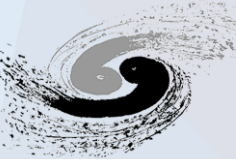


# Grid Sites in China

On Behalf of IHEP-CC

Jingyan Shi

[shijy@ihep.ac.cn](mailto:shijy@ihep.ac.cn)



1

**Overview of WLCG Sites in China**

2

**Beijing LHCb Tier-1 Site**

3

**WLCG Tier-2 Site at IHEP**

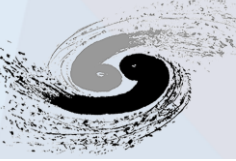
4

**Grid Site of Other Experiments**

5

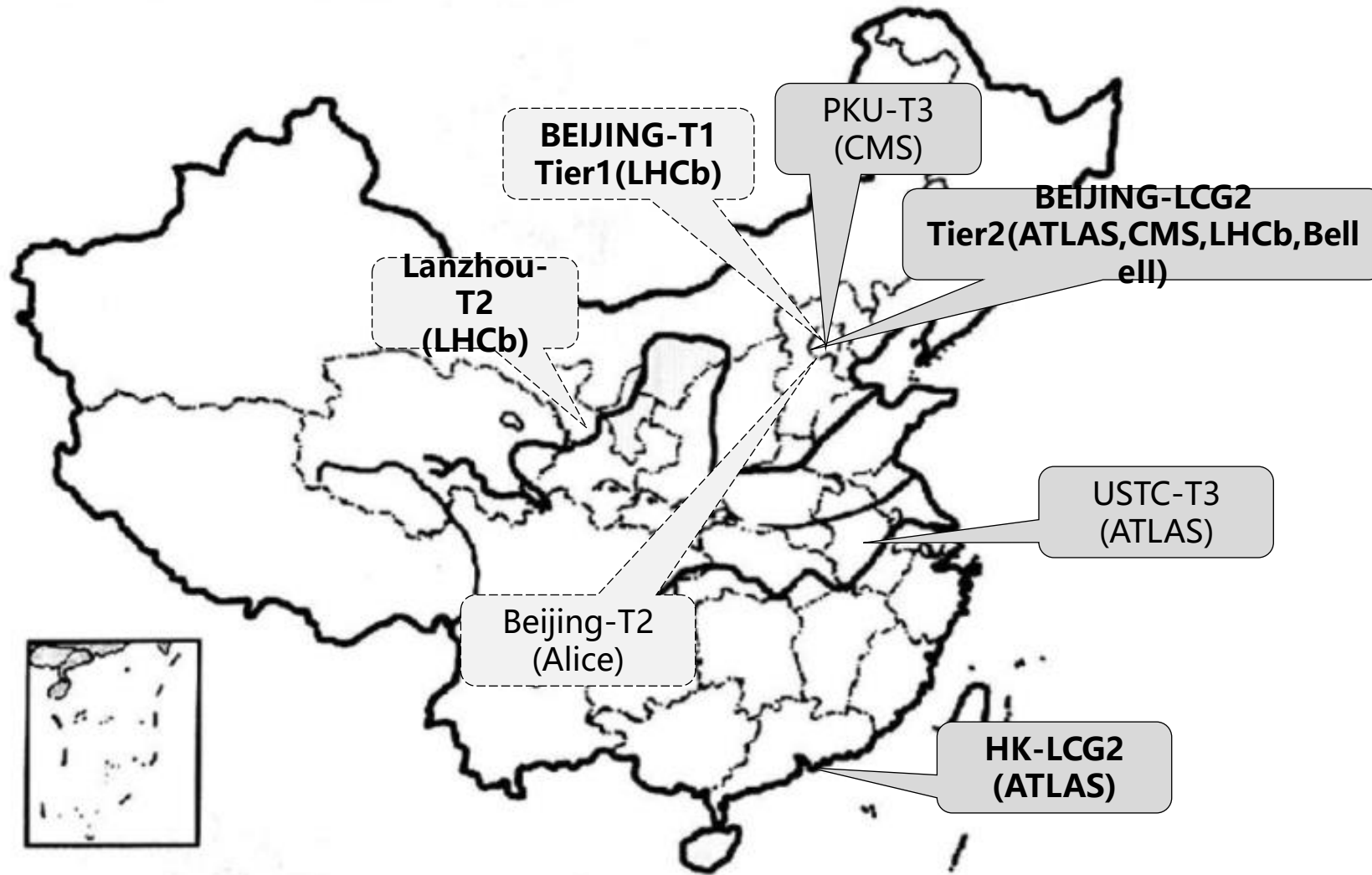
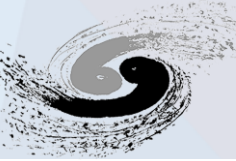
**Summary**

