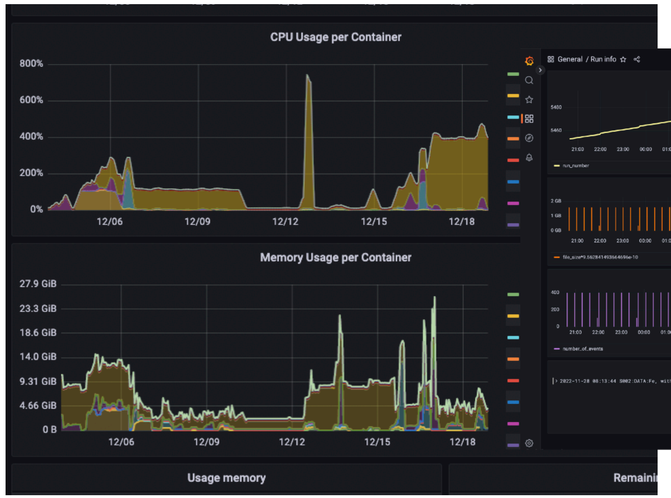
- data are **stored on S3 object storage** (key, metadata, value) that offer typical advantage of cloud system like scalability, accessibility, ecc but is not POSIX
- main advantage accessibility **from anywhere**, if the file are “stream” (root file) you can open directly without download (midas file sequential)
- you can access in the usual way only on the cloud where FUSE is **simulating POSIX**
- you can access and **save directly file from any application** on the cloud (condor queue, LNGS queue ecc) via python API
- tape up to now is accessible via **GFAL, RUCIO and FTS** is going to be implemented for better
- **tips**: use **CYGNO lib**:
  - open_mid(run=5013, tag=‘LNGS’) from cloud
  - open_mid(run=5013, tag=‘LNGS’, cloud=False) form remote (download and open file)
  - open_mid(run=5013, path=‘filepath’, tag=‘LNGS’, cloud=False) open local file

data replica dashboard

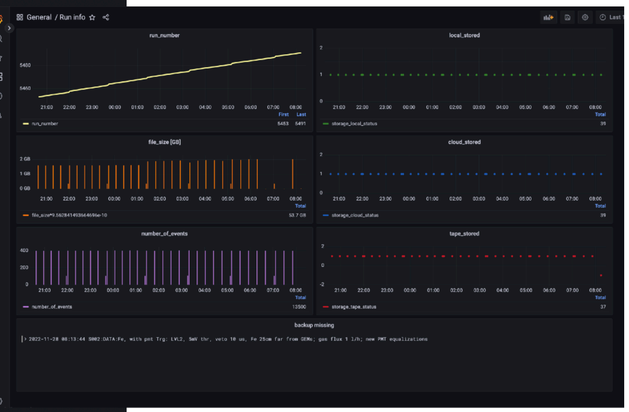
SQL/Meta Data

- the cloud host **two services VM** with SQL db and GRAFANA dashboard for GUI to monitor resources, metadata, slow controls and data quality.
- we have also now a **web server**, hosting PHP script (eg. runs table, metadata table, ecc), to remotely access the SQL and that will solve the faction of been a sort of “orchestrator”
- we have then a **test notebook** and a test queue (with a few resources) where test back-end software
- **tips**: use **CYGNO lib**:
  - data logbook run info
  - metadata status
  - …

