CMS T2/T3 computing

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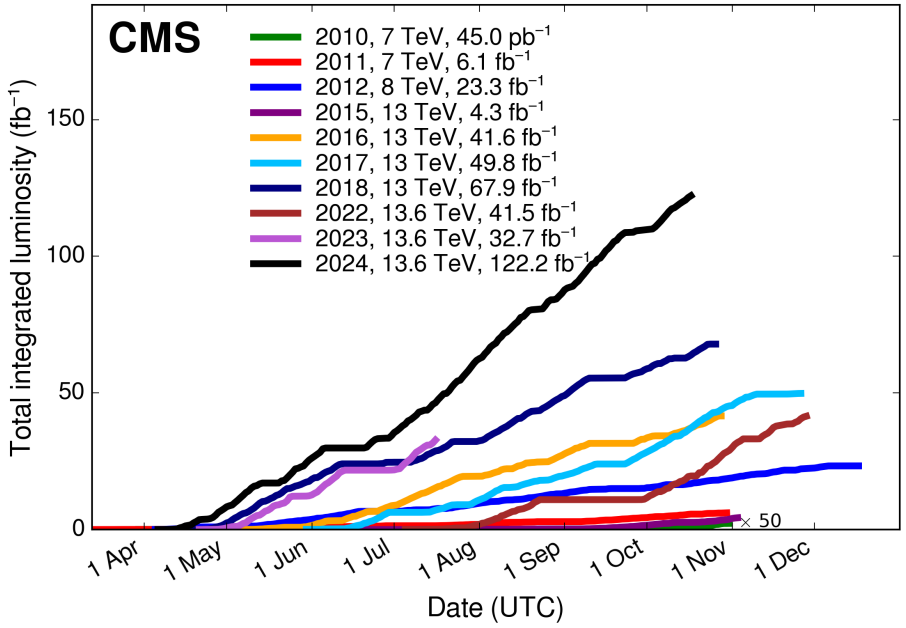
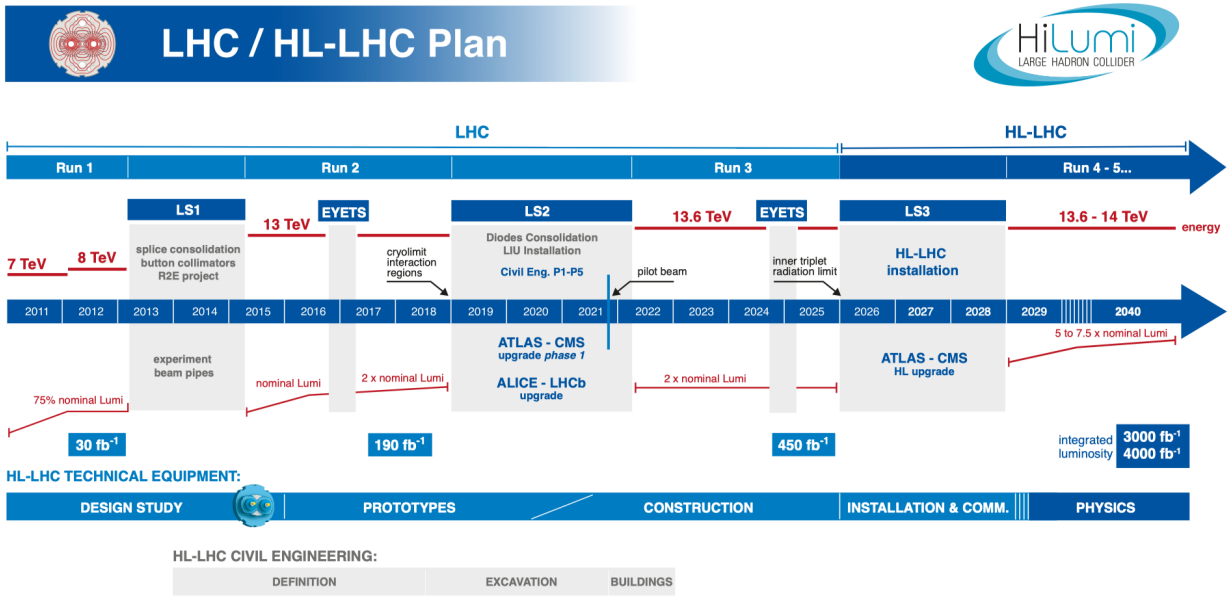
CMS data

