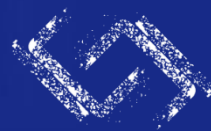




国家高能物理科学数据中心

National HEP Science Data Center



高能所计算中心

IHEP Computing Center

LHC Computing in China

Xiaowei JIANG

IHEP Computing Center

National HEP Science Data Center

2025-11-01



- 1 Overview of LHC and WLCG
- 2 WLCG Sites in China
- 3 Site Management and Operation
- 4 Plan
- 5 Summary

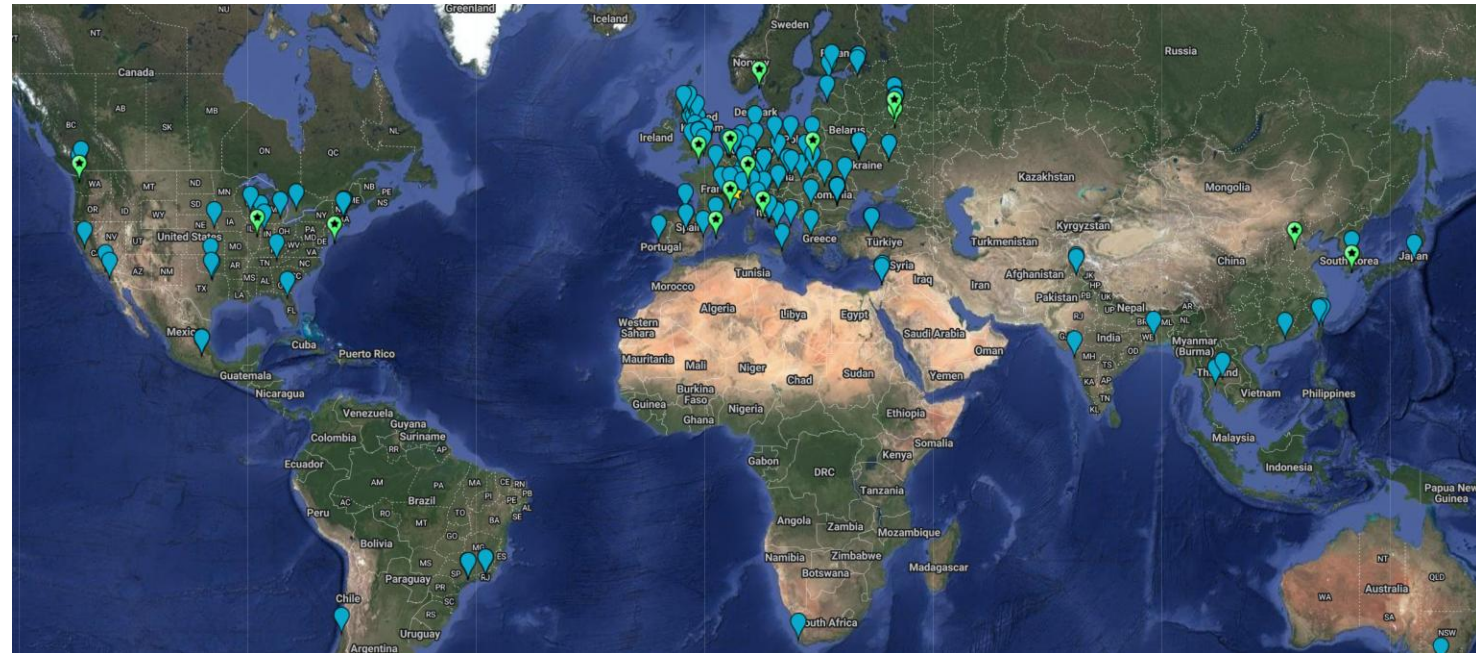
Overview of LHC and WLCG



- LHC (Large Hadron Collider)
 - The world's largest and most powerful particle accelerator: Higgs boson was discovered in LHC
 - 27-kilometre ring with four detectors (experiments): ALICE, ATLAS, CMS, LHCb (>10,000 members)
- WLCG (The Worldwide LHC Computing Grid)
 - A global collaboration of around 170 computing centers in more than 40 countries



