



# C2Or4A-02: New Helium Refrigerator for Institute of High Energy Physics

Innovation & Technology

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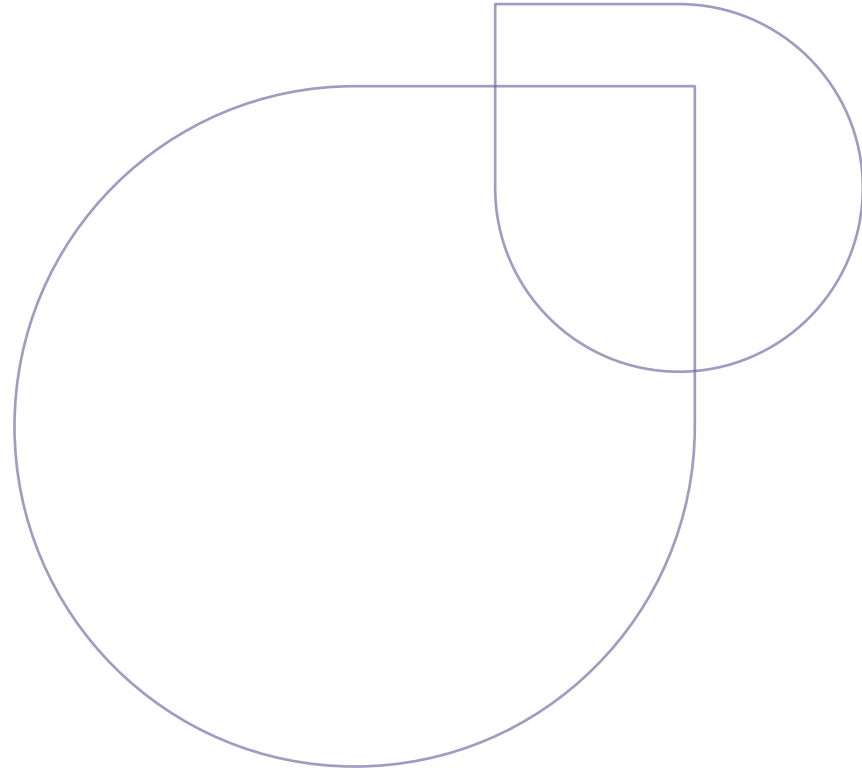
# Summary

1. Air Liquide Cryogenic China Science (ALCCS) presentation
2. Institute of High Energy Physics (IHEP) Cryogenics infrastructures overview
3. New Helium Refrigerator description and timeline
4. Measured Performances
5. Conclusion

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# ALCCS

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# ALCCS in Brief

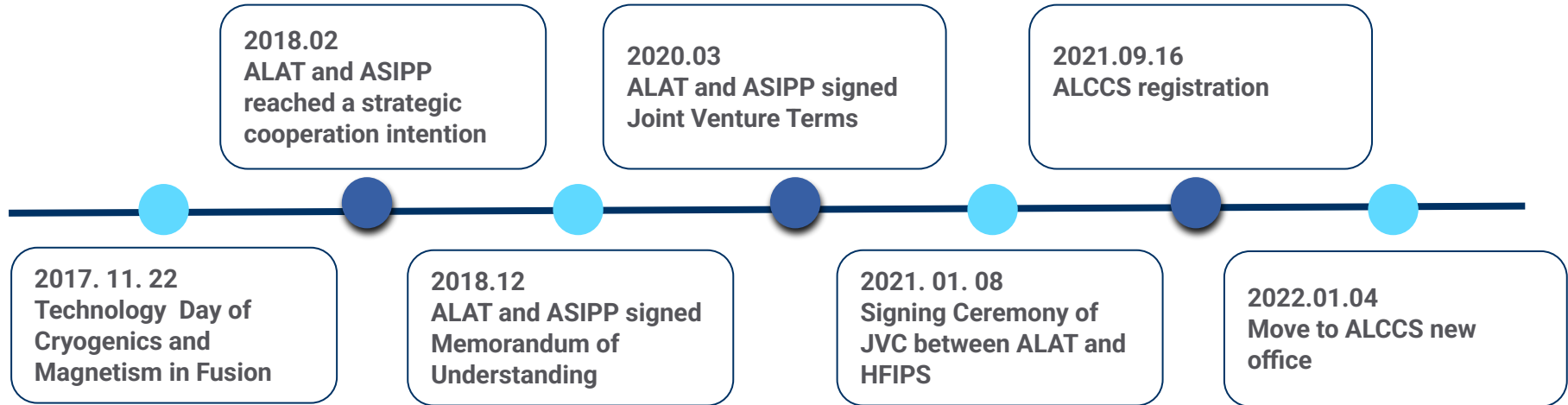
As a joint venture of **Air Liquide Advanced Technologies** and **Hefei Institutes of Physical Science of the Chinese Academy of Sciences**, ALCCS is committed to develop helium cryogenic systems through adapted & innovative solutions to enable standalone fusion & other scientific applications & industrial company in China & Asia.