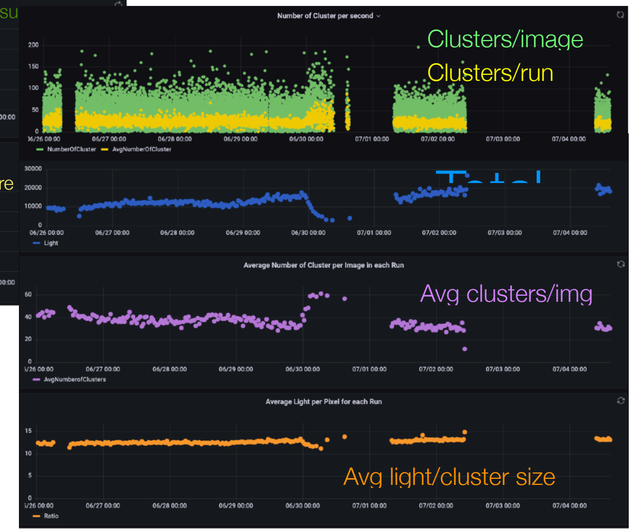
resources monitor



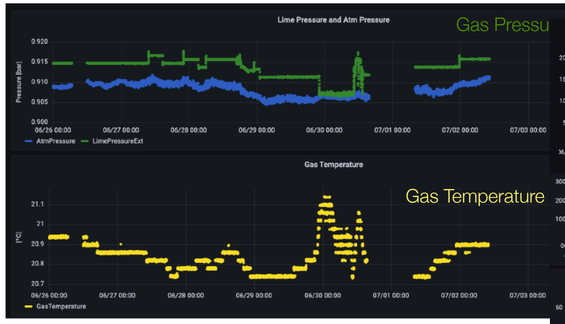
metadata monitor



data quality monitor



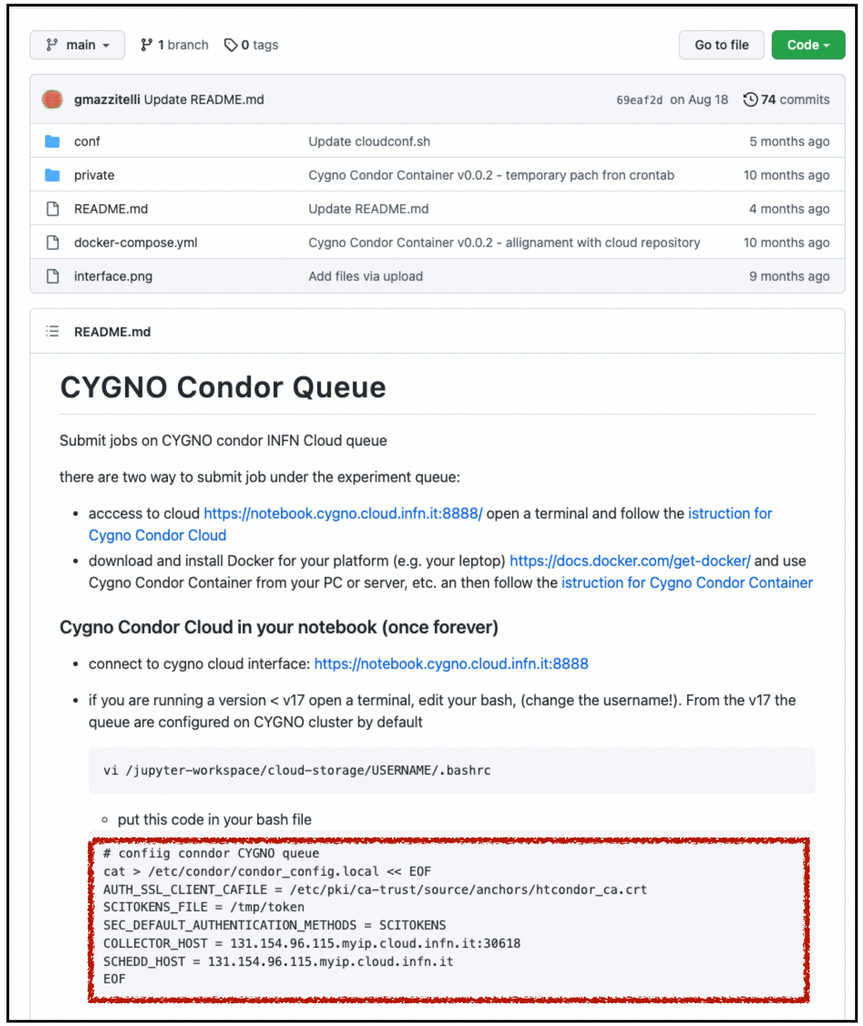
slow control monitor



HTCondor

on demand

- **CYGNO experiment queue** are accessibile form everywhere by:
  - access and submit your process for a terminal in **cloud** (strongly recommended)
  - by “**mycondor**” container installed and configure on any remote machine (maintained)
  - **installing** locally OICD/CONDOR and configuring it from any remote machine (deprecated)
- the queue can access in read/write data from the S3 clod storage via python api.
- package and all needs can easily configure generally in a few minutes.