Four experiments in LHC



WLCG sites around the world

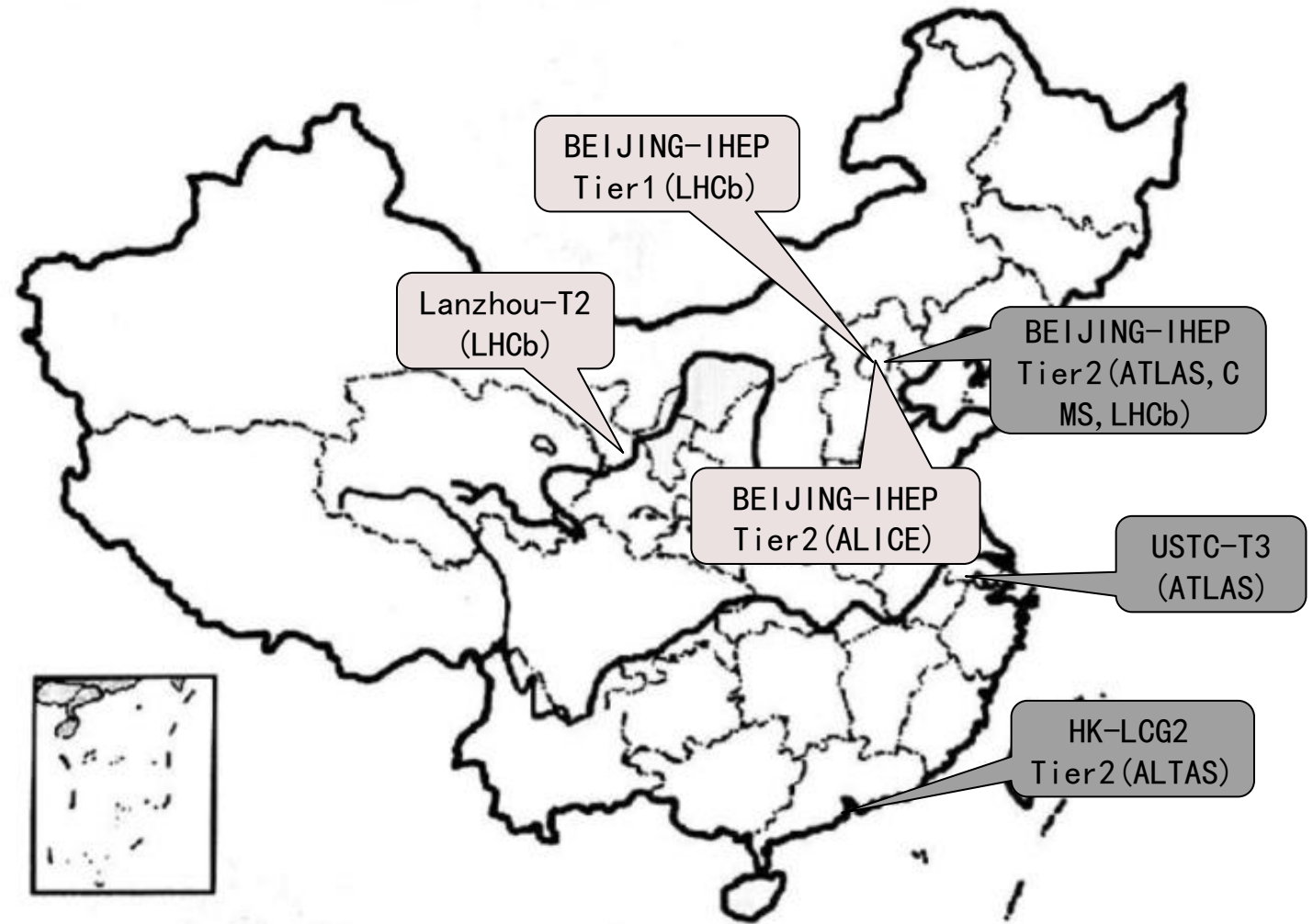


• Tier-2 sites

- BEIJING-IHEP (ATLAS, CMS, LHCb)
- HK-CUHK(ATLAS)

• New sites in these two years

- Tier-1: BEIJING-IHEP (LHCb)
- Tier-2: LZU-T2 (LHCb)
- Tier-2: BEIJING-IHEP (ALICE)





What is an NGI?

