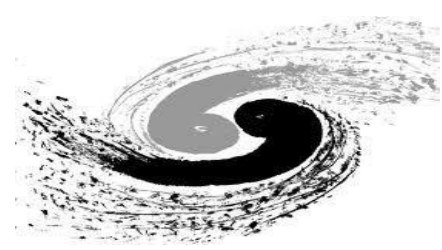


# Status of IHEP Site

Jingyan Shi

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

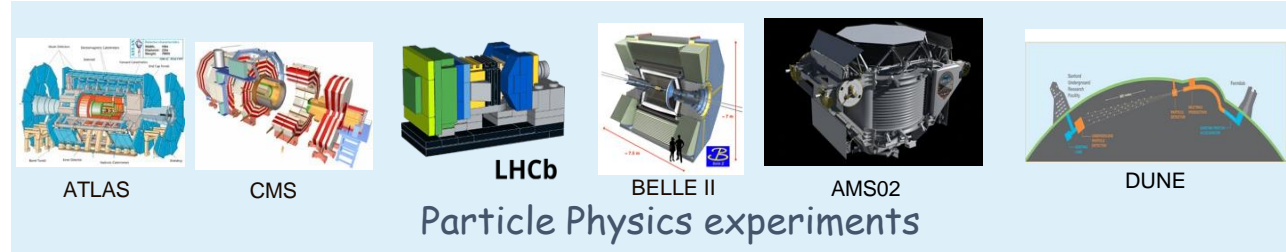
# Introduction to the Institute of High Energy Physics (IHEP)



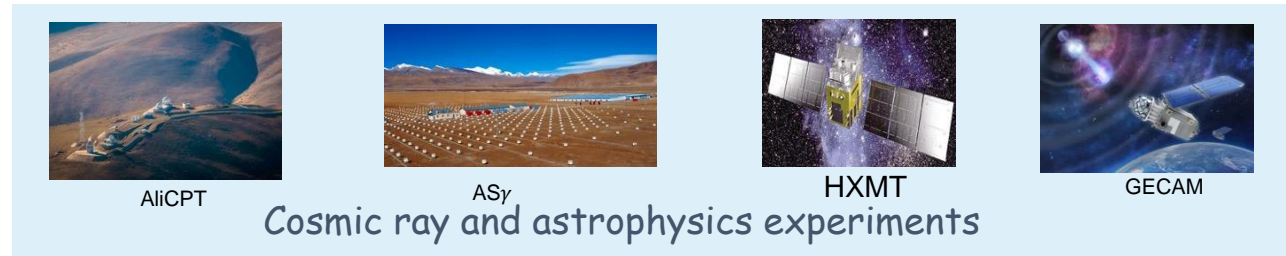
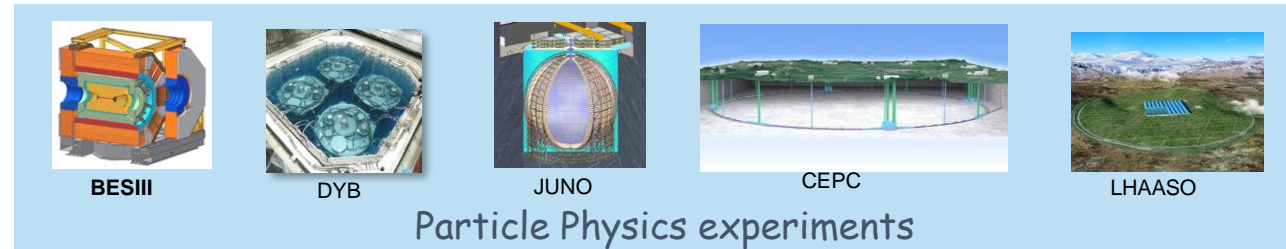
- The largest fundamental research center in China with research fields:

- Experimental Particle Physics
- Theoretical Particle Physics
- Astrophysics and cosmic-rays
- Accelerator Technology and applications
- Synchrotron radiation and applications
- Nuclear analysis technique
- Computing and Network Application