main · 1 branch · 0 tags · Go to file · Code

gmazzitelli Update README.md — 69eaf2d on Aug 18 — 74 commits

conf	Update cloudconf.sh	5 months ago
private	Cygno Condor Container v0.0.2 - temporary pach fron crontab	10 months ago
README.md	Update README.md	4 months ago
docker-compose.yml	Cygno Condor Container v0.0.2 - allignament with cloud repository	10 months ago
interface.png	Add files via upload	9 months ago

README.md

CYGNO Condor Queue

Submit jobs on CYGNO condor INFN Cloud queue

there are two way to submit job under the experiment queue:

- acccess to cloud https://notebook.cygno.cloud.infn.it:8888/ open a terminal and follow the istruction for Cygno Condor Cloud
- download and install Docker for your platform (e.g. your leptop) https://docs.docker.com/get-docker/ and use Cygno Condor Container from your PC or server, etc. an then follow the istruction for Cygno Condor Container

Cygno Condor Cloud in your notebook (once forever)

- connect to cygno cloud interface: https://notebook.cygno.cloud.infn.it:8888
- if you are running a version < v17 open a terminal, edit your bash, (change the username!). From the v17 the queue are configured on CYGNO cluster by default

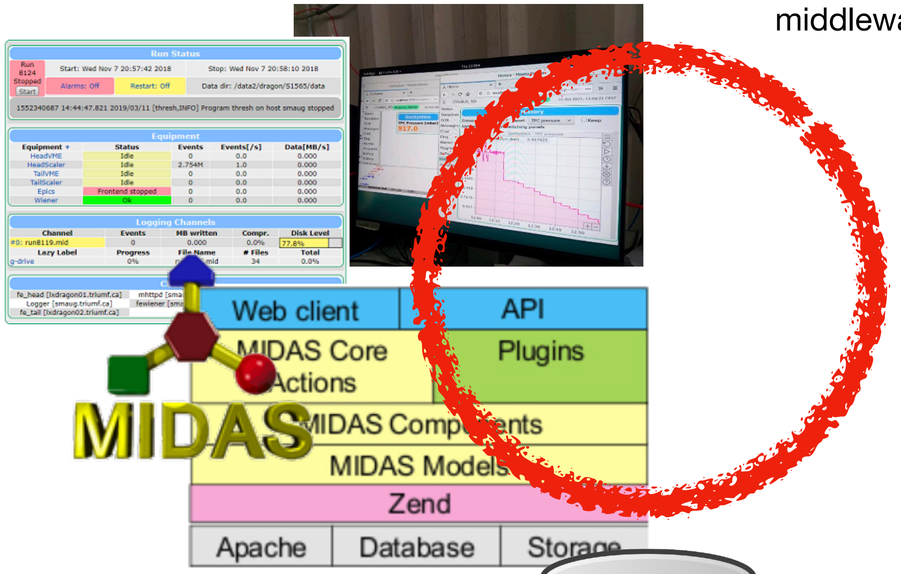
```
vi /jupyter-workspace/cloud-storage/USERNAME/.bashrc
```

  - put this code in your bash file

```
# confiig conndor CYGNO queue
cat > /etc/condor/condor_config.local << EOF
AUTH_SSL_CLIENT_CAFILE = /etc/pki/ca-trust/source/anchors/htcondor_ca.crt
SCITOKENS_FILE = /tmp/token
SEC_DEFAULT_AUTHENTICATION_METHODS = SCITOKENS
COLLECTOR_HOST = 131.154.96.115.myip.cloud.infn.it:30618
SCHEDD_HOST = 131.154.96.115.myip.cloud.infn.it
EOF
```