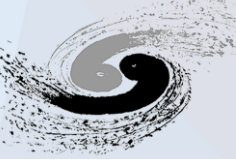
# Overview of Grid Sites in China (1/2)



- Chinese WLCG site history
  - **2006:** IHEP signs the Memorandum of Cooperation with WLCG for ATLAS and CMS Tier-2 sites
  - **2018:** LHCb Beijing Tier-2 site deployed at IHEP
  - **2020:** BelleII Tier-2 site was built at IHEP
  - **2023:** Construction starts for LHCb Tier-1 site and Alice Tier-2 sites at IHEP
  - **2024:** LHCb Beijing Tier-1 goes into production
  - **2024:** Alice Tier-2 goes into production

# Overview of WLCG Sites in China (2/2)





- NGI\_CHINA was founded in 2014
- Resource Centers involved in NGI\_CHINA
  - BEIJING-T1 (WLCG Tier-1)
  - BEIJING-LCG2 (WLCG Tier-2)
  - HK-LCG2 (WLCG Tier-2)
  - CSTCLOUD-EGI (EGI)
  - CENI (EGI)

What is an NGI?

Contacts	
E-Mail	ngi-china@maillist.ihep.ac.cn
ROD E-Mail	ngi-china@maillist.ihep.ac.cn
Helpdesk E-Mail	ngi-china@maillist.ihep.ac.cn
Security E-Mail	ngi-china@maillist.ihep.ac.cn
GGUS Support Unit	NGI_CHINA

Project memberships

EGI

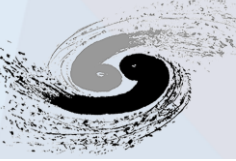
Scope Tags

EGI

11 Sites (Note, Scope values marked with (x) indicate the parent NGI does not share that scope)

Name	Certification Status	Production Status	Scope(s)
Wuhan-t	Closed	Production	EGI
SDU-LCG2	Closed	Production	atlas(x), EGI, wlcg(x)
LCG-USTC	Closed	Production	EGI
BEIJING-LCG2	Certified	Production	atlas(x), cms(x), EGI,
BEIJING-LCG2-t	Closed	Production	EGI
HK-LCG2	Certified	Production	atlas(x), EGI, tier2(x),
Wuhan	Closed	Production	EGI
USTC-T3	Closed	Production	EGI
CSTCLOUD-EGI	Certified	Production	EGI, FedCloud(x)
BEIJING-T1	Candidate	Production	EGI
CENI	Certified	Production	EGI, FedCloud(x)

# International Network Upgrade

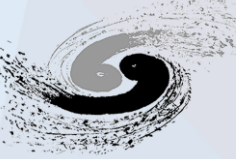


- International network link is upgraded to 100Gbps in 2023
  - CSTNET (CNIC), GEANT, CERN and CN-IHEP collaborated on the upgrade
  - LHCOPN: not less than 20Gbps
    - CSTNET: 20Gbps
    - GEANT: more than 20Gbps promised
  - LHCONE: more than 20Gbps
    - IHEP is the main network user of CSTNET