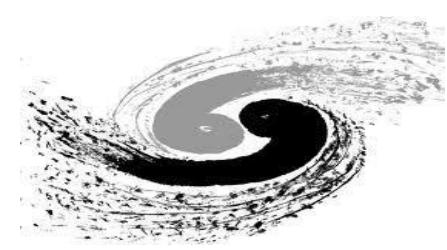
International collaboration



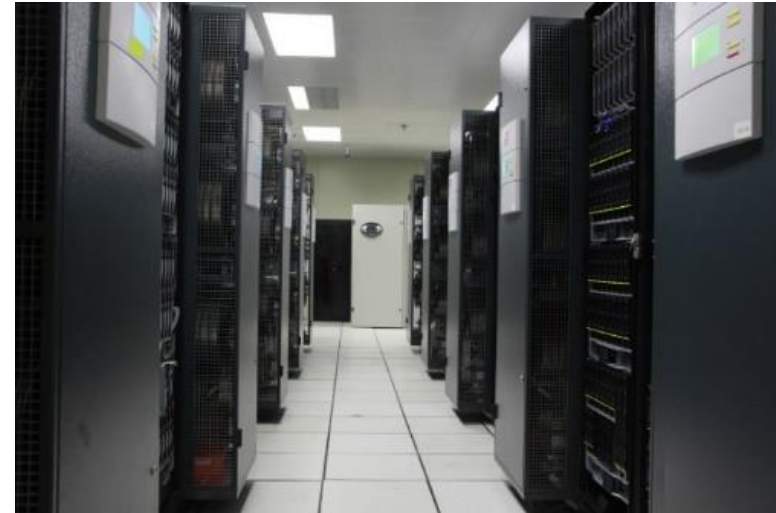
IHEP Leading



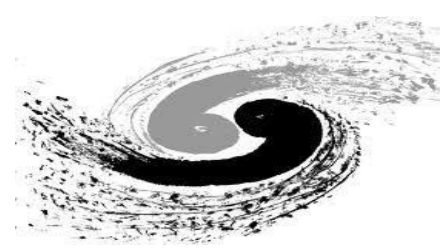
# Computing Center at IHEP



- Provide large-scale scientific computing environments for the experiments
  - Facilities, computing, storage, network
  - Research on computing technologies to benefit high-energy physics research
- Provide the IT services on campus and develop software systems to minimize administrative burden
- Computing platform at IHEP-CC
  - Running Local Cluster
    - HTC and HPC
    - Lustre and EOS file system
    - Tape Library
  - Hosting Grid site of WLCG
    - Tier 2 and new Tier 1

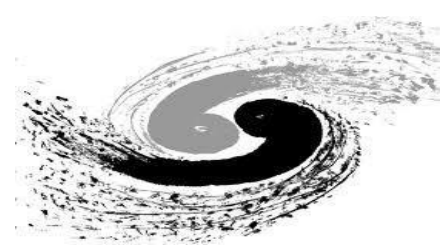


# Resources Overview



- Computing
  - 58K CPU cores and 250 GPU cards supporting over 10 experiments
    - HTC cluster with 42K CPU cores
    - HPC cluster with 10K CPU cores + 250 GPU
    - Distributed computing resource including WLCG, DIRAC etc. (6K cores at IHEP)
- Storage
  - 102 PB disk storage and 80 PB tape storage
    - Lustre with 40 PB supporting POSIX
    - EOS with 62 PB supporting XRootD
    - EOSCTA for tape storage with 80 PB.
      - all have been migrated from Castor to EOSCTA
- Network
  - Support IPV4/IPV6 dual stack
  - Ethernet/IB/ROCE protocols supported
  - WAN Bandwidth: 100 Gbps (LHCOPN and LHCONE 20Gbps)

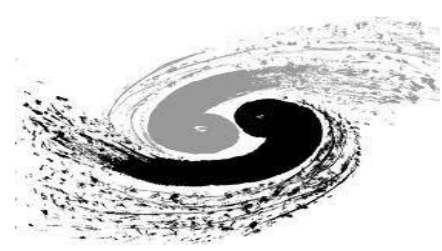
# HTC at IHEP



- HTCondor local cluster with 42 k CPU
  - HTCondor version 9.0.17
  - 3 scheds
    - Two scheds for two big experiments jobs
    - One sched for all the small experiments jobs
  - 2 negotiators
    - One negotiator faces pressure when massive short jobs are coming into the pool
    - Two Negotiators have been set up for the whole pool
      - Each negotiator is responsible for half of the worker nodes
- A Hep job tool developed
  - Simplify the user job management
    - Example: `hep_sub -g bes job.sh`
  - Easy to adjust scheduling policy
    - Extra attributes could be added by the hep job tool without users' knowledge

