

# Jiangmen Underground Neutrino Observatory

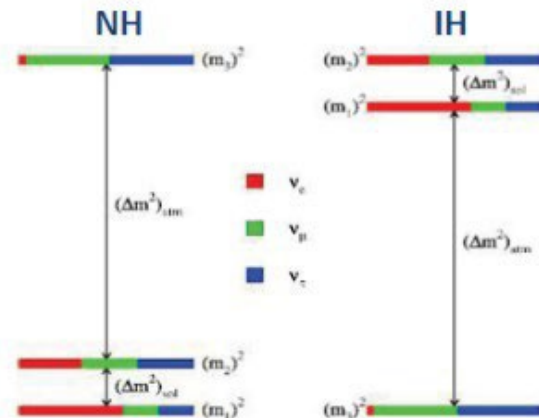
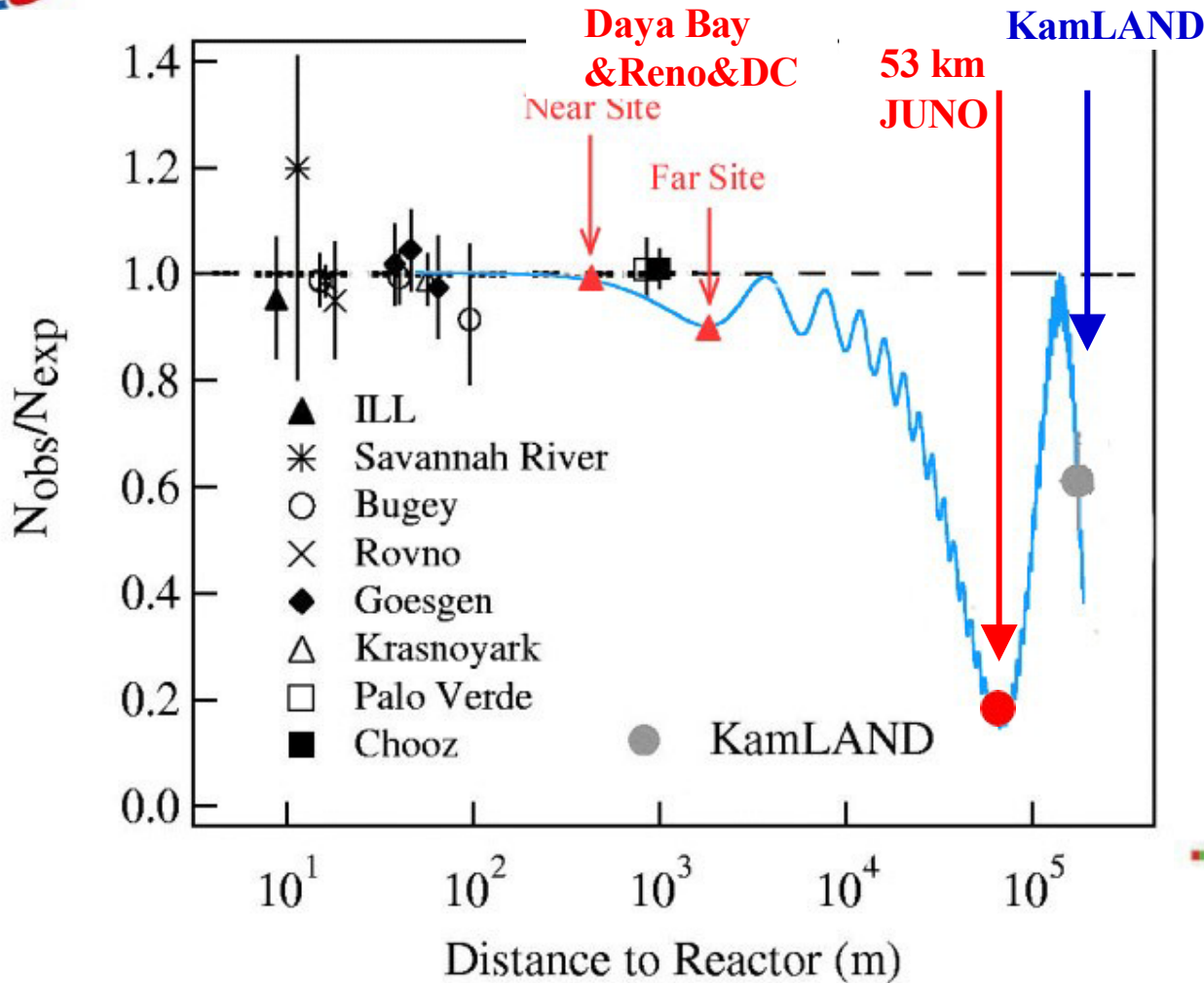
Giuseppe Andronico

On behalf of JUNO collaboration



# JUNO physics summary

- ◆ 20 kton LS detector
- ◆ ~3 % energy resolution-the greatest challenge for MH
- ◆ Rich physics possibilities-neutrino oscillation and other particle program
  - ⇒ Mass hierarchy
  - ⇒ Precision measurement of 3 mixing parameters  $\Delta m^2_{\text{atm}}$   $\Delta m^2_{\text{sol}}$   $\theta_{12}$
  - ⇒ Supernova neutrinos
  - ⇒ Diffuse supernova background
  - ⇒ Geo-neutrinos
  - ⇒ Solar neutrinos
  - ⇒ Atmospheric neutrinos
  - ⇒ Nucleon Decay
  - ⇒ Exotic searches