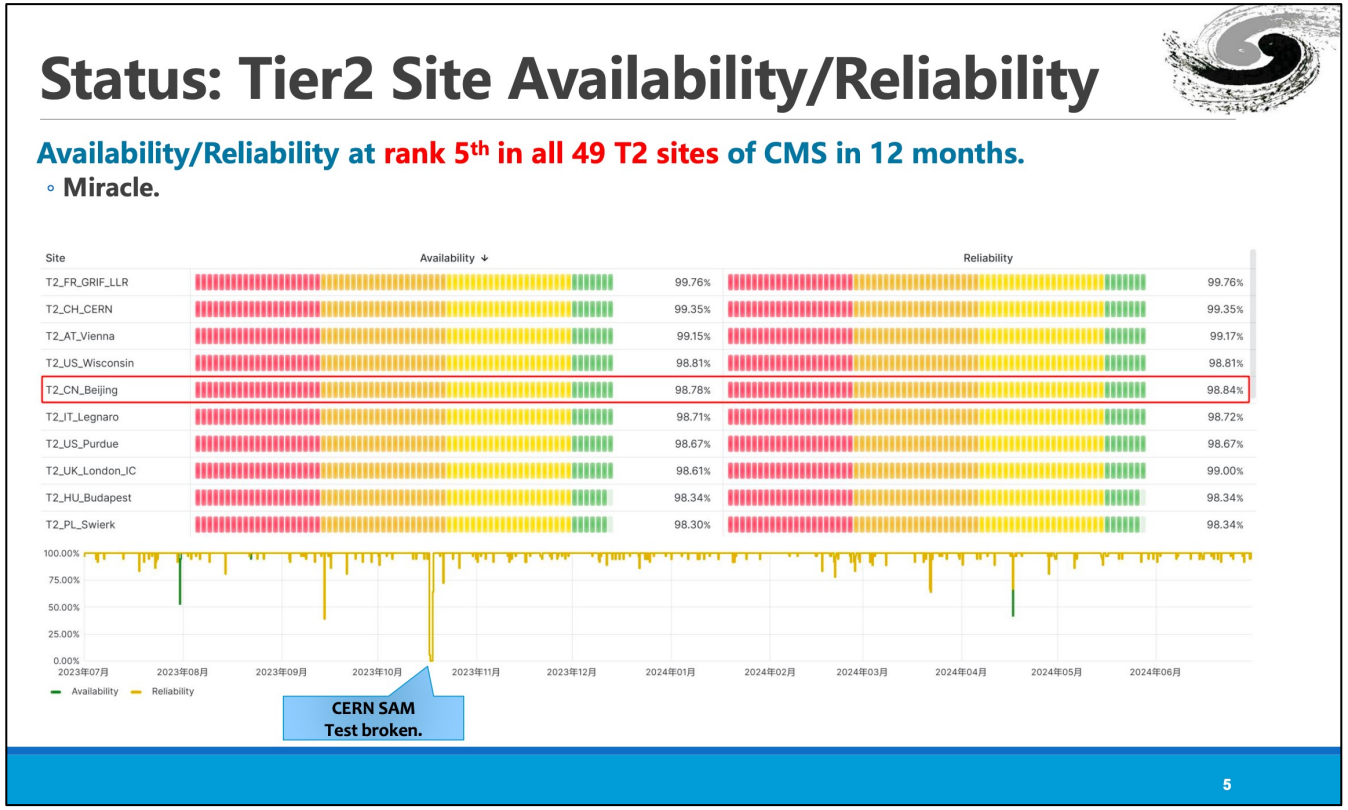
- **Collision Engery:**
  - First Run (Run1): 7-8TeV
  - Second Run (Run2): 13 TeV
  - Third Run (Run3): 13.6 TeV
  - Future:14TeV
- **Integral Luminosity:**
  - First Run(Run1):30fb^{-1}
  - Second Run (Run2): 190fb^{-1}
  - Third Run (Run3):450 fb^{-1}
  - Future:3000~4000 fb^{-1}