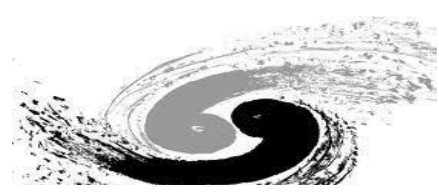
# HPC at IHEP

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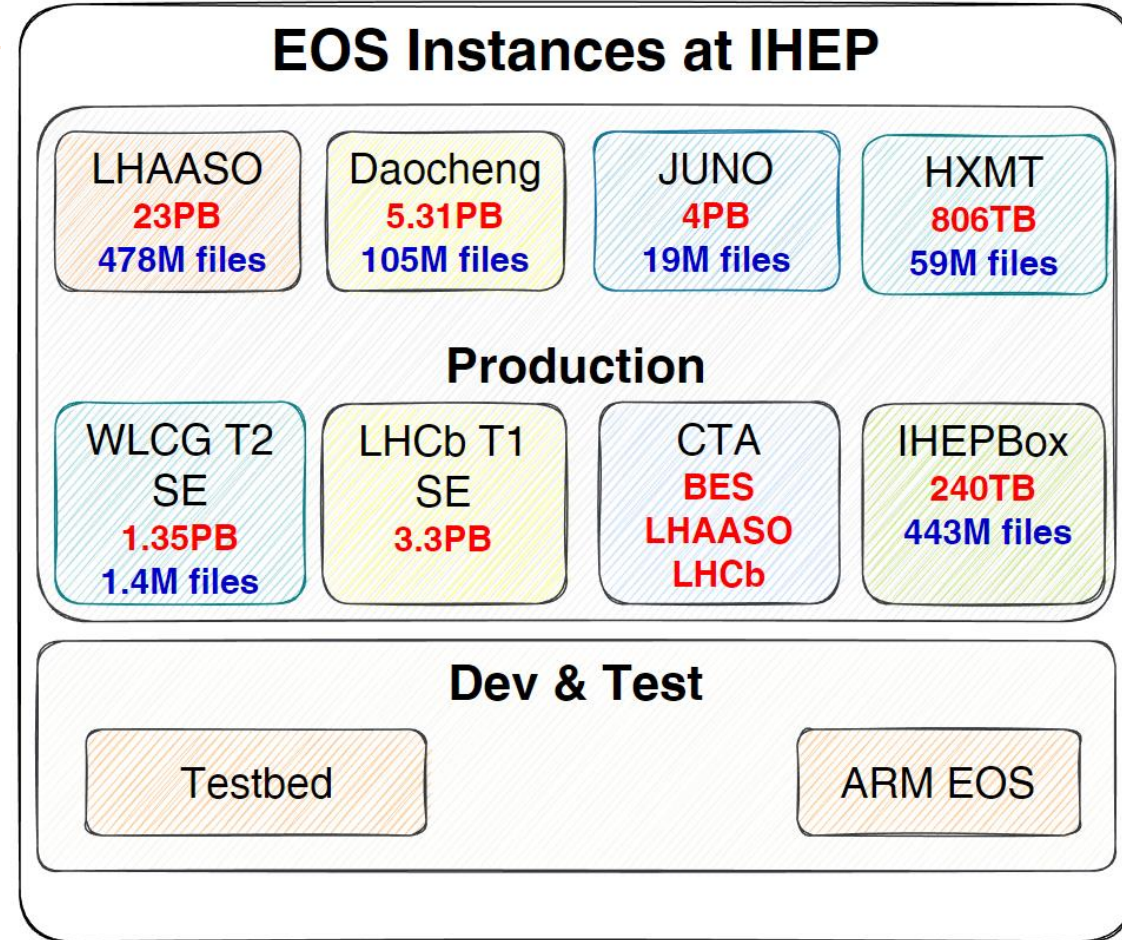


- Slurm local cluster
  - Slurm verion 23.02.6
  - ~10k Cpu cores
    - parallel jobs from accelerator design, nano biology and more
  - 250 GPU cards
    - Theoretical physics: Lattice Quantum Chromodynamics (LQCD)
    - AI computing
    - Quantum computing