- National Grid Initiatives or Infrastructures
 - Set up by individual countries to manage the computing resources.
 - Regional operation center of EGI & WLCG
 - Central of the China LHC computing.
- Contributes a number of sites to the grid infrastructure.
 - BEIJING-T1
 - BEIJING-LCG2
 - LZU-T2
 - CSTCLOUD-EGI
 - CENI
 - HK-LCG2
 - Others were deprecated
- Support For Tier1 & Tier2 daily operations
- Yearly review of all resources

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

Project memberships

EGI

Scope Tags

EGI

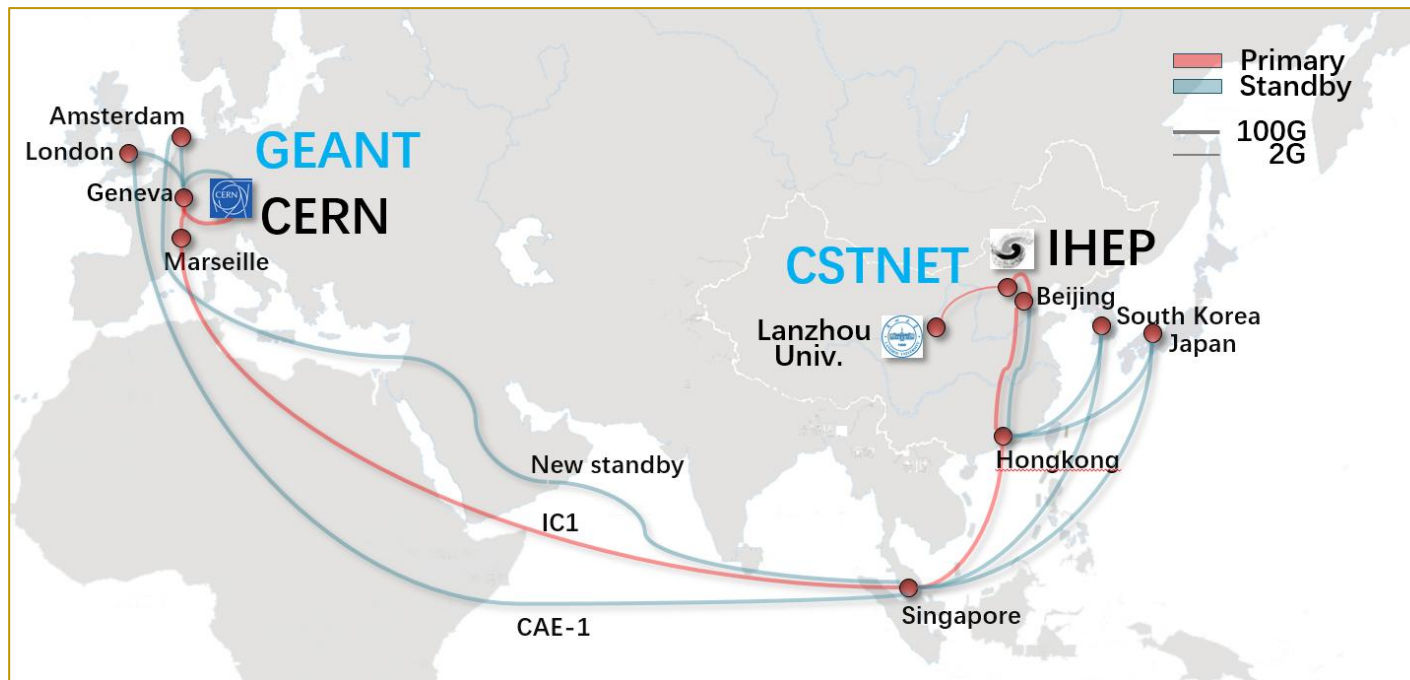
12 Sites (Note, Scope values marked with (x) indicate the parent NGI does not share that scope)