Hefei Institutes of Physical Science,  
Chinese Academy of Sciences



# ALCCS - Milestones of ALCCS

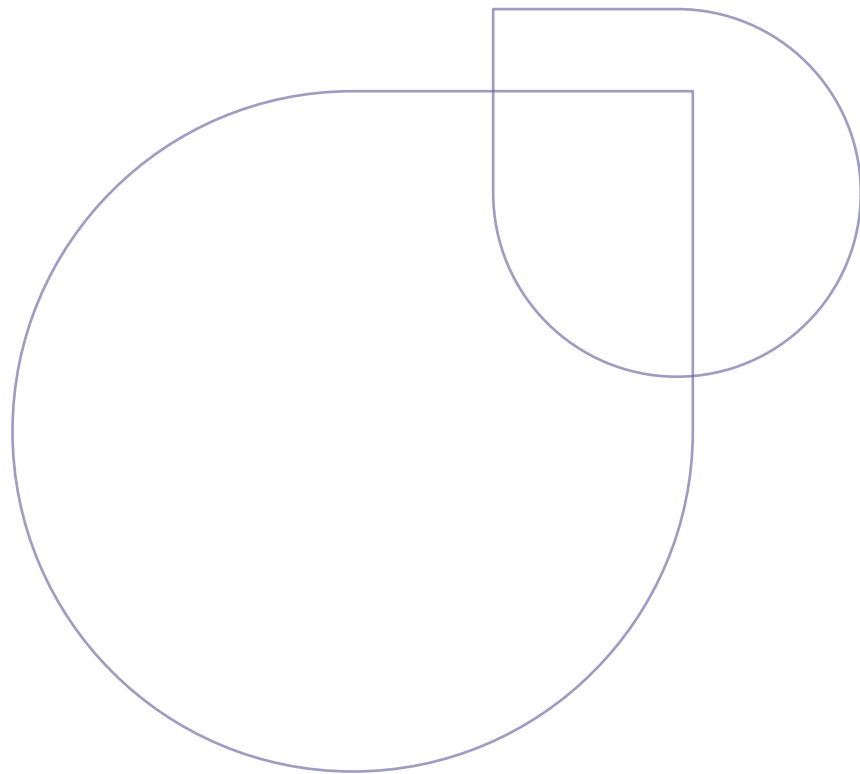


**Signature of New Helium refrigerator for IHEP by ALCCS on September 2022**

# IHEP

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## Cryogenics infrastructures overview