# Storage at IHEP



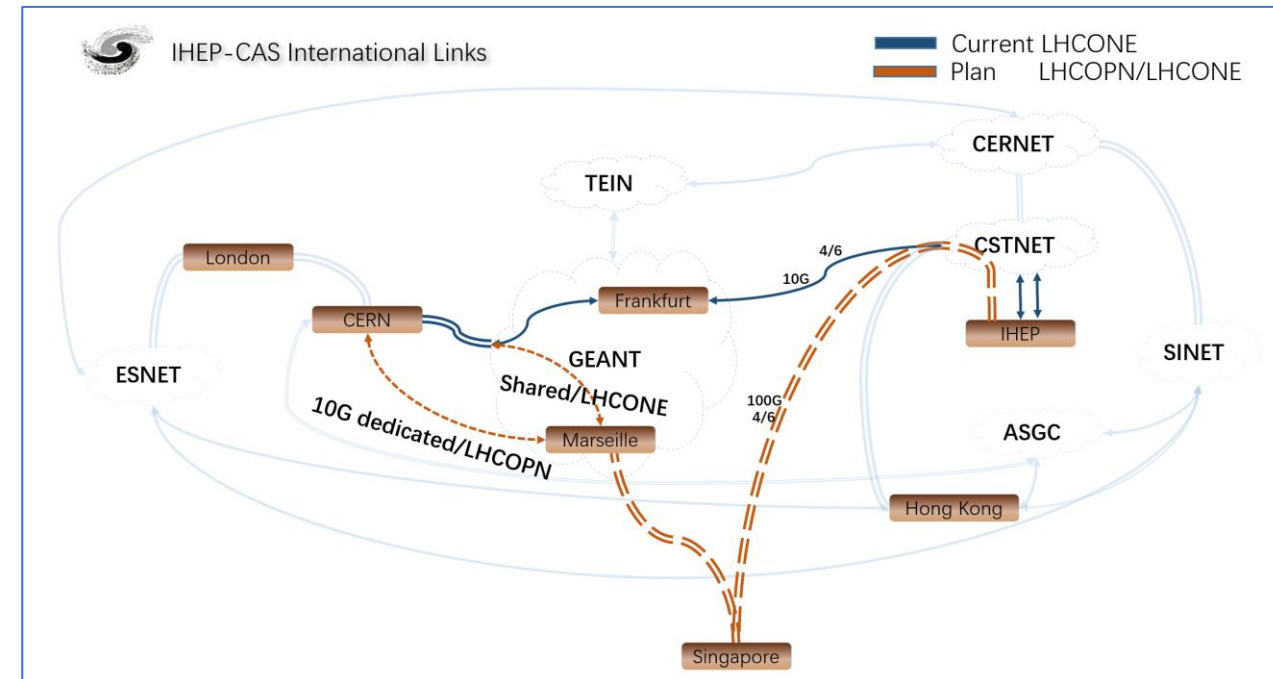
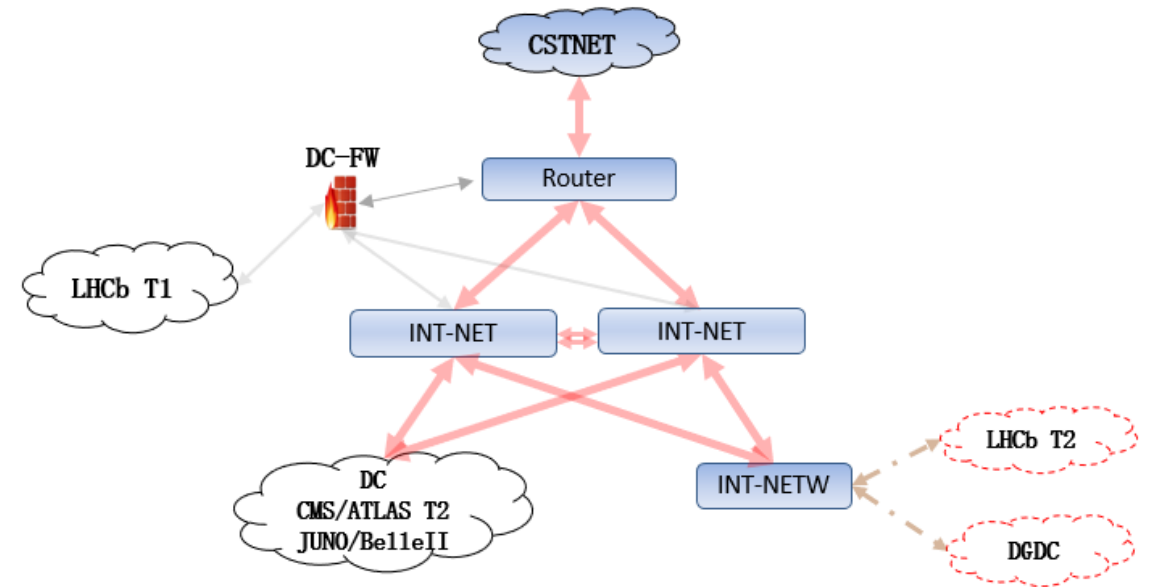
- **Disk storage - EOS**
  - 6 instances supporting 3 experiments, IHEPbox and CTA
  - 2 new instances for WLCG grid site (disk and tape)
- **Disk storage - Lustre**
  - 22 instances for BES, JUNO, HXMT, CEPC, HEPS, etc.
- **Tape storage – EOS-CTA**
  - Supporting 6 experiments including LHAASO, BESIII, JUNO, etc.
  - Upgrade all CTA&EOS to V5
  - Setup a tape buffer for LHCb Tier-I site