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	alice(x), alice.tier2(x),
BEIJING-LCG2-t	Closed	Production	EGI
HK-LCG2	Certified	Production	atlas(x), atlas.tier2(x),
Wuhan	Closed	Production	EGI
USTC-T3	Closed	Production	EGI
CSTCLOUD-EGI	Certified	Production	EGI, FedCloud(x)
BEIJING-T1	Certified	Production	EGI, lhcb(x),
CENI	Certified	Production	EGI, FedCloud(x)
LZU-T2	Certified	Production	EGI, lhcb(x),

The International Network for LHC



- A new international 100Gbps network link: established by CSTNET, cooperated with GEANT
 - 20Gbps bandwidth dedicated (3 links redundancy)
 - 100Gbps bandwidth shared (WLCG is the largest user currently)



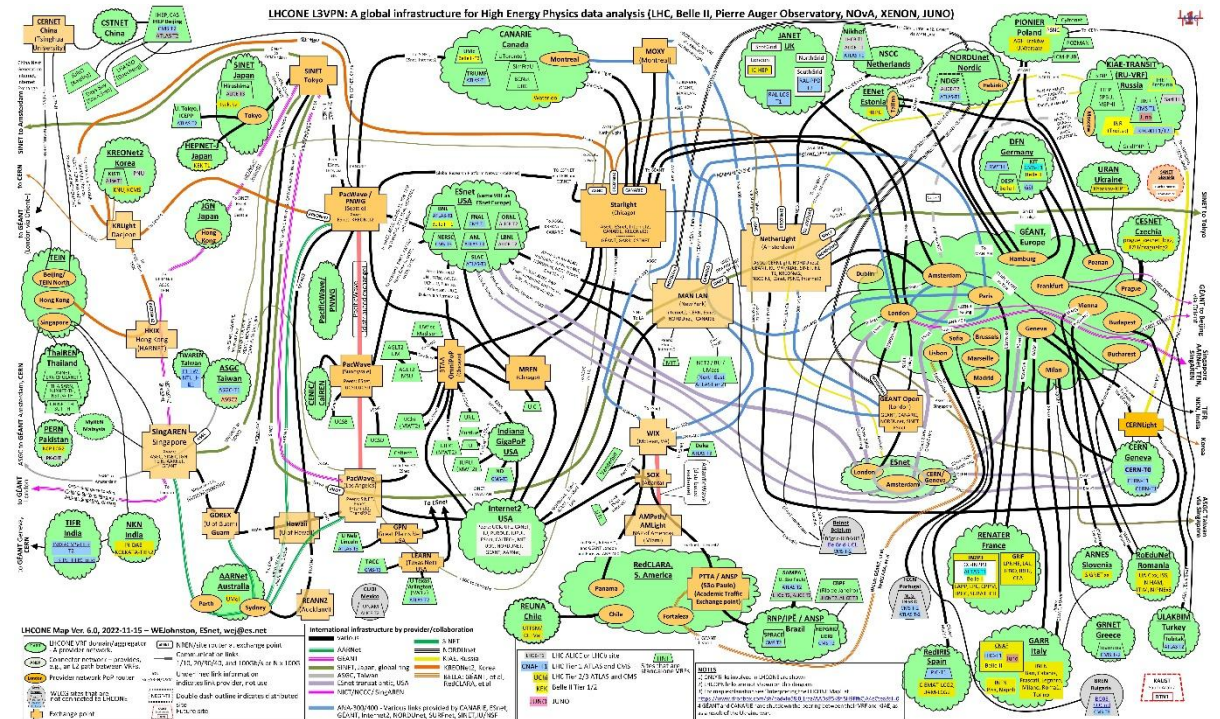
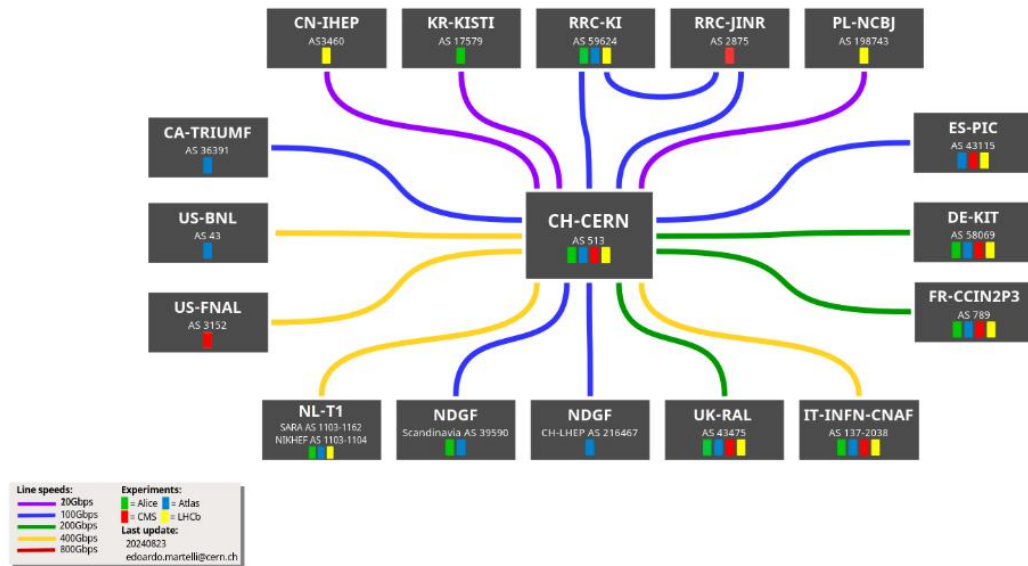
The IPv6-only is under preparation that to increase the scale of network clients and plan to deploy in the following months