CMS Beijing T2 – excellent running

- T2 Computing resources:
  - 420(-22) CPU cores
- T2 Storage resources:
  - 673.5 TB in total
  - **~527.0 TB**, 81.1% in 650 TB for **central managed data**
  - ~106 TB, 90% in **120 TB for user data: temporary storage, transit**



过去两年计算消耗CPU时间为200万单位小时，约传输800TB数据和45万文件
北京T2为CMS合作组做出了重大贡献，为国内CMS用户提供了高效率的支持

Upgrade plan of T2

非常感谢计算中心同事多年不懈的努力！

- T2 Site Resources Extension Plan
  - Maintenance and Procurement Project 2023 (**2023修购项目**) was approved!
    - CMS Resource upgrade plan with **1.5 million RMB**,
  - Procurement and equipment will be finished before the end of December 2024.

Resource Type	Current	Purchased Time	Plan to Extent to	Notes
T2 CPU cores	420 cores	2011, 2015 (2 batches)	1560 cores **(3.7x)**	Old resources will be all replaced
T2 Disk Storage	673.5 TB	2020	1.8 PB **(2.6x)**	Old resources will be kept

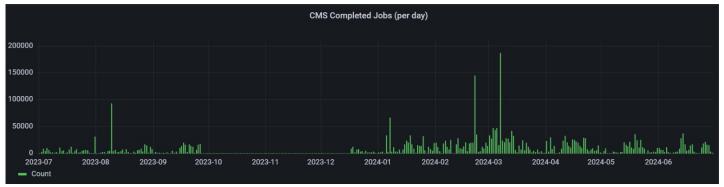
- **T2-T3 connection**
  - Allow user access T2 data on T3,
  - Allow user access T3 data on T2.
  - **Will be ready in the end of 2024**

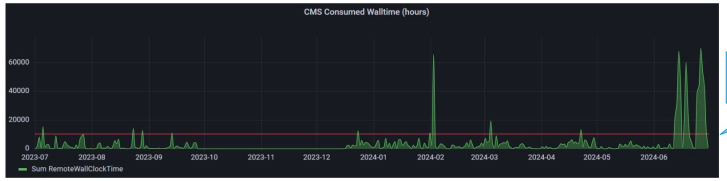
T3 status

Status: Tier3 Computing @IHEP

T3 Site production (compared with last year),
- **2,156,354 (10.7%↑) jobs completed,**
- **1,035,552 (41.7%↓) CPU time consumed.**

Resources status:
- **640(-14) cores. 14 cores broken and removed.**

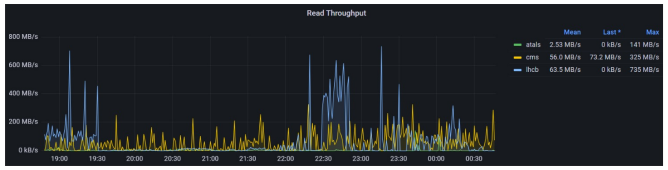


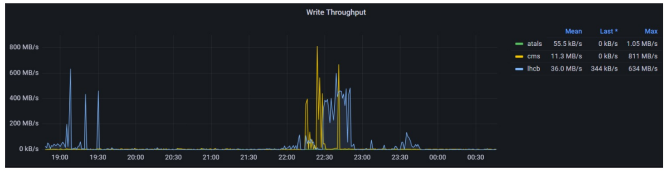


CPU time theoretical limit, according to available cores.

Status: Tier3 Storage @IHEP

Lustre based /publicfs storage for CMS,
- **754.9 TB in use (849.1 TB in total), 94% used, almost full.**
- **Available time >99%,**
- **Please remove your files which you don’ t need to save space for other users.**





- In addition, some local farms (T3 sites?) at PKU, Tsinghua, etc.
  - Connection through T2-Beijing

GPU farm at IHEP

- To support the computing power demands of machine learning, the computing center established a GPU cluster.
  - CMS group only contributed one GPU card (~ 1/200)
- This GPU cluster supports the CMS group at IHEP, primarily for machine learning training.
  - Used extensively for training models such as DNN, BDT, GCN, and Generative Models, etc.
  - The cluster has significantly contributed to CMS group analyses
- Huge thanks to Computing Centre again!