International network connection of IHEP

# Network Performance Test



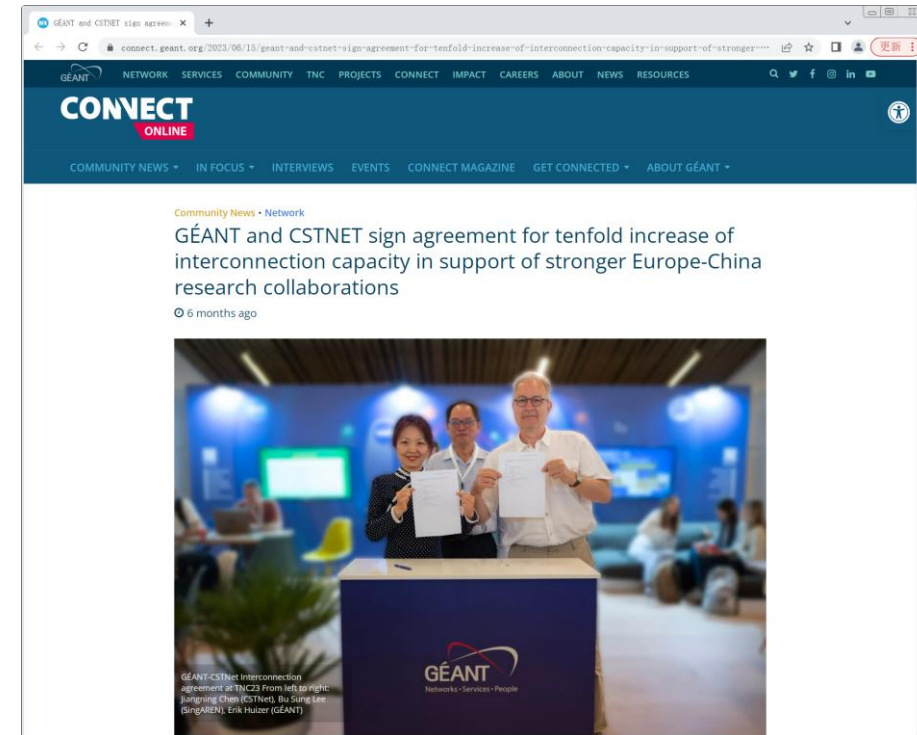
- Time line of the 100Gbps network link creation for IHEP
  - **07/06/2023:** CSTNET and GEANT signed an agreement to increase the interconnection capacity by tenfold
  - **13/07/2023:** CSTNET 100G Europe Link became operational
  - **15/12/2023:** IHEP-LHCOPN was ready
- Network Performance Test
  - JUNO data transferred
    - Data transferred between IHEP and INFN, IN2P3 based on LHCONE
    - Max speed reached to 50.9Gbps
  - Iperf3 test
    - Iperf3 test conducted between IHEP and CERN based on LHCOPN
    - Max speed reached to 30Gbps
  - Network Latency: ~210ms



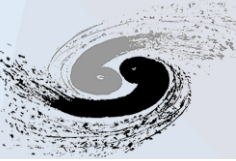
Juno data transfer between IHEP and INFN, IN2P3



Iperf3 Test between IHEP and CERN



Agreement signed between CSTNET and GEANT



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**Overview of WLCG Sites in China**

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**Beijing LHCb Tier-1 Site**

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**WLCG Tier-2 Site at IHEP**

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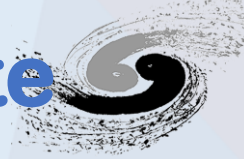
**Grid Site of Other Experiments**

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**Summary**



# Construction and Resource of LHCb Beijing Tier-1 Site



- Construction
  - **Oct. 2023:** Chinese LHCb collaboration and CC-IHEP decided to construct Tier-1 Site for LHCb
  - **Dec. 2023:** Discussed and received the approval from WLCG
  - **Feb. 2024:** Construction completed
- Resource provided for LHCb Beijing Tier-1
  - Computing:
    - 40 worker nodes (Intel & AMD) with 3216 CPU cores: 67,000 HepScore
  - Disk storage
    - 4 sets of storage array provide 3.2 PB
  - Tape storage:
    - 4 drivers (IBM) and 170 tapes with 3PB
  - Network equipment and management server:
    - 6 switches, 1 router, 2 band cards and 10 servers
- First data challenge has been done
  - 189TB data was transferred into IHEP Site in ~2 days
  - Average transfer speed is about 1.55GB/s (Max is 1.98)
  - Transfer efficiency is close to 100%