LHC Network Organization



- LHC is using LHCOPN and LHCONE to support the data transfer needs of the LHC community and serve the networking requirements of the distributed computing models
 - LHCOPN (LHC Optical Private Network): linking Tier 0 and the Tier 1s
 - LHCONE (LHC Open Network Environment: linking the Tier 2 community

LHCOPN





- All the middleware are following a typical WLCG site

- Computing System: HTCondorCE and HTCondor

- Disk Storage System: EOS

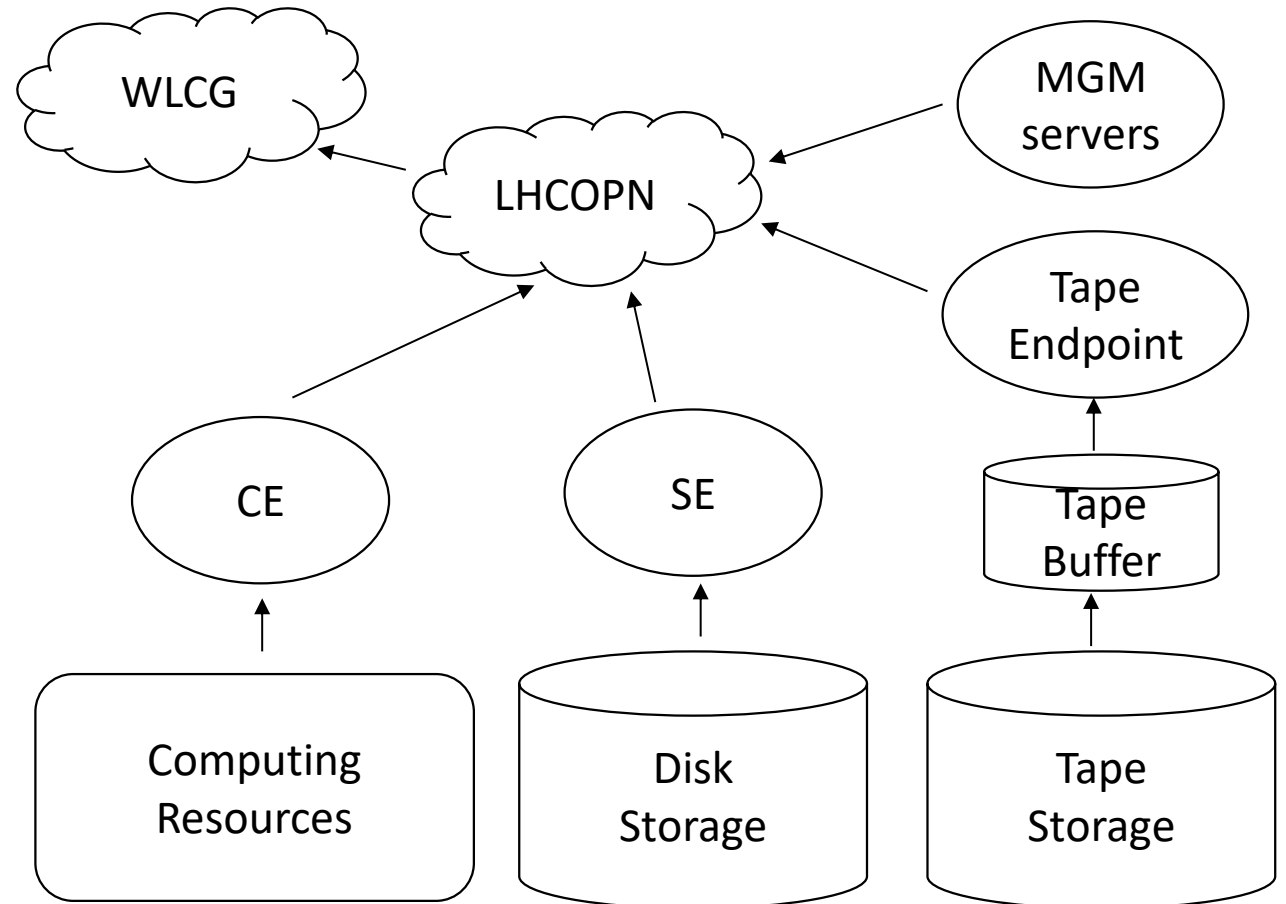
- Tape Storage System: EOS-CTA

- Other services

- ◆ Certification service: Argus

- ◆ Grid information service: BDII

- ◆ Accounting service: APEL



Site Management and Operation



- The Chinese sites have MoU with WLCG

- We are member of CB, OB, GDB, ...

- Operation meetings

- WLCG operation meeting every Monday.
- LHCb operations meeting every Monday, Wednesday and Friday
- IHEPCC grid operation meeting every Monday

- Site operations

- With WLCG: exchange the site information via the ticket system (almost 24 hours a day)
- For our sites: IHEPCC is responsible for software from remote and the local teams take care of infrastructure and hardware