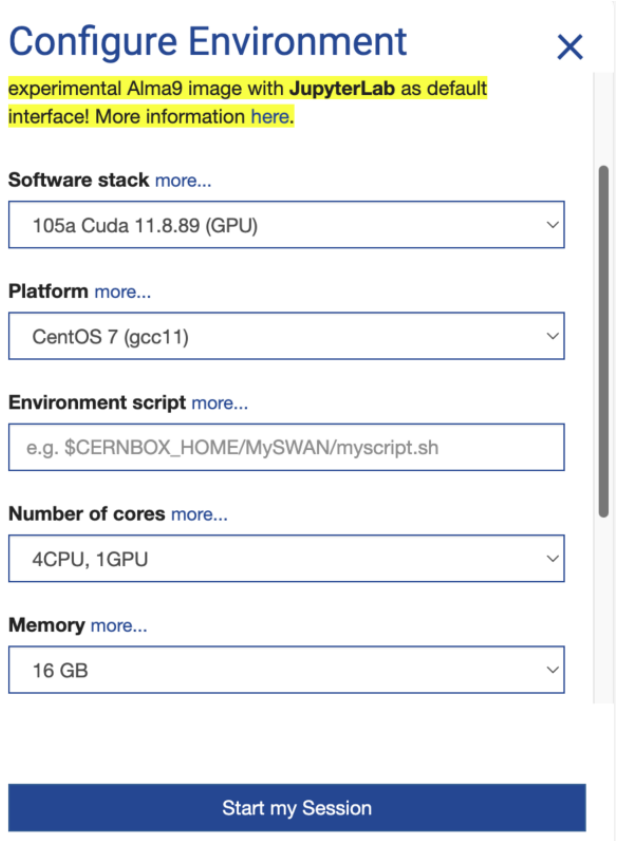
cmsgpu	**QOS cmsnormal** - 每个作业运行时间不超过**48小时** - 每个作业每CPU核最大可使用**40GB**内存 - 每组作业数量（运行+排队）不超过**128个** - 每组可使用的GPU卡数量不超过**17**张 - 每组最多可使用**72**个CPU核 - 每组可使用的最大内存总量为**720GB** - 每个用户作业数量（运行+排队）不超过**36个** - 每个用户可使用的GPU卡数量不超过**9**张 - 每个用户最多可使用**36**个CPU核 - 每个用户可使用的最大内存总量为**360GB** **QOS debug** - 作业运行时间不超过**15分钟** - 每个作业每CPU核最大可使用**40GB**内存 - 每组作业数量（运行 + 排队）不超过**256个** - 每组可使用的GPU卡不超过**64**张 - 每组最多可使用**108**个CPU核 - 每组可使用的最大内存总量为**1TB** - 每个用户作业数量（运行+排队）不超过**24个** - 每个用户可使用的GPU卡不超过**16**张 - 每个用户最多可使用**54**个CPU核 - 每个用户可使用的最大内存总量为**512GB**	- 共24个节点，其中： - 23个节点，每个节点可用内存**360GB**； - 1个节点，每个节点可用内存为**240GB** - 共183张GPU卡，其中 - 182张 NVIDIA V100 nvlink GPU卡 - 1张 NVIDIA A100 PCIe GPU卡 - 共892个CPU 核

Wishlist: some tools

SWAN (Service for Web-based Analysis)

SWAN: is a web-based analysis tool provided by CERN

- **Enabling cloud-based, interactive data analysis**: allowing users to write and run data analytics directly from a web browser.
- **Immediate Access to CERN Resources**: By connecting to SWAN, users gain access to CERN's central storage, software, and computing resources necessary for their analyses.
- **Terminal Shell Integration**: SWAN includes a terminal shell service, making it easy to execute tasks on the CERN cluster.
- **Jupyter-notebook Configuration**: The platform allows users to create, modify, and configure Jupyter notebooks seamlessly, setting up custom running environment