**Discussion on China Tier1 and Tier2**  
Monday 12 Dec 2022, 09:30 → 11:00 Europe/Zurich  
2/r-030 (CERN)

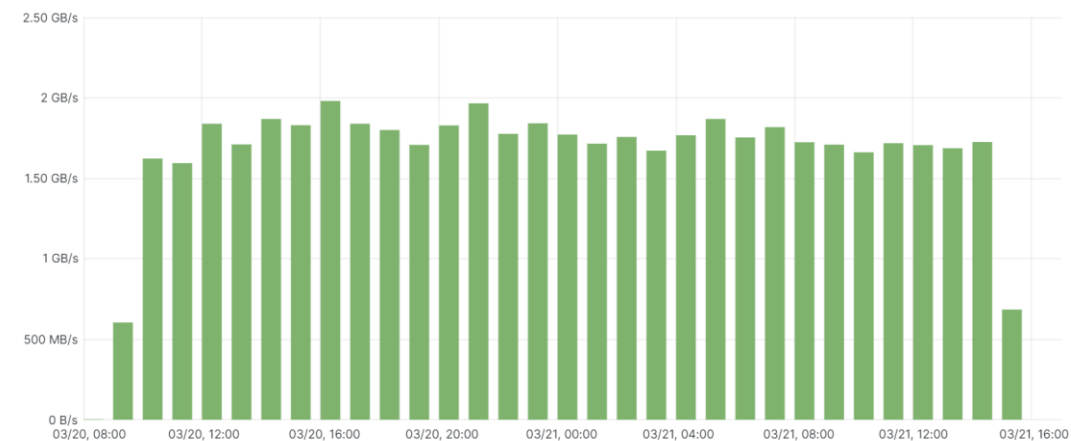
Videconference 2-r-030

**09:30 → 09:40 Setup / context** (10m)

**09:40 → 10:00 Tier 1 IHEP and Tier2 Lenzhou: status and evolution** (20m)  
Currently available resources at IHEP Beijing (CPU, disk, tape, network) and their evolution; underlying technical infrastructure, e.g. batch system, storage system, processor type, memory, internal network, etc.  
**Speakers:** Fazhi Qi, Fazhi Qi (Chinese Academy of Sciences (CN)), Jingyan Shi (Chinese Academy of Sciences (CN)), Jingyan Shi, Tao Cui (Chinese Academy of Sciences (CN)), Xiaofei Yan (Chinese Academy of Sciences (CN)), Xiaofei Yan (Institute of High Energy Physics)

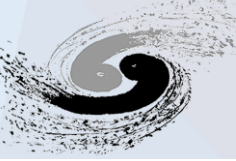
**10:00 → 10:20 LHCb requirements** (20m)  
**Speakers:** Christophe Haen (CERN), Federico Stagni (CERN), Vladimir Romanovskiy (Institute for High Energy Physics of NRC Kurchatov Institute (RU))

International network connection of IHEP

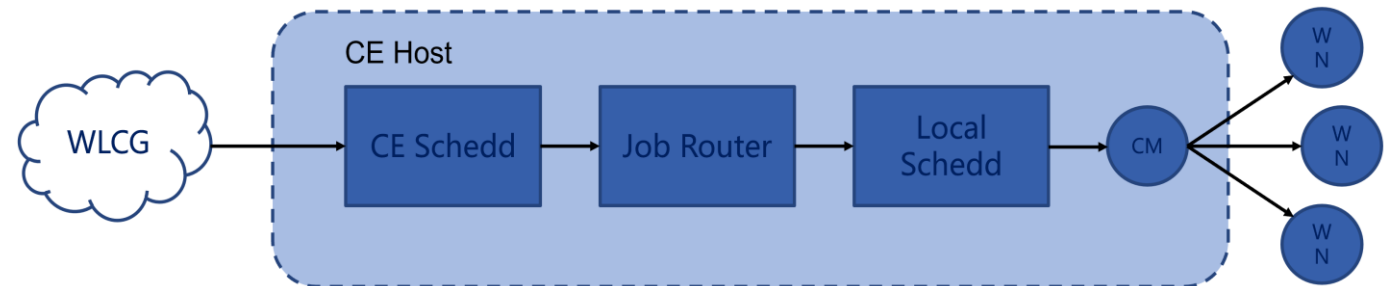
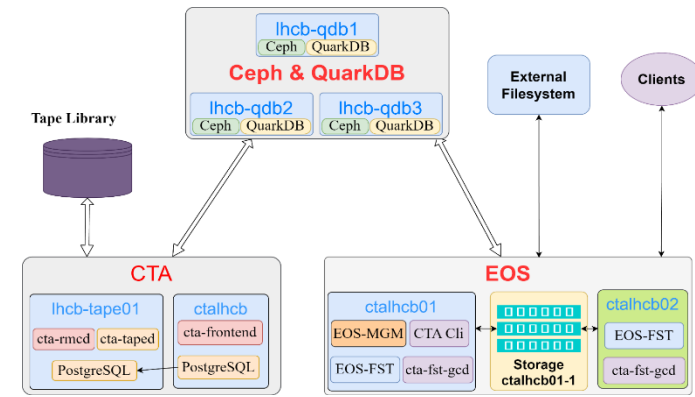
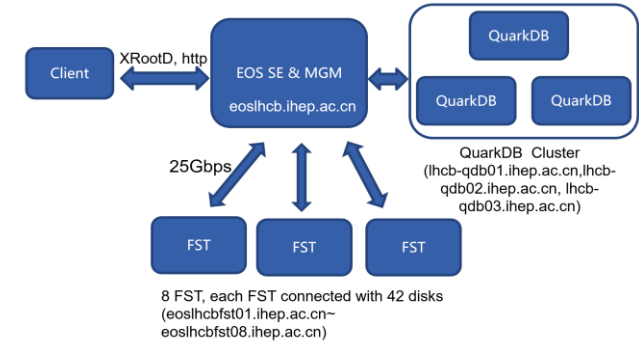