CTA	LHAASO	YBJ	HXMT	DYB	BES3	TOTAL
Files	7M	2419	1.5K	1.3M	258K	8.5M
Used	9.25PB	185.28TB	25.17T	1.16PB	3.18PB	13.77PB

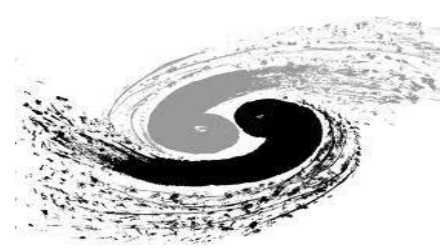
# Network at IHEP

- Network Bandwidth
  - Backbone: 200GbE (dual-machine redundancy) (July 2023)
  - Internet: 100GbE to CSTNET (Aug 2023)
- Internal network status (inside IHEP)
  - Max throughput is 233 Gbps
  - The proportion of 25GbE hosts is 62%
- Experiment Supports
  - LHCOPN
    - 20GbE LHCOPN and 20GbE LHCONE
    - Based on CSTNET-GEANT-100G

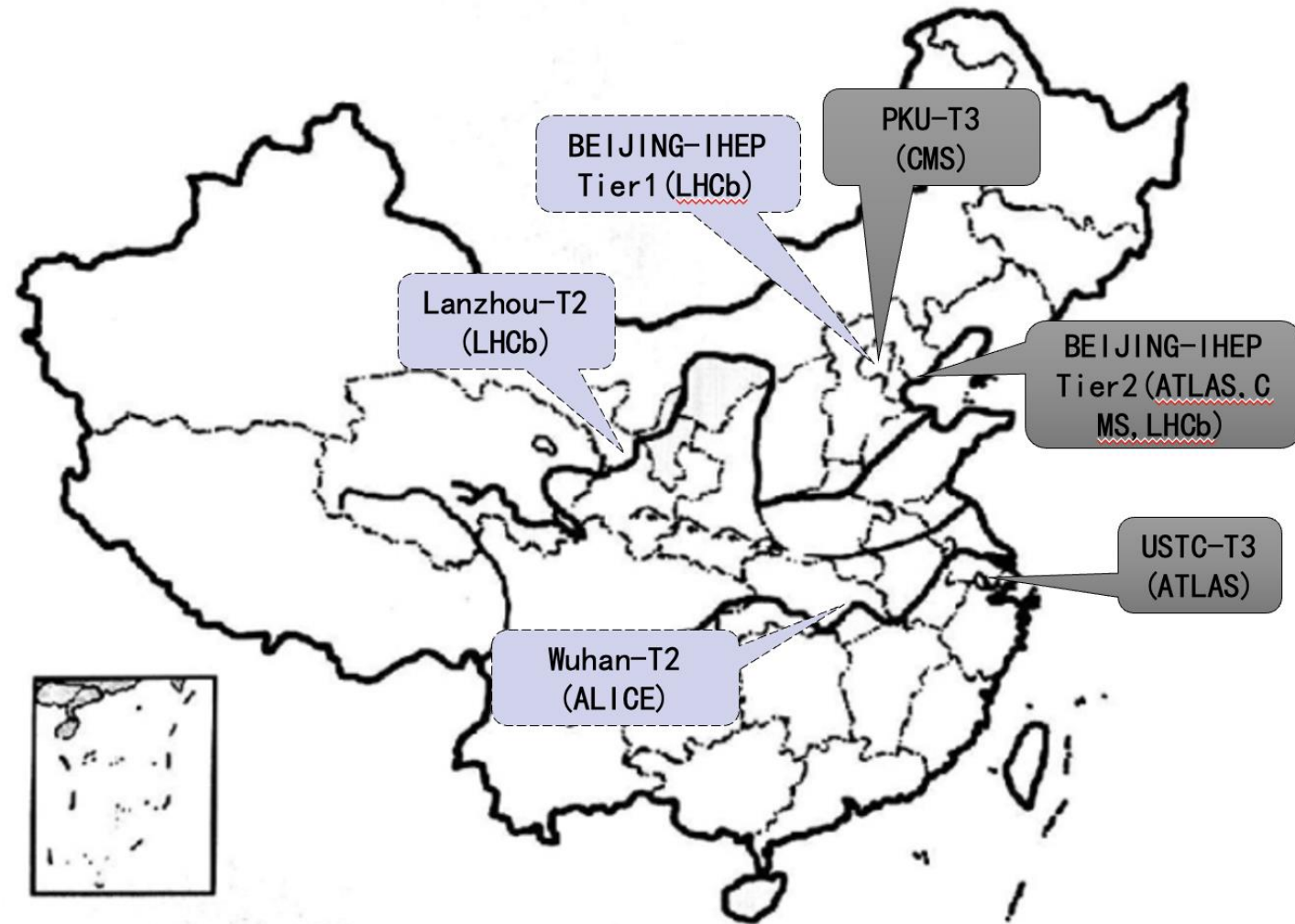




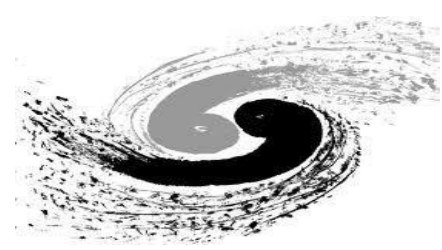
# Current Status of WLCG in China–Mainland



- Tier-2 sites
  - BEIJING-IHEP (ATLAS, CMS, LHCb)
- Tier-3 sites
  - PKU-T3 (CMS)
  - USTC-T3 (ATLAS)
- Certification Authority at IHEP
  - [cagrid.ihep.ac.cn](http://cagrid.ihep.ac.cn)
- Sites under development
  - Tier-1: BEIJING-IHEP (LHCb)