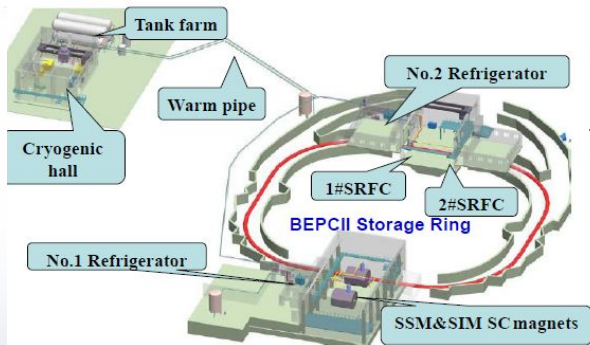




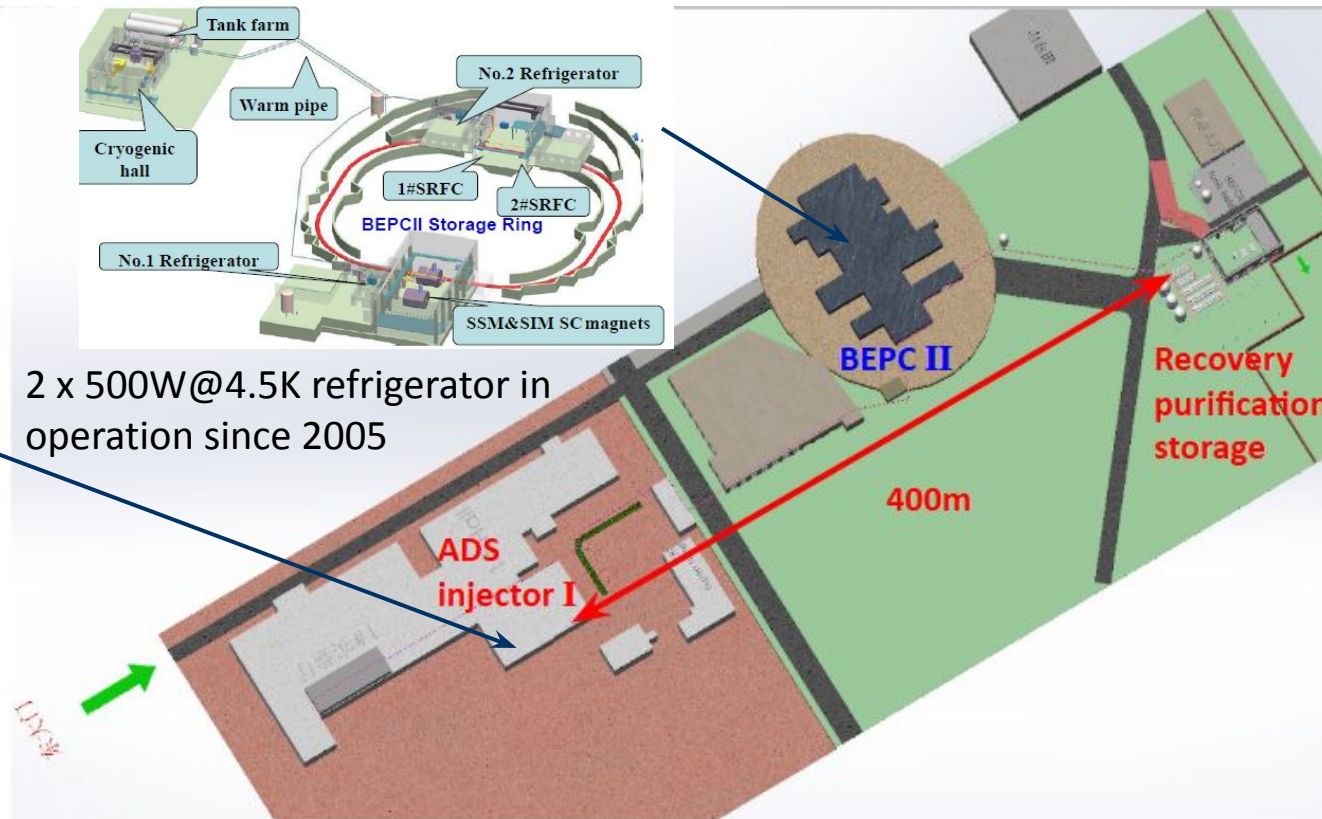
# IHEP Cryogenic ADS/BEPC Infrastructure overview



HELIAL LF in operation  
since 2015 for ADS



2 x 500W@4.5K refrigerator in  
operation since 2005



# IHEP Cryogenic BEPCII Infrastructure overview

## BEPC II-U is a system upgrade project.



The Chinese Academy of Science (CAS) has upgraded the Beijing Electron-Positron Collider II-Upgrade (BEPC II-U). The original helium refrigeration plant with 500W@4.5K was dismantled (WCS, CB, Dewar, Analyzer...) and then upgraded to 1kW@4.5K.

## Automated, highly stable and reliable systems are essential for customer.



CAS has a clear failure rate consideration index for the operation and maintenance of BEPC II-U with a cryogenic system **failure rate of <2% during 7000 hours of annual high-power operation.**





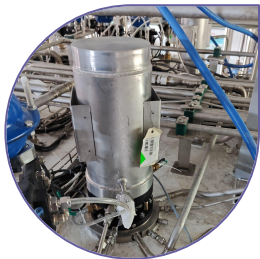
# Helium Refrigerator

## Description and Timeline

*1kW @ 4.5K to cool-down the upgraded IHEP II-U superconducting cavity to accelerate electrons.*