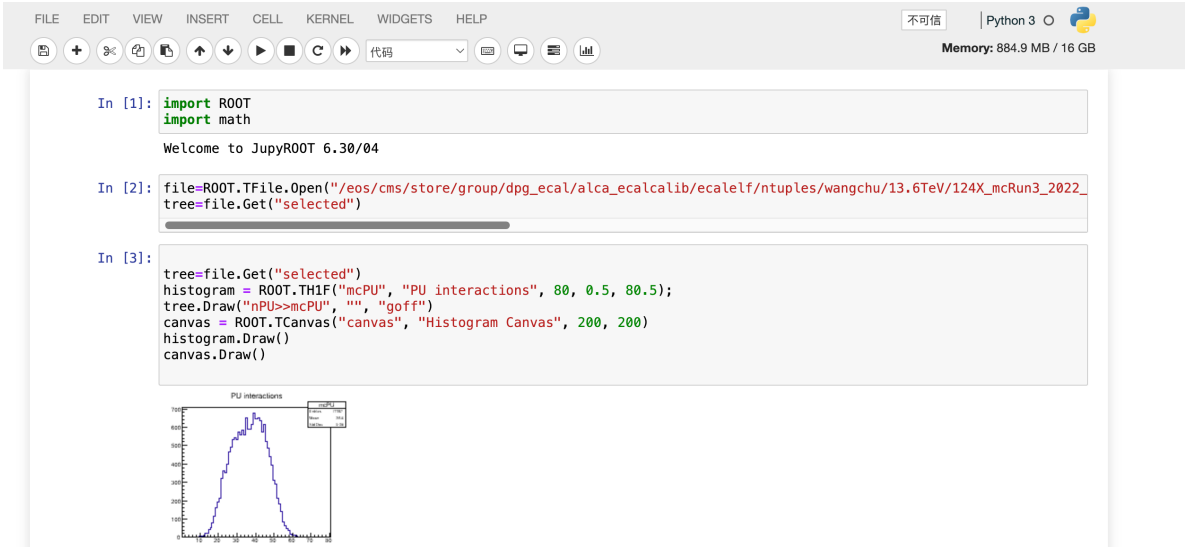


https://swan.cern.ch

SWAN (Service for Web-based Analysis)

SWAN: is a web-based analysis tool provided by CERN

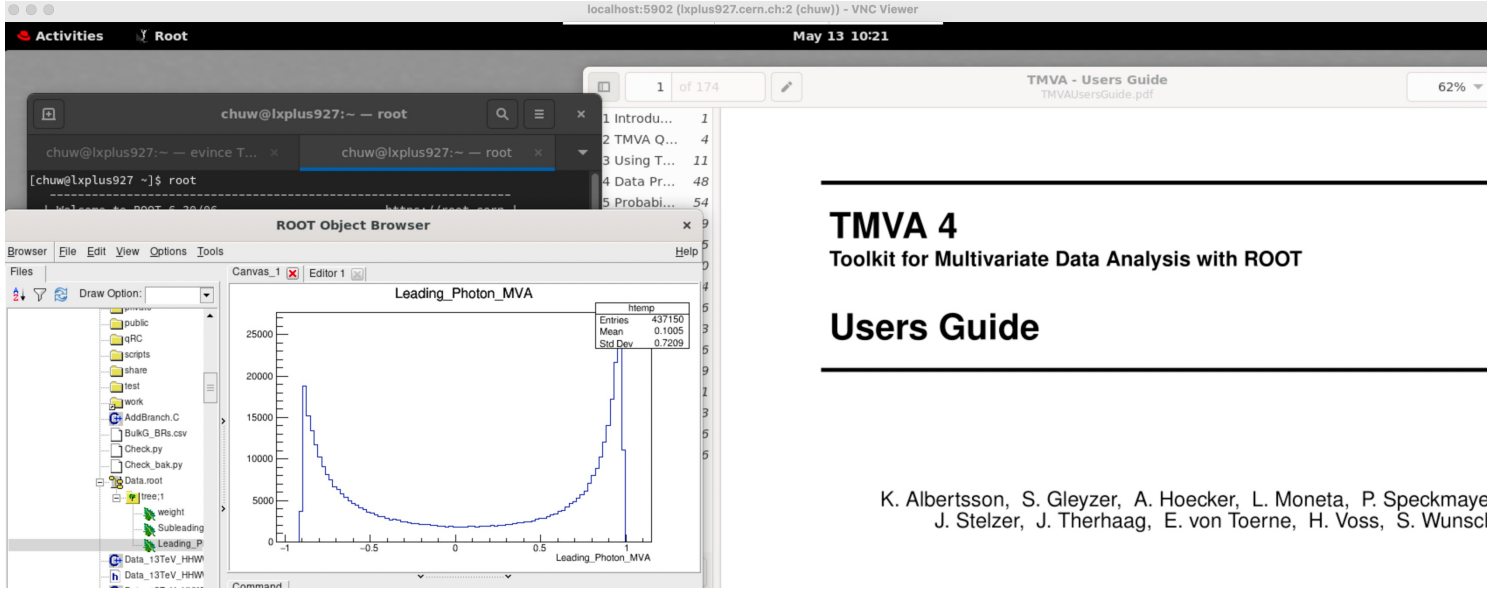
- **Supports multiple coding languages**: Octave, R, ROOT, python, etc.