  - Tier-2: Lanzhou-T2 (LHCb)
  - Tier-2: Wuhan-T2 (ALICE)

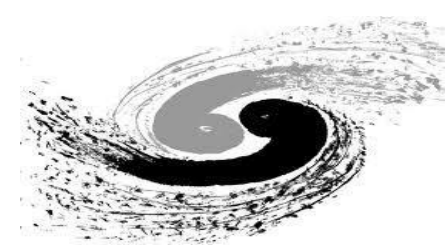


# Distributed Computing at IHEP



- WLCG Grid Site
  - Has been running Atlas, Cms and LHCb Tier 2 sites
    - ATLAS, CMS, from 2006
    - LHCb, from 2018
  - LHCb Tier I is going to be ready
- DIRAC at IHEP
  - Serving BESIII, JUNO, HERD, CEPC
  - DIRAC for computing and data management,
    - upgrade to v8.0.26 and move to distributed deployments since July 2023
  - Start to manage JUNO's First Data Challenge
  - HERD IAM at IHEP deployed and in test

# Status of IHEP Grid Site (T2)



## ● CPU: 4232 cores

- Intel Golden 6338: 1152 Cores
- Intel Golden 6238R: 672 Cores
- Intel Golden 6140: 2160 Cores
- Intel E5-2680V3: 696 Cores
- Intel X5650: 192 Cores

## ● CE & Batch: HTCondorCE & HTCondor

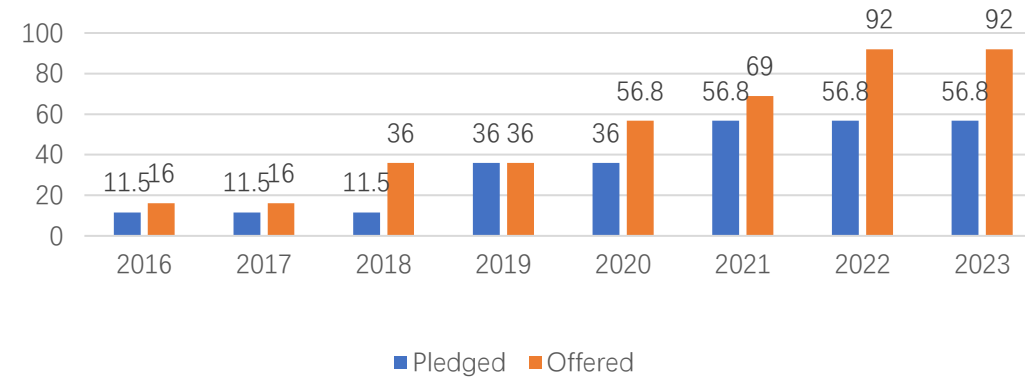
## ● VO: ATLAS, CMS, LHCb, BelleII, JUNO, CEPC