Network traffic of the first data challenge

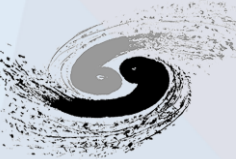
# Software of LHCb Beijing Tier-1 Site



- Disk storage: EOS
  - services: QuarkDB, MGM, FST
  - protocol: xrootd and http
- Tape storage: EOS & EOS-CTA
  - Protocols: xrootd and http(s)
  - Authentication: SCI-Token and GSI
- CE: HTCondor-CE & HTCondor
  - Support for SCIToken and GSI
- Other middle software
  - Argus, BDII, APEL



Software of LHCb BEIJING Tier-1



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**Overview of WLCG Sites in China**

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**Beijing LHCb Tier-1 Site**

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**WLCG Tier-2 Site at IHEP**

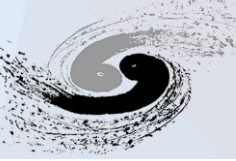
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**Grid Site of Other Experiments**

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**Summary**

# Chinese Tier-2 Site Federation



- CPU: 4472 cores with 95,000 HepScore

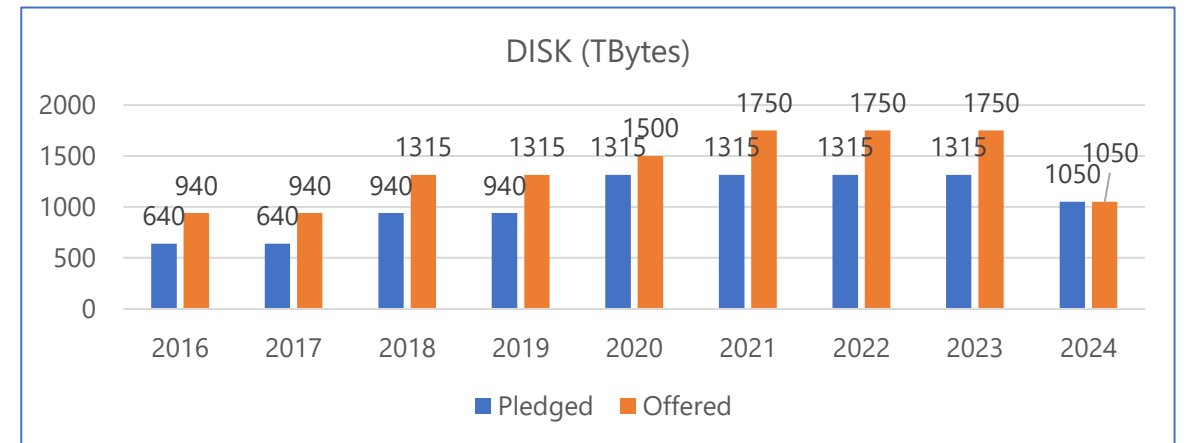
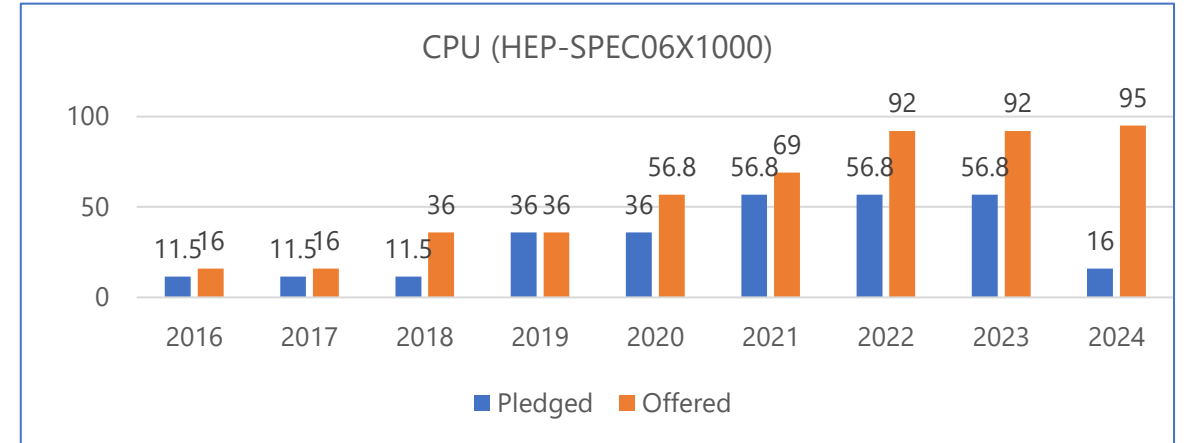
- AMD 9654: 1152 Cores
- Intel Golden 6338: 1280 Cores
- Intel Golden 6140: 1152 Cores
- Intel E5-2680V3: 696 Cores
- Intel X5650: 192 Cores