data flow - schematic view

from detector to cloud



middleware

slow info
fast reco
image
production

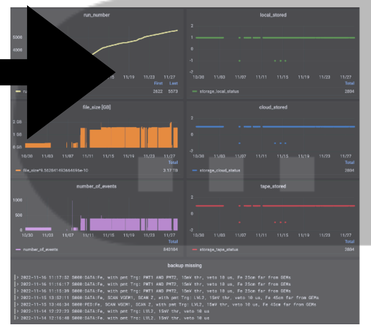
local
storage

storage worker
midas2cloud

INFN cloud storage
interactive and batch data analyse and simulation

METADATA
SLOW INFO

TAPE DRIVE

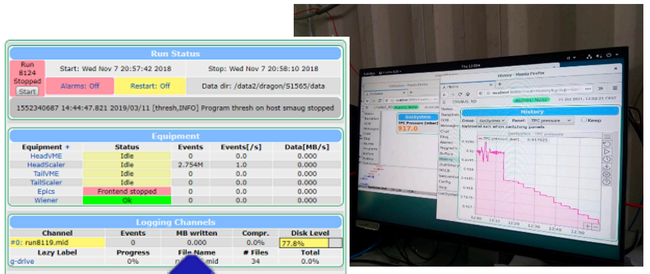


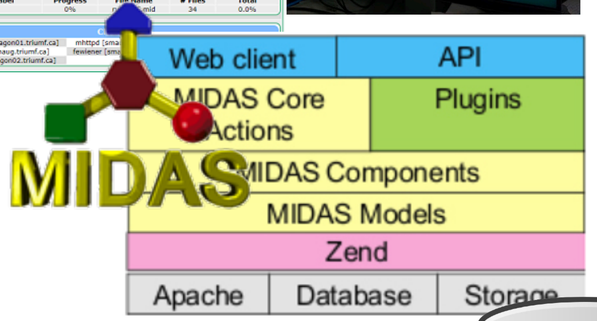
local data center

data flow - schematic view

from detector to cloud

INFN cloud storage
interactive and batch data analyse and simulation

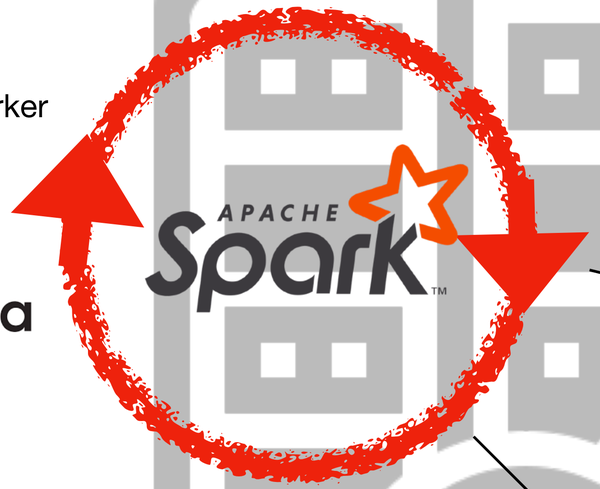




local
storage

data worker

middle ware



storage worker

local data center

conclusion

critical issues

- the CYGNO use case **is part of fundamental prototype to design computing model for CSN2** experiments and INFN. Is also part of **PNRR** where tools and founds are available to develop one of the main computing infrastructure in Italy.
- thanks to the strong collaboration with the INFN/CNAF personnel we have/are developing and tacking part to **DODAS** project.
  - we still have to learn/develop many thinks and we are not system manager (too slow, too busy, too..)
- **complete backup on tape**:
  - but MANGO data and other buckets are still not automated, we are now not protected by storage hardware fault/accidental removal from users on data-analysis and data-sim buckets
  - we stil need to implement backup of SQL and metadata
  - we are also waiting for RUCIO and FTS implementation from INFN

conclusion

critical issues

- the **young people** are strongly exploiting the resources (I stodgily thanks everybody for the feedback with a special nomination to Flaminia)
  - there is a “**age gap**” that requires some special effort, we asked, because of interest form other experiments to this development, to realise an “INFN” training corses the “**old ones**”
- please use and contribute to **cygno** library
- we are still **missing analysis and sim metadata** (related to run data) in the official relational DB
- test and deploy **services to host fast reco on cloud**
  - still missing a **full reconstruction** optimised and with a design at **plugin** in order to be able faster it **switching on/off** not essential part for quality data and pre-produce **metadata to faster** full reconstruction