Background challenge target range for g/g of U and Th

$10^{-15}$  (minimum requirement)

$10^{-17}$  (ideal)

*Neutrino Physics with JUNO*, J. Phys. G 43, 030401 (2016)

*JUNO physics and detector*, Progress in Particle and Nuclear Physics 123, 103927 (2022)



# A large LS spherical detector

- LS large volume: → for statistics
- High Light yield and transparency → for energy resolution

## Steel Truss

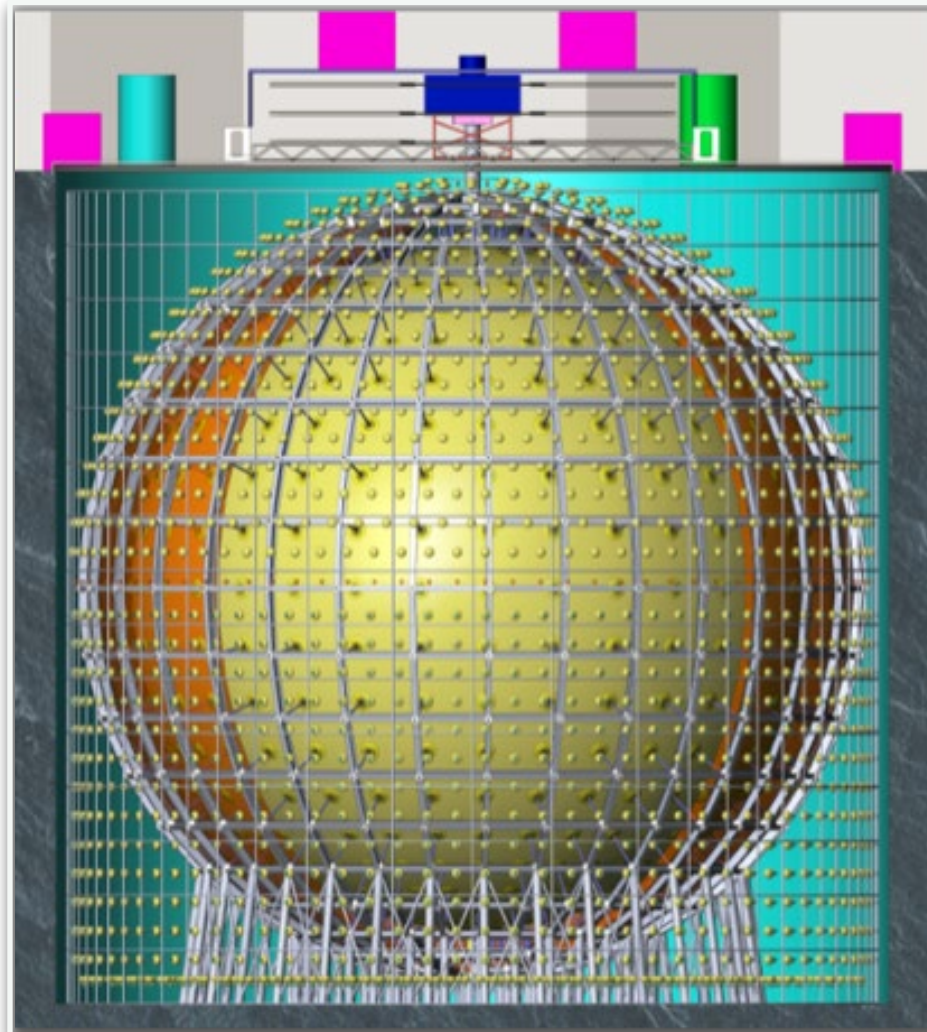
Holding PMTS

17612 x 20''

25600 x 3''

## Acrylic Sphere

filled with 20 kton  
of liquid scintillator



**JUNO collaborations is made from 74 institutes in 17 countries and more than 700 collaborators**

Armenia	Italy
Belgium	Pakistan
Brazil	Russia
Chile	Slovakia
China	Taiwan-China
Czech	Thailand
Finland	U.K.
France	U.S.A.
Germany	