- CE & Batch: HTCondorCE & HTCondor

- VO: ATLAS, CMS, LHCb, BELLEII, JUNO, CEPC

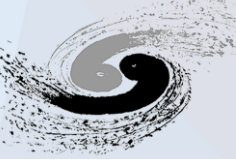
- Storage: 1050TB

- 4TB \* 24 slots with Raid 6, 5 Array boxes
- DELL MD3860 8TB \* 60 slots
- DELL ME4084 10TB \* 42 slots
- DELL ME4084 12TB \* 84 slots



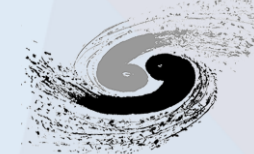
Computing and Storage Pledge of BEIJING LCG Tier- 2

# New Budget for ATLAS and CMS

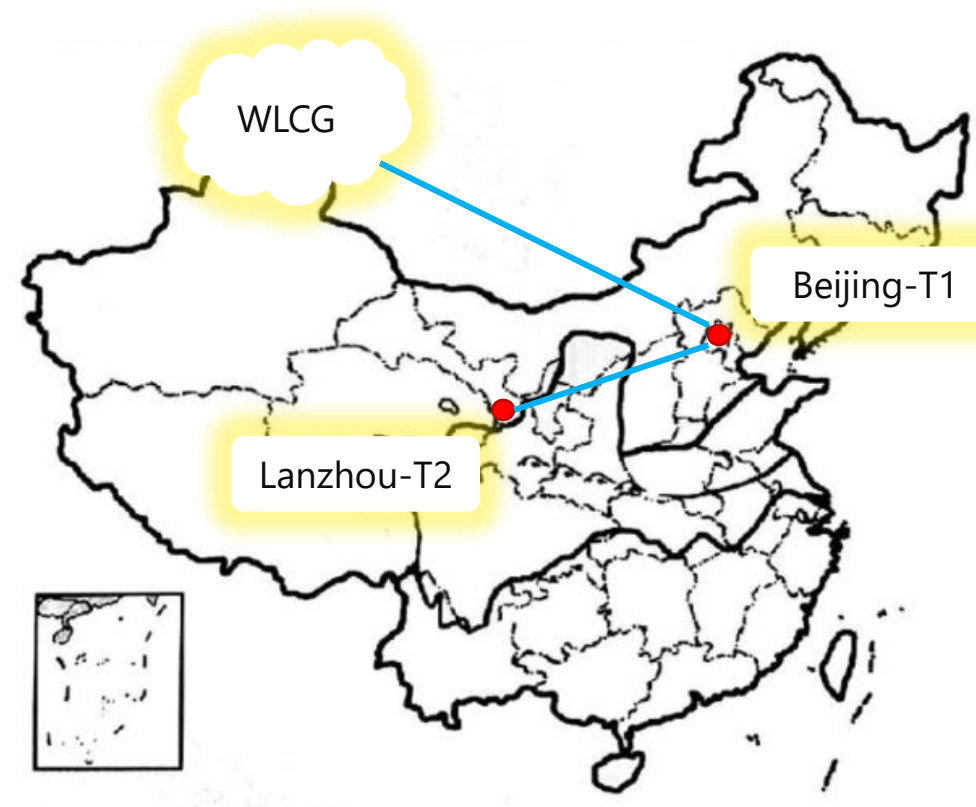


- New budget for ATLAS and CMS Beijing Tier-2 site
  - Total budget: RMB 3Million
  - Allocation:
    - CPU: 60,000 HepScore
    - Disk storage: 2.5PB
- Upgrade timeline
  - The upgrade of ATLAS and CMS Beijing Tier-2 will be completed in 2024