## ● EOS: 1750TB

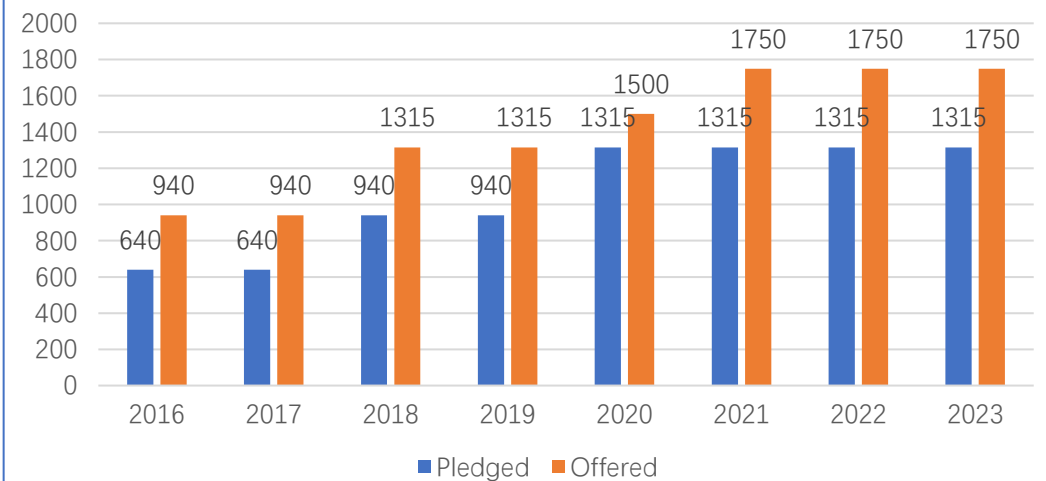
- 4TB \* 24 slots with Raid 6, 5 Array boxes
- DELL MD3860 8TB \* 60 slots
- DELL ME4084 10TB \* 42 slots
- DELL ME4084 12TB \* 84 slots

## ● EOS replaced DPM in May. 2023

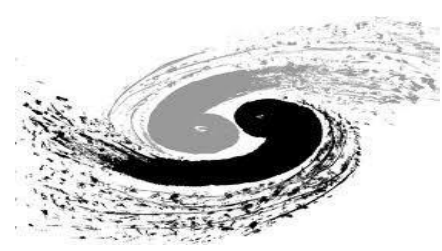
CPU (HEP-SPEC06X1000)



DISK (Tbytes)