# CD status

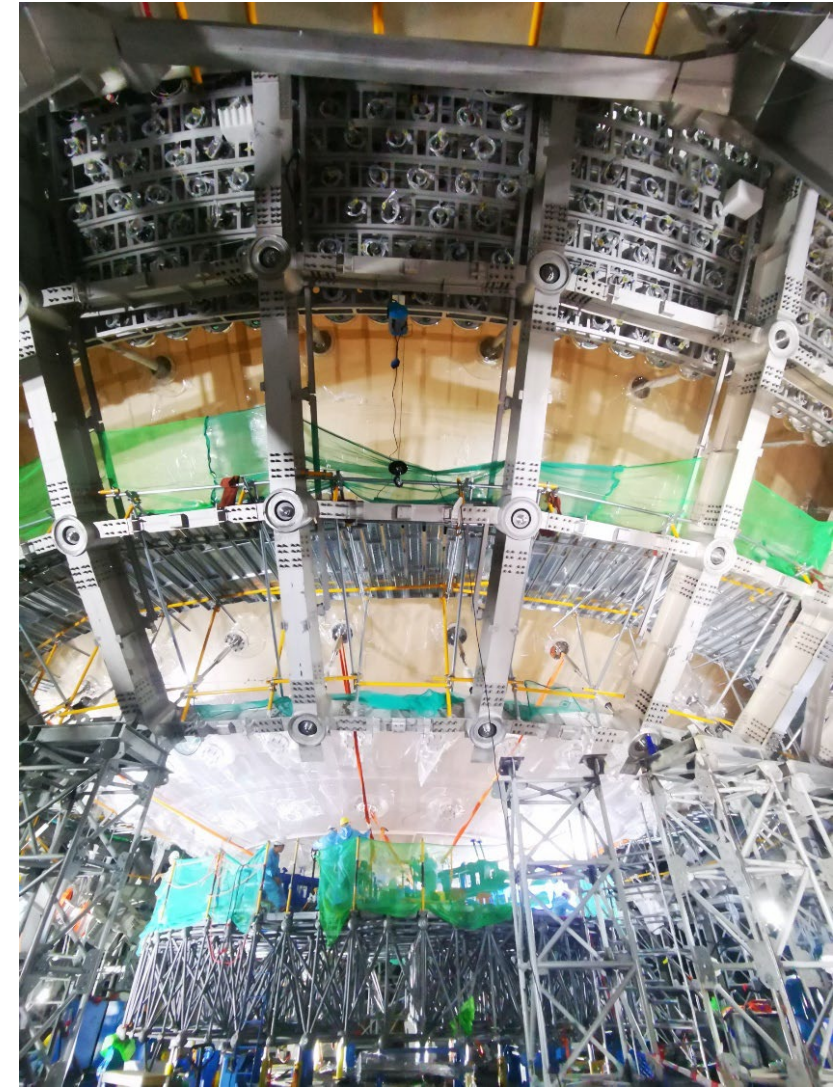


Acrylic



LPMT  
Modules

Data  
taking  
expected  
on  
12/2024



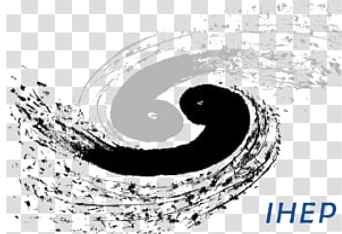




# Data volumes, computational requirements

Estimated Raw data production	60 MB/s $\leftrightarrow$ 2PB/year
Estimated other data (reconstructed, calibration, analysed)	1.0 PB/year
Bandwidth required to copy 3 PB in 1 year	0.8 Gbps

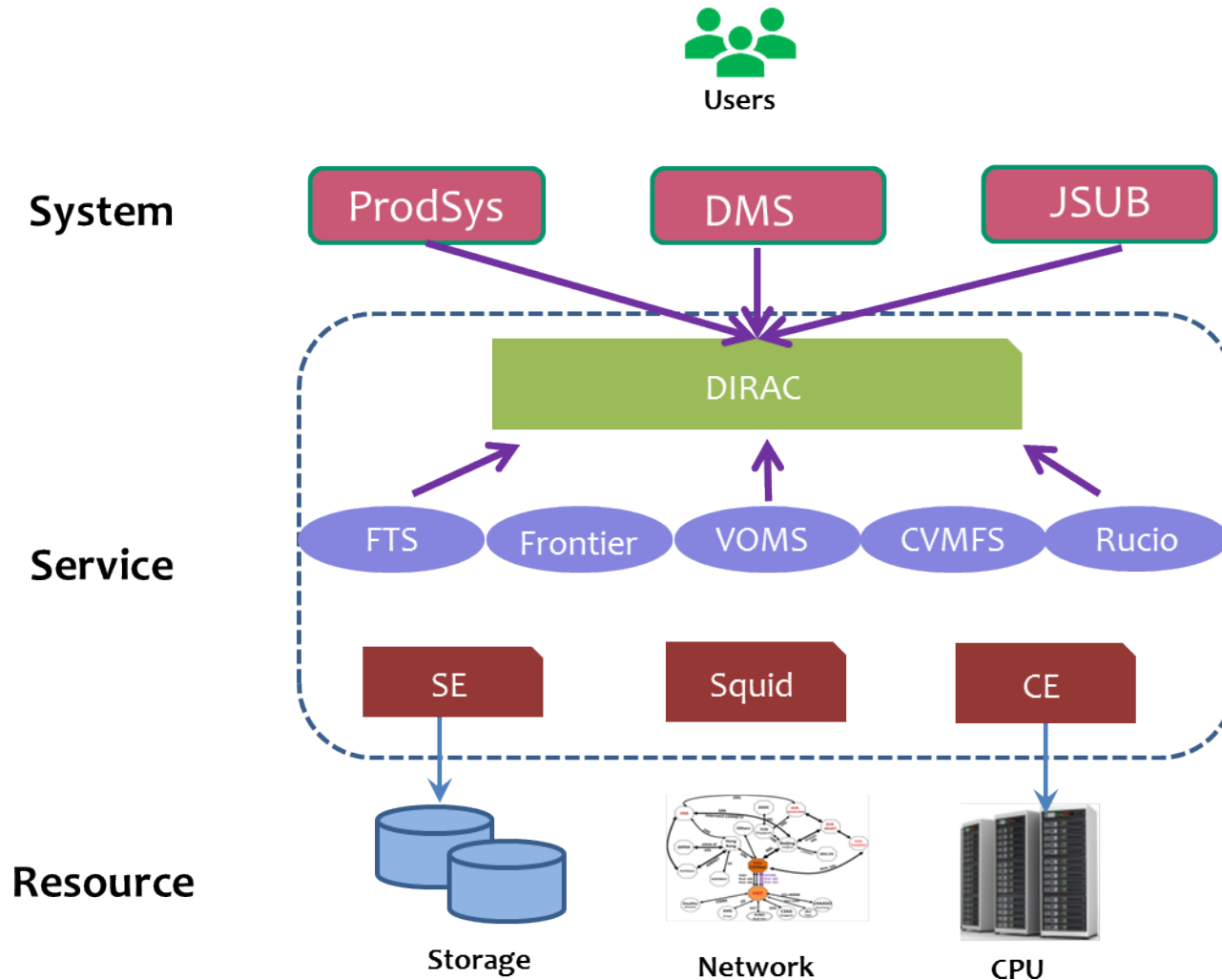
- 1 event reconstruction goal: 5s with a 18 HS06 core
- Rate: 1kHz
- Reconstruct 1 year data in 1 year then requires about 155 kHS23.