# New Tier-2 Site for LHCb at Lanzhou University

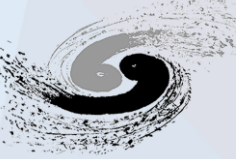


- Construction started in Oct. 2023
  - ~3500 CPU cores with 77,000 HepScore
  - ~3PB Disk Storage
  - Dedicated 2Gbps link between IHEP and Lanzhou Univ.
- Progress
  - Hardware installation completed
  - Network link established
  - Software deployment will be started in April
- Jointly maintained by CC-IHEP and Lanzhou Univ.
  - Hardware maintenance: Lanzhou Univ.
  - Software deployment and maintenance: CC-IHEP

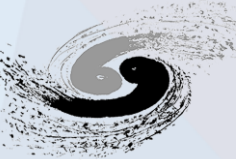


Lanzhou Univ. LHCb Tier-2 Site

# New Tier-2 Site for Alice is Under construction



- Chinese Alice collaboration would like to build Tier-2
  - Discussed with CC-IHEP in Dec. 2023
    - The Alice Tier-2 to be built at IHEP
    - CC-IHEP to be responsible for the overall maintenance
- Current Status
  - Hardware procurement in progress
    - 1152 CPU cores with 30,600 HepScore
    - 840TB disk storage
- Expected Production: Aim for production in 2024



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**Overview of WLCG Sites in China**

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**Beijing LHCb Tier-1 Site**

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**WLCG Tier-2 Site at IHEP**

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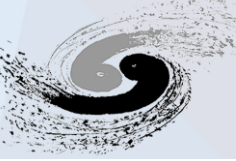
**Grid Site of Other Experiments**