Annex 1. WLCG Tier-0 and Tier-1 Centres

Tier-0

Pledged Experiments				Representative to WLCG Collaboration
ALICE	ATLAS	CMS	LHCb	
X	X	X	X	E. Perrot

Tier-1

Centre	Pledged Experiments				Representative to WLCG Collaboration	Funding Agencies
	ALICE	ATLAS	CMS	LHCb		
Canada, TRIUMF					J. Trnka, B. Tait	CD
China, IHEP Beijing					G. Chen	MoST, NSFC
France, CC-IN2P3	X	X	X	X	L. Laperroux (alt: U. Bouvet)	CNRS/IN2P3 and CEA/DSM/IRFU
Germany, KIT	X	X	X	X	A. Streit (alt: A. Petzold)	BMFT/KIT
Italy, INFN	X	X	X	X	L. Dell'Agnello (alt: D. Cesini)	INFN
Netherlands, LHC/Tier-1	X	X	X	X	J. Timpson	NIKHEP
Nordic Data Grid Facility (NDGF)	X	X			A. Azab (alt: M. Wadenstein)	NSRC/HIP/RCN/SRC
Poland, NCBJ				X	W. Wlodek (alt: H. Gienza)	Ministry of Science & Higher Education
Republic of Korea, KISTI-GSDC	X				Kujin Cho (alt: Byungyun Kong)	MSIT and NRF
Spain, PIC			X	X	G. Merino (alt: J. Flix)	Ministerio de Ciencia, Innovación y Universidades
Russia, JINR-T1			X		V. Kurenkov, N. Voytishin	JINR
UK, RAL	X	X	X	X	D. Britton	STFC
USA, BNL		X			A. Klimentov (alt: O. Rind)	DOE
USA, FNAL			X		O. Gutsche (alt: D. Hufnagel)	DOE