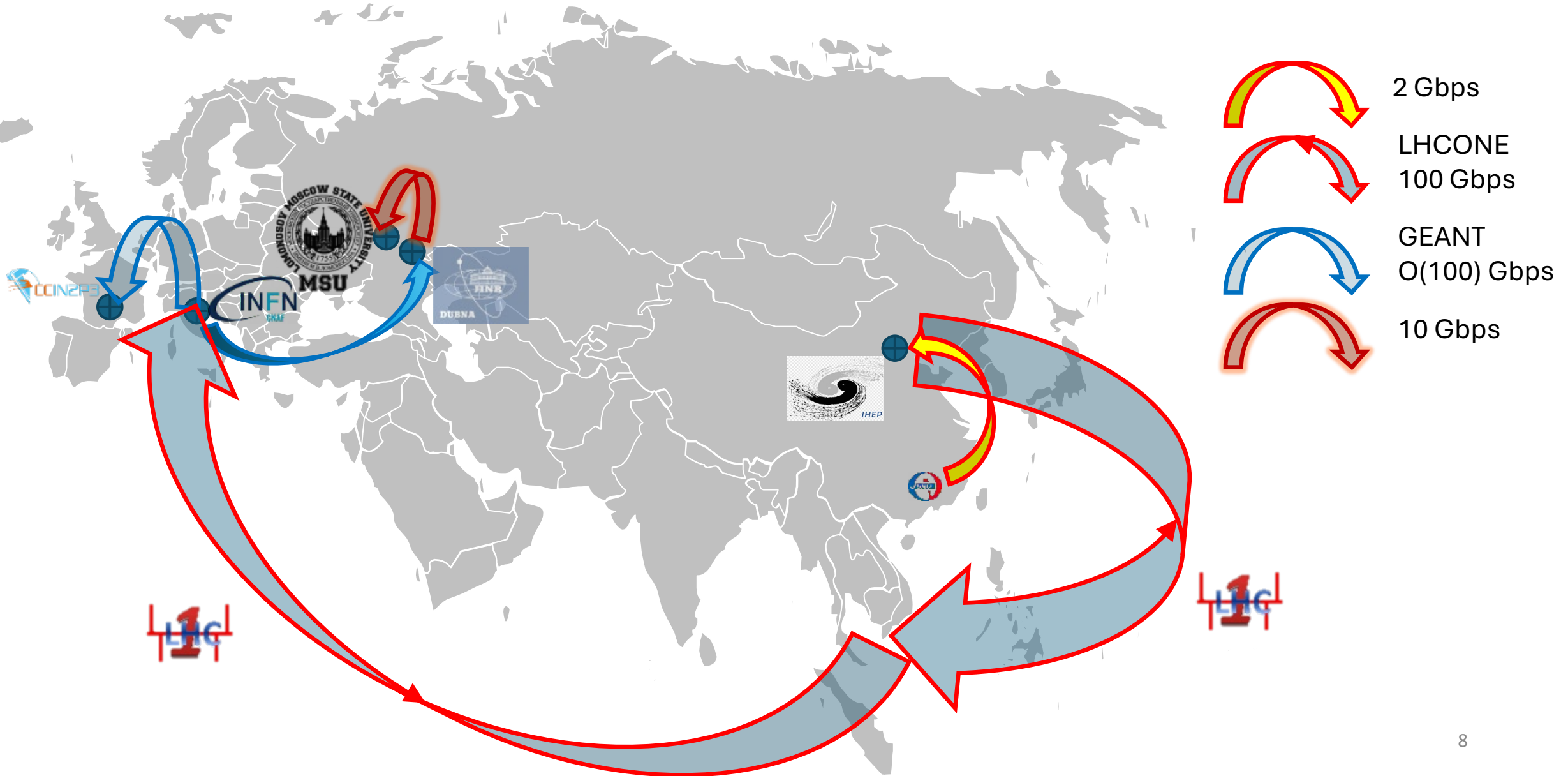
# JUNO Data Centres

	Role	Available in 2024		
		CPU (kHS06)	Disk (PB)	Tape (PB)
	T0: next to JUNO site, collect all data, DQM, first reconstruction	180	8.0	4.0
	T1: 1/3 of data, computing power	15	0.2	2.0
	T1: full data, computing power	20	3.0	1.0
	T1: full data, computing power	120	10.0	10.0
	T2: no data, computing power; not yet on line			
<b>Totals</b>		<b>335</b>	<b>21.2</b>	<b>17.0</b>