5

**Summary**

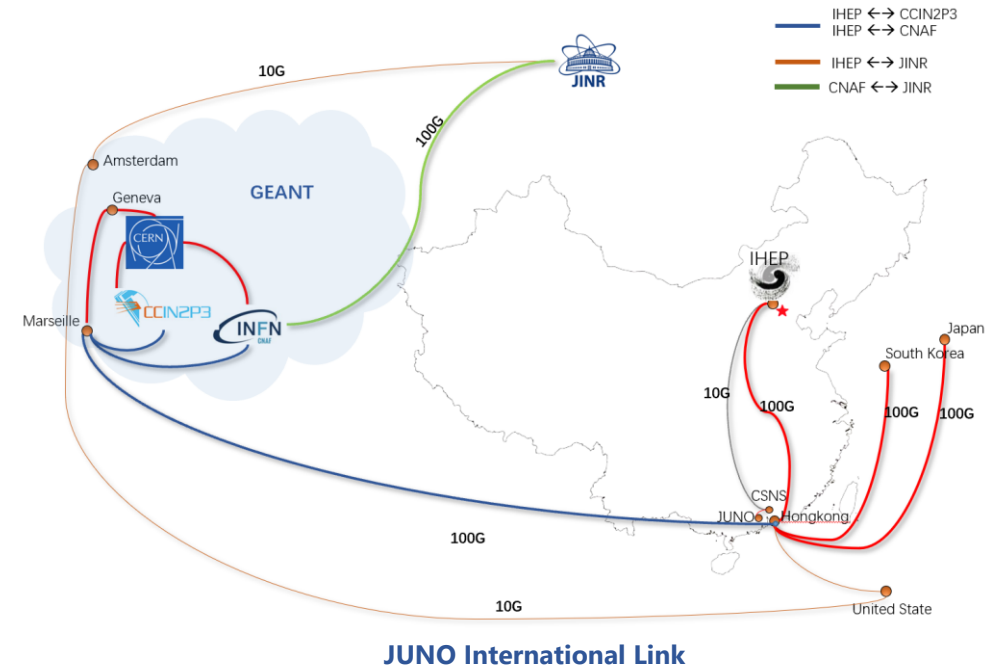


# JUNO at IHEP

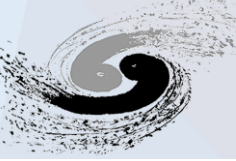


- JUNO: Jiangmen Underground Neutrino Observatory
  - To be in production in 2024
- Grid Computing started since 2018,
  - Includes INFN, CC-IN2P3, JINR, IHEP, for JUNO Production and raw data transfer.
- Grid computing platform at IHEP:
  - **DIRAC system with IHEP-extensions**
    - monitoring, production system and job-submission API
  - Shared middleware and infrastructures: FTS3, VOMS, TPC, etc.
- Software deployed at IHEP:
  - **Storage:** EOS, Lustre on disk, EOS-CTA on tape.
  - **Computing:** HTCondor on x86, Slurm on ARM and GPU.
  - **Network:** 10Gbps(From JUNO-onsite to IHEP), 100Gbps(From IHEP to GEANT).
- Data Challenge 1:
  - 12<sup>th</sup> ~ 26<sup>th</sup> Feb 2024, corresponding to WLCG DC24.
  - Pressure transfer (500-1000 Mbps) with 4-8 times throughput than JUNO design.
  - IHEP -> CNAF/IN2P3 transfer worked well, almost no failure. IHEP->JINR is bad and always get stuck.

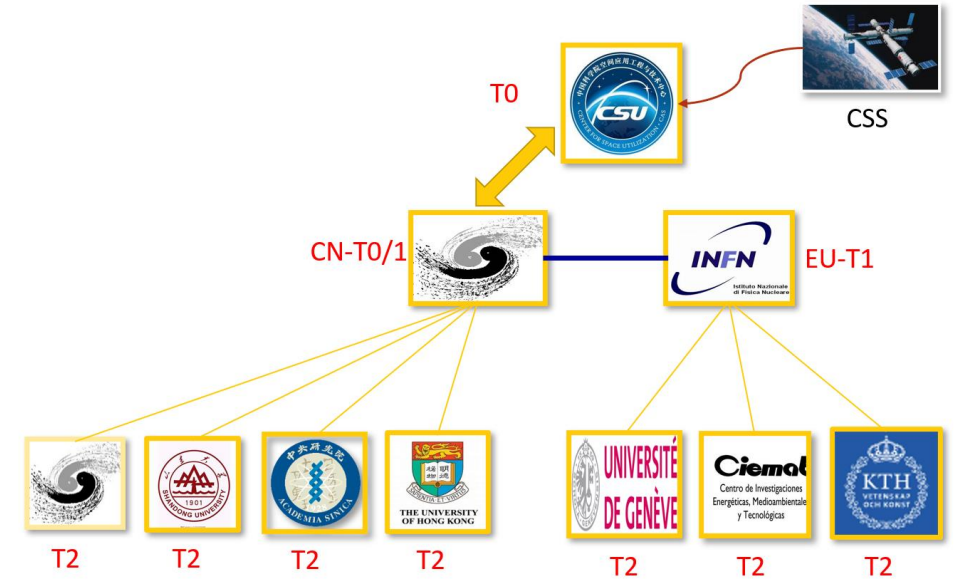
Sites	Resources in 2024		
	CPU (KHS06)	Disk (PB)	Tape (PB)
IHEP	180	8	4
CNAF	20	3	1
IN2P3	15	0.2	2
JINR	120	10	10



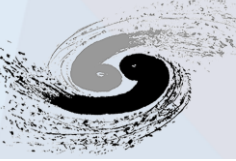
# HERD & CEPC Plan at IHEP



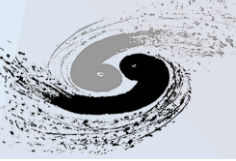
- HERD and CEPC is under construction
  - **HERD:** High Energy Radiation Detection Facility
  - **CEPC:** Circular Electron Positron Collider
- HERD: To be in production in 2027
  - Storage requirements: 45.5 PB in 10 year
  - Computing requirement: >13000 CPUs in 10 years
  - Computing model:
    - Two Tier-1 sites run at China and Europe
    - Several Tier-2 sites disperse across China and Europe
    - Computing system: DIRAC + dHTC(HTC&HPC)
    - Data storage and transfer management: Rucio.
- CEPC: At the very beginning, everything is in design
  - Distributed Computing System: DIRAC + Rucio integration in developing.
  - Infrastructure and middleware: IAM, FTS3, etc.



Computing Model of HERD



- The establishment of WLCG sites in China started in 2006 and has since undergone continuous upgrade
- The construction of LHCb Beijing Tier-1 sites is progressing smoothly
- CC-IHEP takes responsibility of most of the LHC experiments grid sites in China
- Grid computing is utilized for the experiments led by IHEP



Thank you !

Question?