WLCG Tier-2 Centres and Federations of Centres that together constitute a Tier-2 Centre

Current configuration of existing federations can also be found in CRIC at <https://wlcg-cric.cern.ch/core/federation/list/>

Institution	Pledged Experiments				Representative to WLCG Collaboration	Funding Agencies
	ALICE	ATLAS	CMS	LHCb		
Austria, Austrian Tier-2 Federation	X	X	X		F. Schmitt, D. Kuhn	BMWFW
Australia, University of Melbourne		X			G. Taylor	AusHEP
Brazil, SPRACE, São Paulo			X		S. F. Novaes (UNESP), E. de M. Gregores	FAPESP
Belgium, Belgian Tier-2 Federation			X		G. Bruno (UCL), P. Vanlaere (ULB)	FNRS (UCL, ULB, UMH) and FWO (UA, VUB, UGent)
Canada, Canada-East Federation		X			O. Devroede (VUB)	Digital Research Alliance of Canada
Canada, Canada-West Federation		X			P. Savard, L. Groer	Digital Research Alliance of Canada
China, IHEP, Beijing	X	X	X	X	R. Sobie, Reda Taitout	MoST, NSFC, MOE
Czech Rep., PZU AS, Prague	X	X			Fazhi Qi, Qiye Shou, Peirong Li	MSMT CR
Estonia, NICDR			X		J. Chudoba	Estonian Ministry of
					M. Karlačik	

Plan – 2026 Pledges



- Resource contributions

- The LHC China Collaborations
- IHEPCC and NHEPSDC
- CSTNET (Network)

All LHC experiments told us that needs more resources in 2026, 2027,..., expecting 15% increase for each year.

Federation	Tier	Experiment	Year	VO	2026 Pledge	2025 Pledge	Remark
CN-IHEP-T1	1	LHCb	2025	Tape	20000 TBytes	20000 TBytes	
CN-IHEP-T1	1	LHCb	2025	Disk	12500 TBytes	12500 TBytes	
CN-IHEP-T1	1	LHCb	2025	CPU	110000 HEPscore23	67000 HEPscore23	Need more CPUs
CN-IHEP	2	ALICE	2025	CPU	30000 HEPscore23	30000 HEPscore23	
CN-IHEP	2	ALICE	2025	Disk	840 TBytes	840 TBytes	
CN-IHEP	2	ATLAS	2025	CPU	40000 HEPscore23	40000 HEPscore23	
CN-IHEP	2	ATLAS	2025	Disk	1000 TBytes	1000 TBytes	
CN-IHEP	2	CMS	2025	CPU	40000 HEPscore23	40000 HEPscore23	
CN-IHEP	2	CMS	2025	Disk	1400 TBytes	1350 TBytes	
CN-IHEP	2	LHCb	2025	CPU	77000 HEPscore23	77000 HEPscore23	
CN-IHEP	2	LHCb	2025	Disk	3400 TBytes	3400 TBytes	



• Future possible contributions

- China collaborations: HTU for LHCb (funding confirmed)
- NHEPSPDC and IHEPCC
 - ◆ LZ Projects added some storage to IHEP site last month
 - ◆ **Applying a cooperation project and the funding covers part of storage (disk and tape)**

• AI becomes more important as the resource, middleware and software

- We are also working hard on the construction of AI infrastructure
- Hope to continuously provide more AI service and resource abilities to LHC users