# DCI Architecture



# International networks

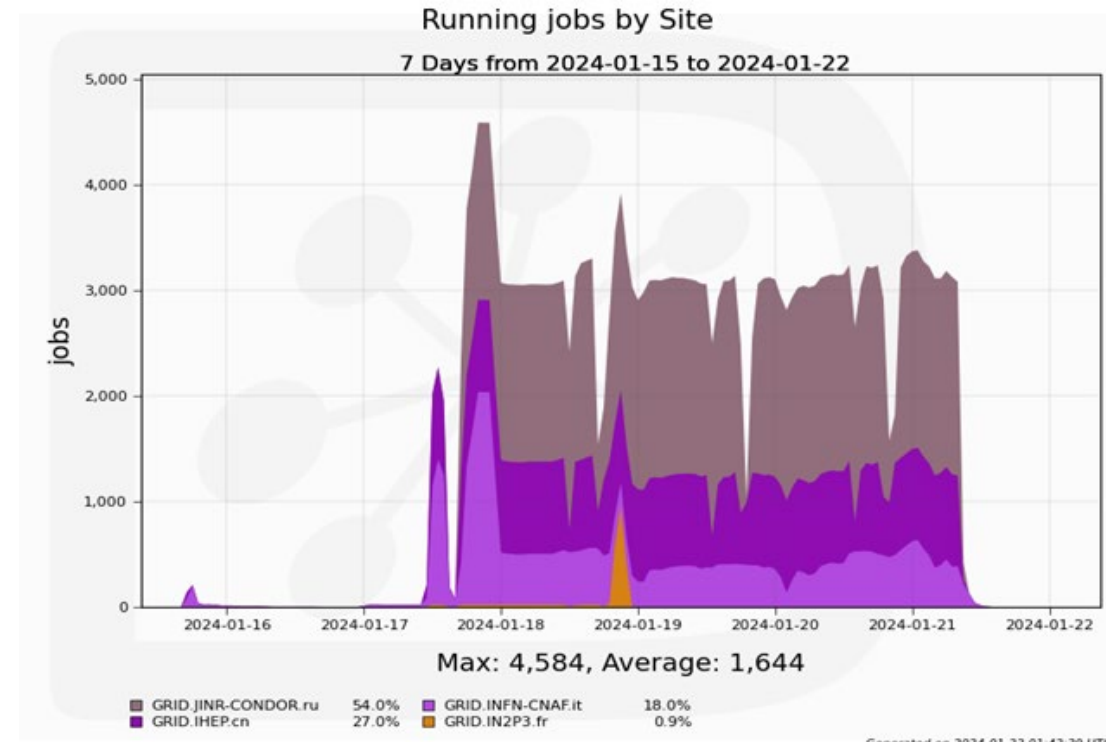
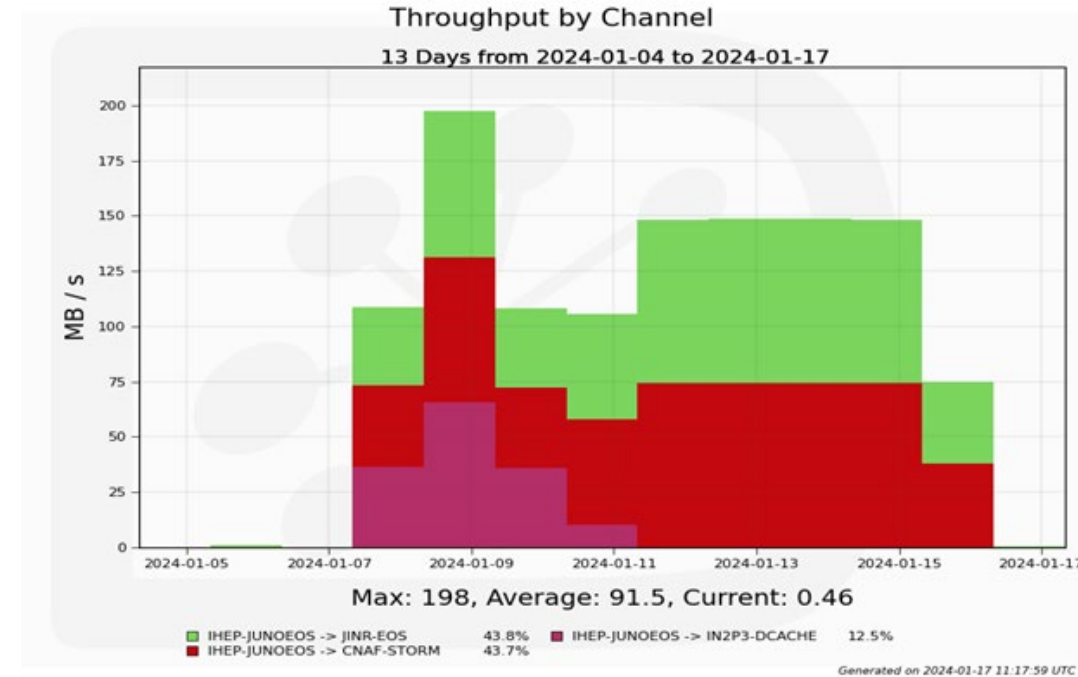




# Data challenges

DC-1: functions of physics production

- RTRaw distributed to three data centers (IN2P3 only a small part)
- Split and scheduled jobs to proper data centers depending on data location and resource availability
- Production monitoring