# Helium Refrigerator overview



**2 expanders  
manufactured by  
ALAT are based on  
the static gas bearing  
technologies**

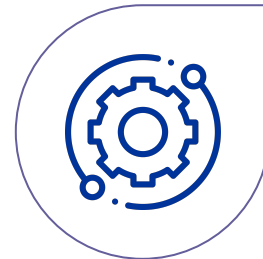
**1000W  
@4.5K  
or 280L/h**

**Refrigeration Mode or  
Liquefaction Mode  
can be switched**



**Adjustable cooling  
capacity with VFD  
compressor and  
adjustable turbine  
speed.**

**4.5~80K cold energy  
can be recovered by  
CB.**

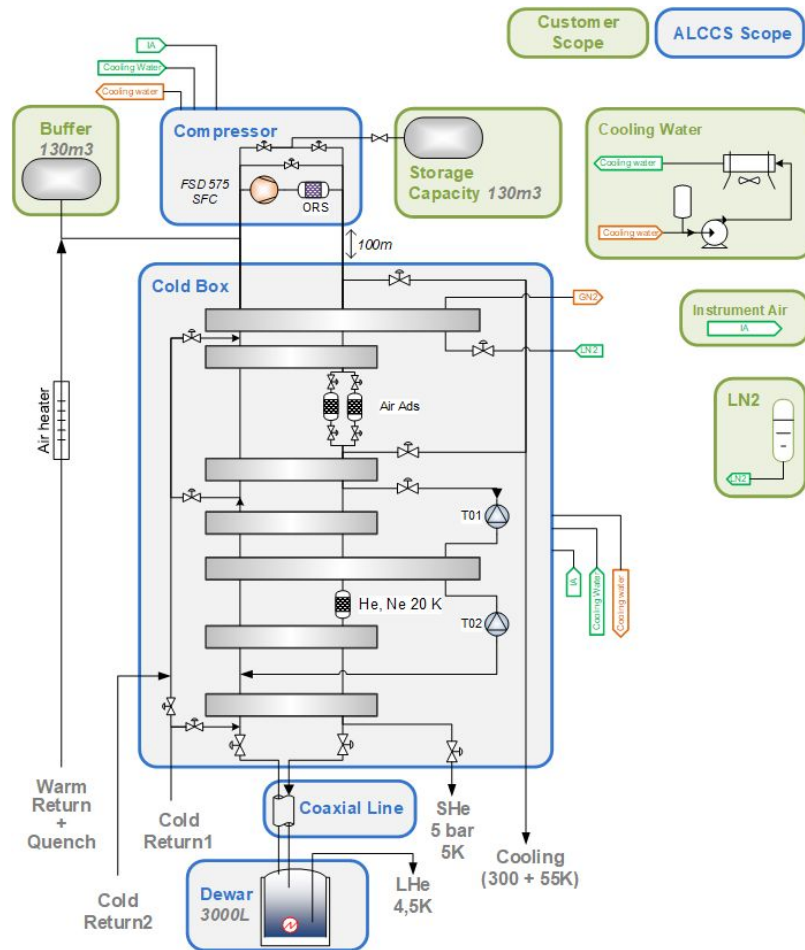


**Safety-assessed design.**

**Automated start-up,  
cool-down, warm up,  
regeneration, alarms  
and trips.**

# Helium Refrigerator Description

- KAESER compressor FSD 575
- 1kW@4.5K Standard cold box
  - Twin Air adsorber (push-pull)
  - Single H<sub>2</sub>/Ne adsorber
  - 2 vertical expanders (Static gas bearing)
  - SHe & LHe delivery
- Wessington Dewar 3000L



# Helium Refrigerator Description

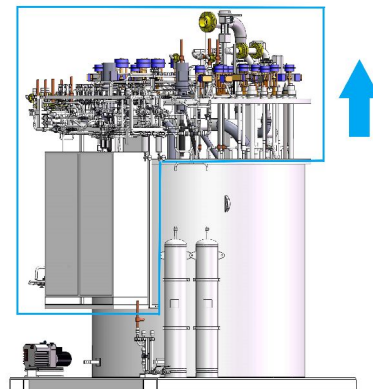
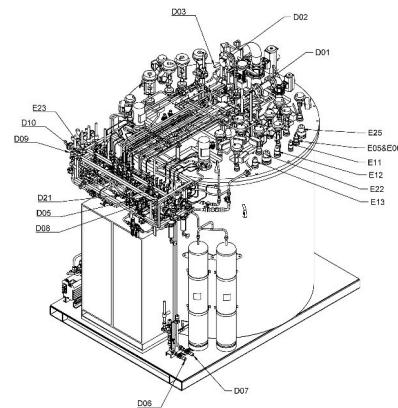
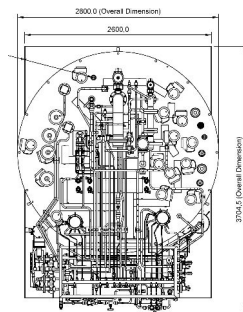
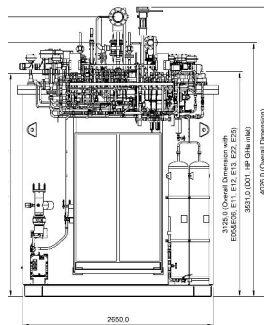
1kW@4.5K Cold Box