- **Wish to have similar services on the IHEP cluster, especially for GPU computing**.
  - Currently, interactive notebooks can be run through port forwarding, but the configuration is quite cumbersome

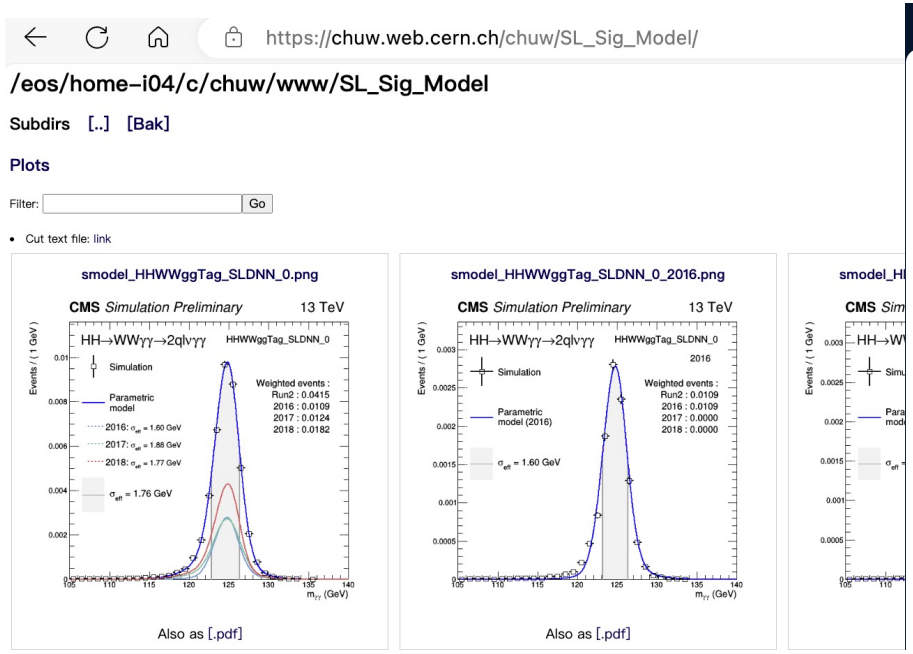
Visualizing Cluster via VNC Service

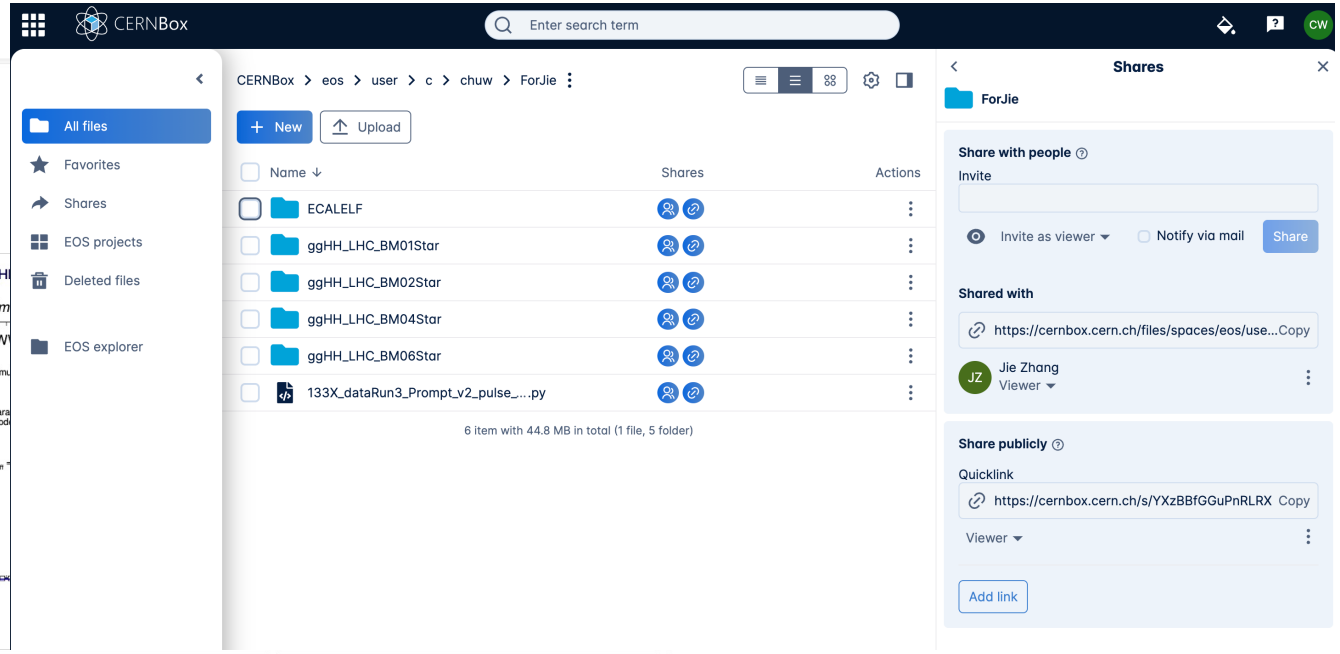
- When analyzing data, it is often necessary to view plotted images in real-time. Although it is possible to view images using ssh with an xserver, the speed is often slow, especially when dealing with large files or using ROOT, and there can be operational delays that prevent real-time operations such as zooming on images.
- CERN's cluster offers VNC server services. Users simply need to open the VNC server on the target machine and start the VNC client on their local machine to connect to the server, thereby visualizing CERN's cluster and smoothly viewing various files.



Personal Website/CERNBox for Sharing Analysis Results

- CERN offers a **personal website service** that allows users to access their **EOS-based www** directory through a web browser.
  - The user's domain name is in the format **username.web.cern.ch**.
  - Users can personalize their web pages by writing HTML and other methods.
  - This service facilitates the convenient sharing of analysis results within collaboration groups.
  - It also allows for the deployment of jsROOT on the website, enabling access to personal ROOT files through the web.
- **Files on EOS can also be shared via CERNBox.**





Summary

- Status on Beijing CMS T2 Site Storage and Computing
  - Small in scale, but running well
  - Plans to upgrade T2 with more resources soon
  - Hope to develop a more reasonable, unified, and sustainable operation and maintenance (including regular upgrades) plan
    - Hardware, network, electricity costs, etc.
    - Operation and maintenance personnel, etc.
- Wishlist: some tools
  - Web-based analysis tool SWAN
  - Visualizing the cluster through VNC services
  - Accessing EOS through personal websites, IHEPbox

感谢计算中心对CMS合作组的大力支持！

谢谢张玄同和王储准备的材料！

Backup

CMS Run 2 Data Flow