Grid Sites for More Experiments



- CEPC & JUNO

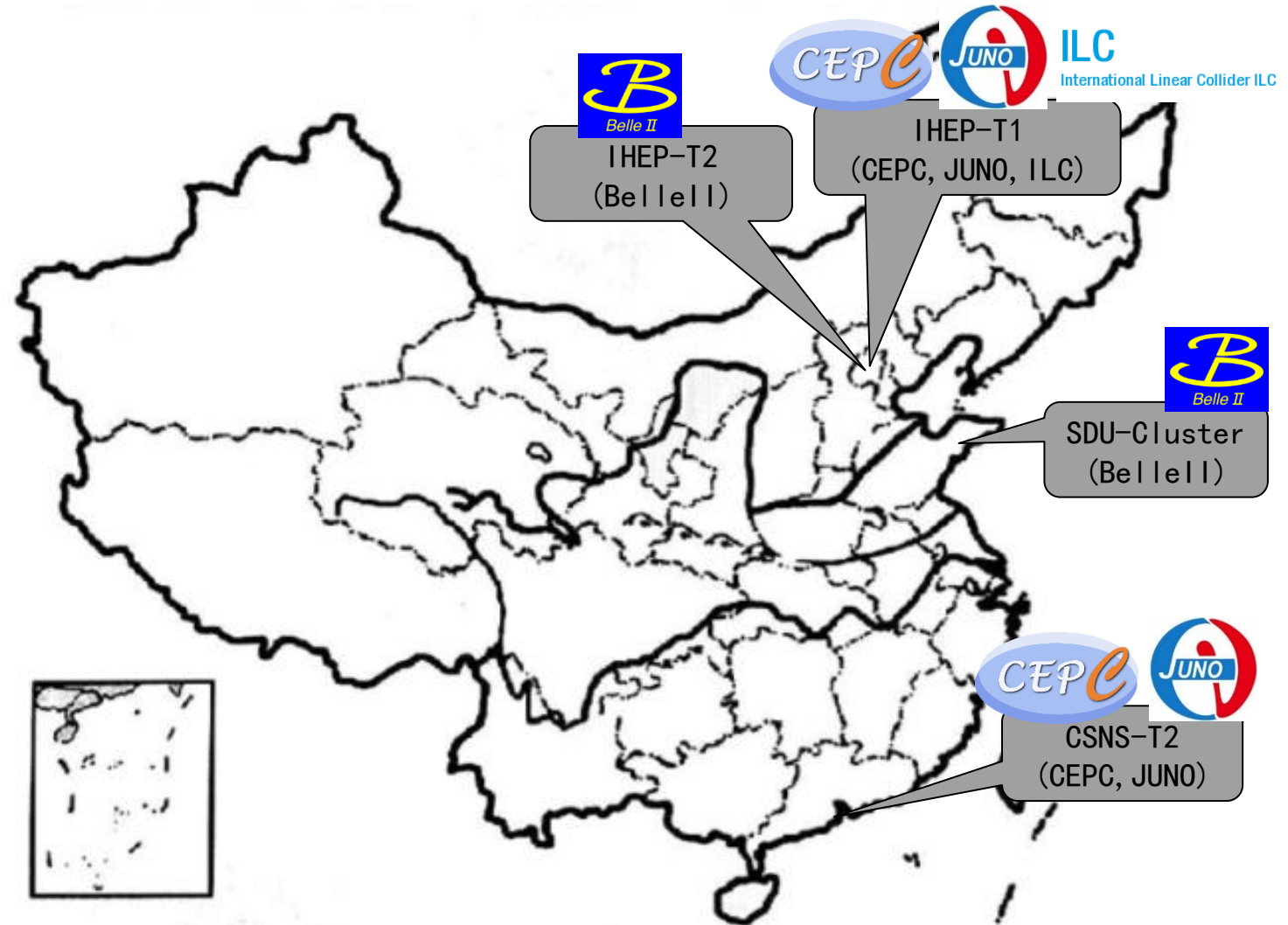
- T0&T1 is located at IHEP
- CSNS Tier2 site in Dongguan

- BELLEII

- Tier-2: BEIJING-IHEP
- Cluster: SDU

- ILC

- Cluster: IHEP





- The LHC computing scalability in China is increasing fast in recent years
 - All the sites keep in busy status in the whole year
- All the Chinese LHC collaborations and IHEPCC (NHEPSDC) are working hard together to look for more possible resource contribution
 - We still need more resources with expectation from LHC experiments
- Thanks to the Chinese LHC Collaborations, the partner sites, CSTNET(CNIC) and all the friends involving the LHC computing

Thanks! Q&A