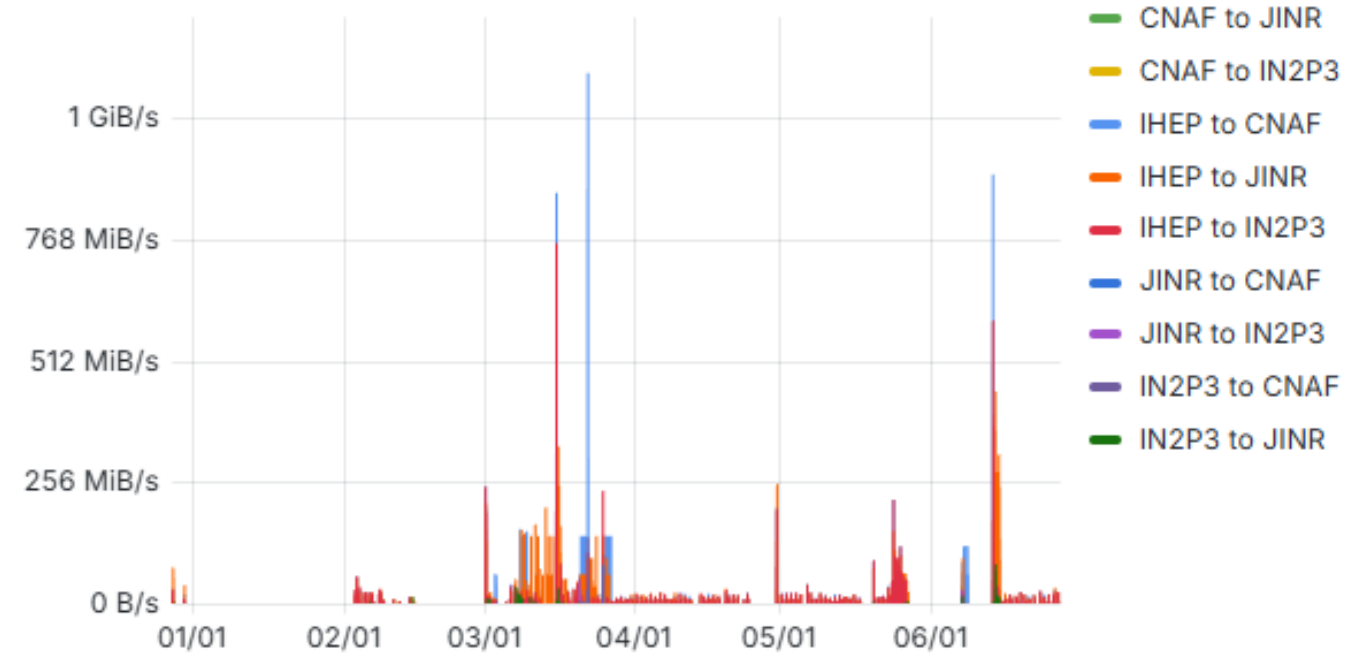


# Data transfers

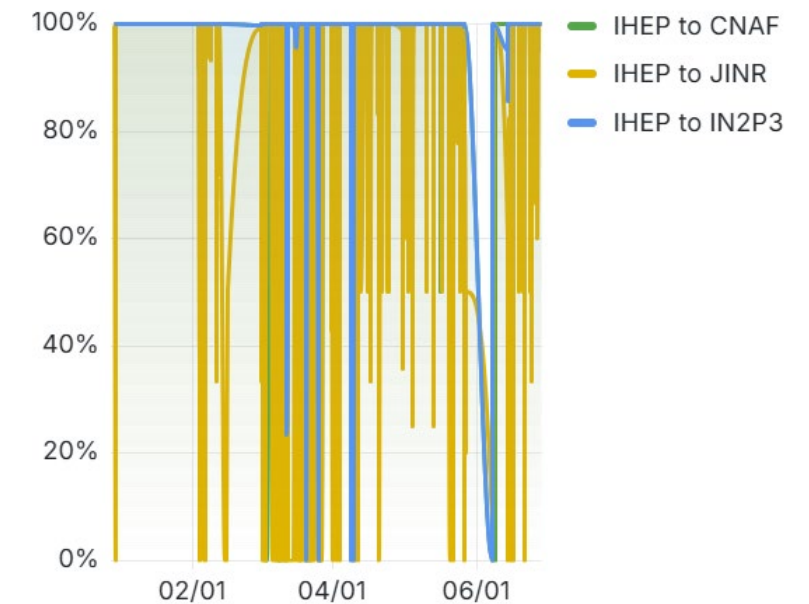
## Data transfer

- RAW files
- OSIRIS

Transfer Throughput 1h



Efficiency

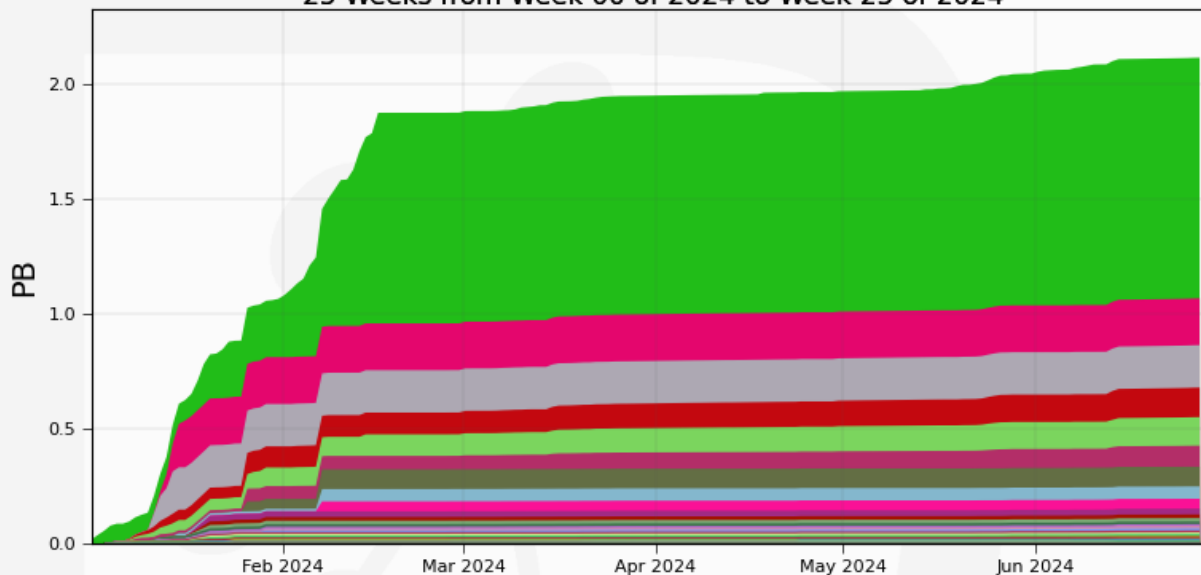


# Data transfers

During the first half of 2014, total transferred data is about 2PB

Transferred data by Channel

25 Weeks from Week 00 of 2024 to Week 25 of 2024



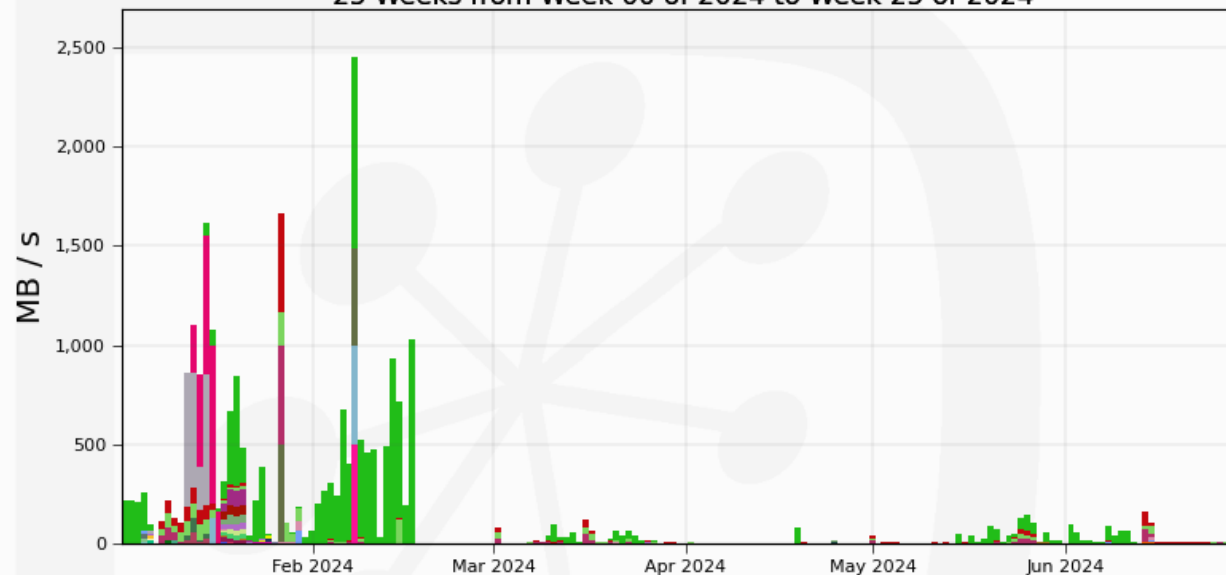
Max: 2.12, Min: 0.02, Average: 1.68, Current: 2.12

DIRAC.Client.cn -> IHEP-JUNOEOS	1.0	JINR-EOS -> GRID.JINR-CONDOR.ru	0.0
ihep.ac.cn -> IHEP-JUNOEOS	0.2	IHEP-JUNOEOS -> GRID.IHEP.cn	0.0
IHEP-JUNOEOS -> IHEP-TAPE	0.2	GRID.JINR-CONDOR.ru -> JINR-EOS	0.0
IHEP-JUNOEOS -> CNAF-STORM	0.1	IN2P3-DCACHE -> IHEP-TAPE	0.0
IHEP-JUNOEOS -> JINR-EOS	0.1	GRID.IHEP.cn -> IHEP-JUNOEOS	0.0
IHEP-JUNOEOS -> IN2P3-DCACHE	0.1	CNAF-STORM -> JINR-EOS	0.0
ihep.ac.cn -> JINR-EOS	0.1	IN2P3-DCACHE -> JINR-EOS	0.0
ihep.ac.cn -> IN2P3-DCACHE	0.1	CNAF-STORM -> IHEP-TAPE	0.0
ihep.ac.cn -> CNAF-STORM	0.0	... plus 130 more	