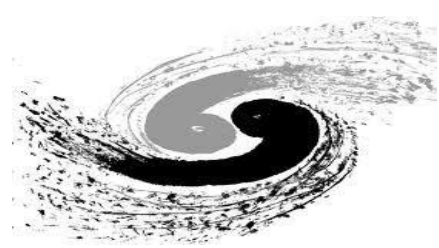


# LHCb Beijing T1 Construction

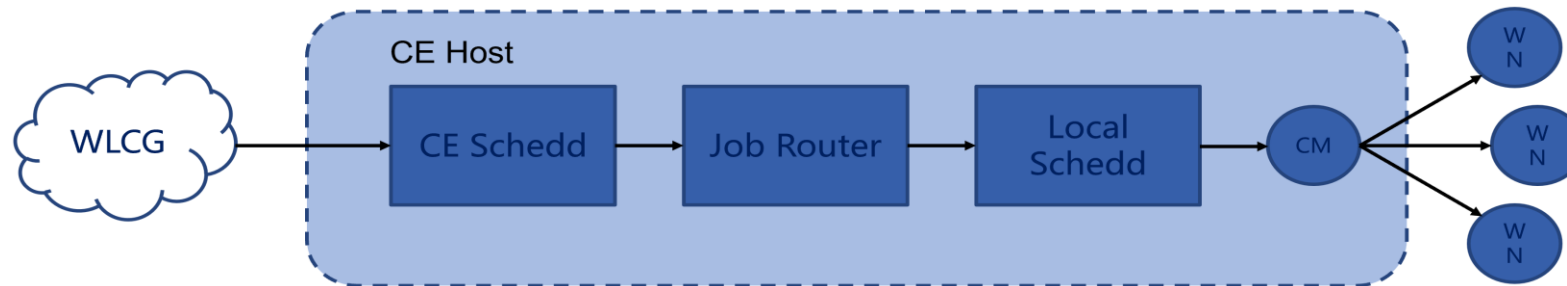
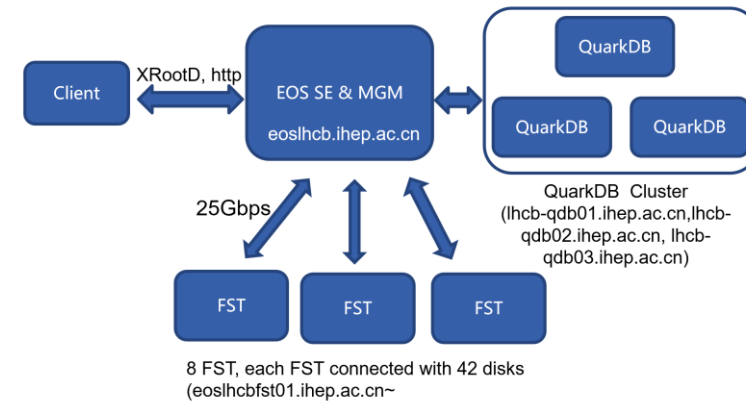
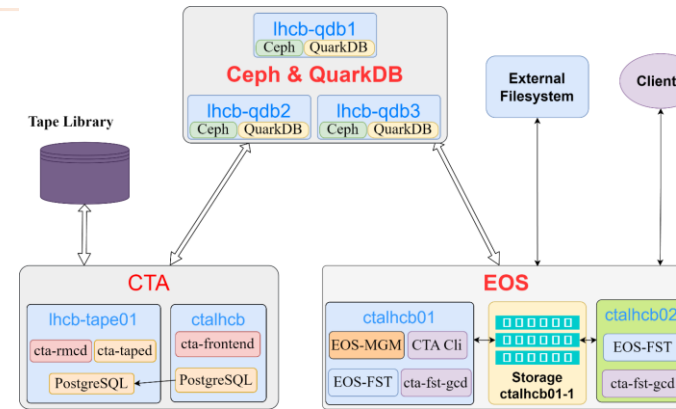


- Proposed in Dec. 2022
- Hardware
  - Computing: 3216 CPU cores, 40 worker nodes (Intel & AMD)
  - Disk storage: ~3.2PB, 4 sets of storage array
  - Tape storage: ~3PB, 170 tapes, 4 drivers (IBM)
  - Network equipment: 6 switches, 1 router, 2 band cards
  - Management servers: 10 servers
- Currently Tier I site is also reusing part of existing hardware
  - Firewall device, tape library, CA system, ...

# LHCb Beijing Tier1 Site Construction

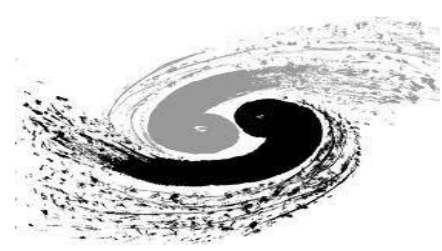


- Disk storage: EOS
  - services: QuarkDB, MGM, FST
  - protocol: xrootd and http
- Tape storage: EOS & EOS-CTA
  - Protocols: xrootd and http
- CE: HTCondor-CE & HTCondor
  - Support for SCIToken and GSI
- Other middle software
  - Argus, BDII, APEL
- LHCb Data challenge is ongoing

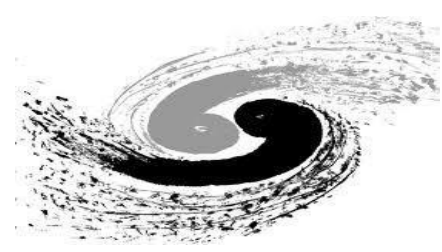


# Summary

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- IHEP CC runs the large scale computing platform including local cluster and grid site for the HEP and other Exp. Of IHEP
- Both local cluster and grid site have been running smoothly
- LHCb Tier I is going to be in production



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**Thank You!**