Generated on 2024-06-28 14:05:43 UTC

Throughput by Channel

25 Weeks from Week 00 of 2024 to Week 25 of 2024



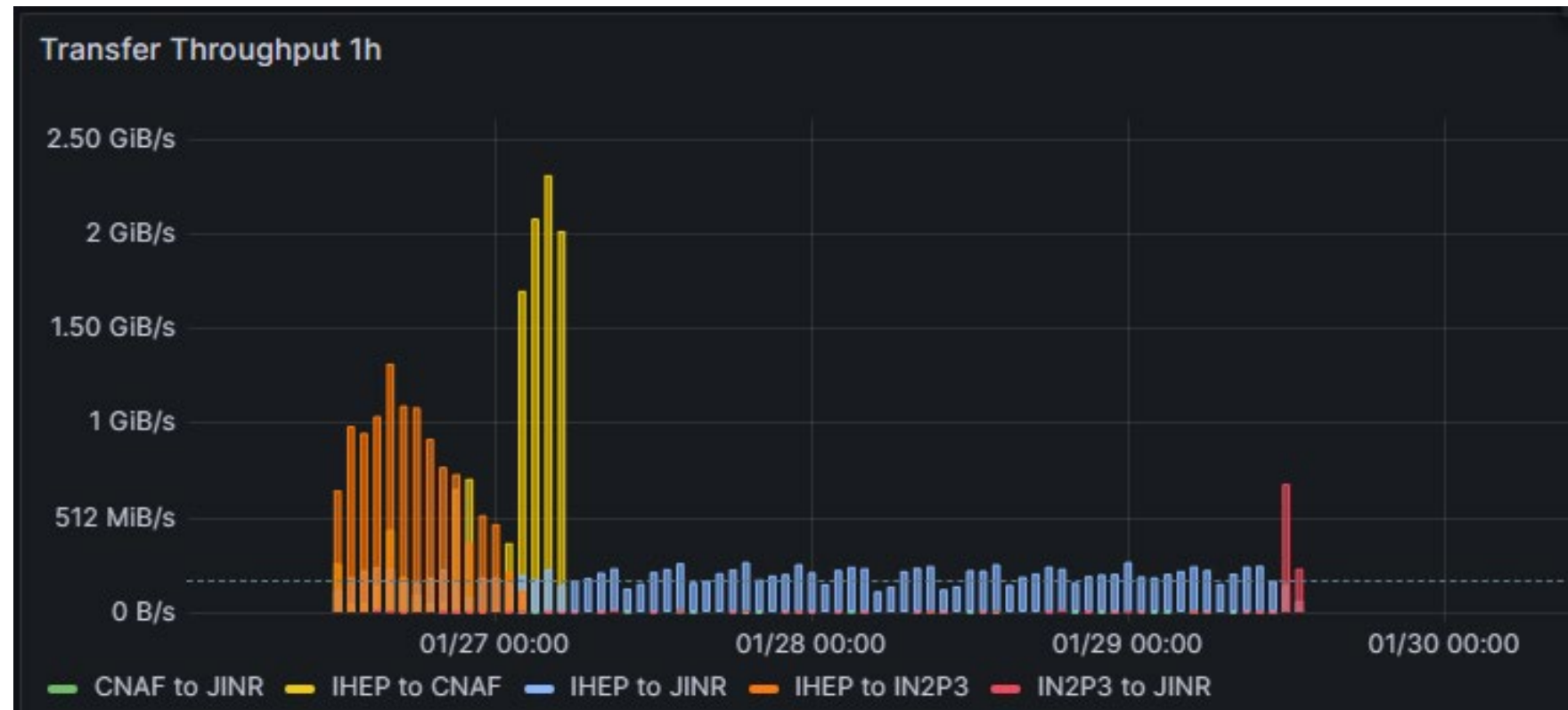
Max: 2,447, Average: 137, Current: 6.65

DIRAC.Client.cn -> IHEP-JUNOEOS	49.5%
ihep.ac.cn -> IHEP-JUNOEOS	9.6%
IHEP-JUNOEOS -> IHEP-TAPE	8.7%
IHEP-JUNOEOS -> CNAF-STORM	6.1%
IHEP-JUNOEOS -> JINR-EOS	5.9%
IHEP-JUNOEOS -> IN2P3-DCACHE	4.3%
ihep.ac.cn -> JINR-EOS	4.0%
ihep.ac.cn -> IN2P3-DCACHE	2.6%
... plus 139 more	

Generated on 2024-06-28 14:11:57 UTC

# Network data challenge

- IHEP-> CNAF, JINR, IN2P3
  - 8000files, each file 5GB
- IHEP->CNAF and IHEP->IN2P3 very good performance
  - CNAF can reach 20Gb/s and IN2P3 can reach 10Gb/s
  - Success rate 100%



<input type="checkbox"/>	4544	<span style="color: green;">■</span> Active	Automatic	Transfer-J...	5G_IHEP2JINR	8000
<input type="checkbox"/>	4543	<span style="color: green;">■</span> Active	Automatic	Transfer-J...	5G_IHEP2DCACHE	8000
<input type="checkbox"/>	4542	<span style="color: green;">■</span> Active	Automatic	Transfer-J...	5G_IHEP2CNAF	8000



# Summary

- JUNO is about to start data taking in December
  - Data taking will increase smoothly till full data flow in a couple of months
- JUNO DCI in test is performing well
- JUNO DCI is able to take advantage from existing network