CB internal

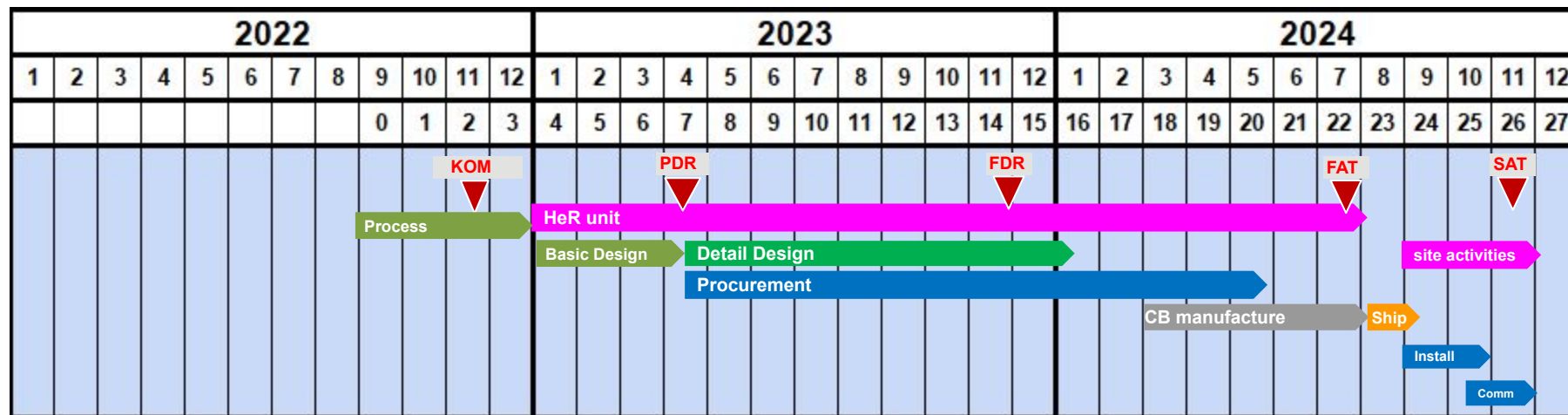
Warm panel

Electrical cabinet

Can be lifted together directly  
during maintenance



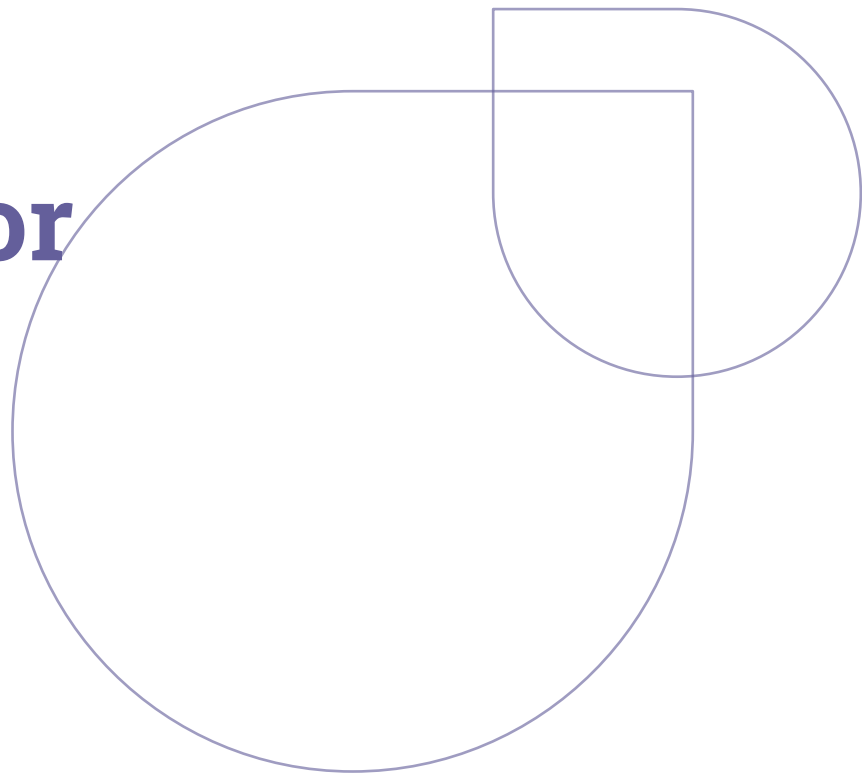
## Timeline





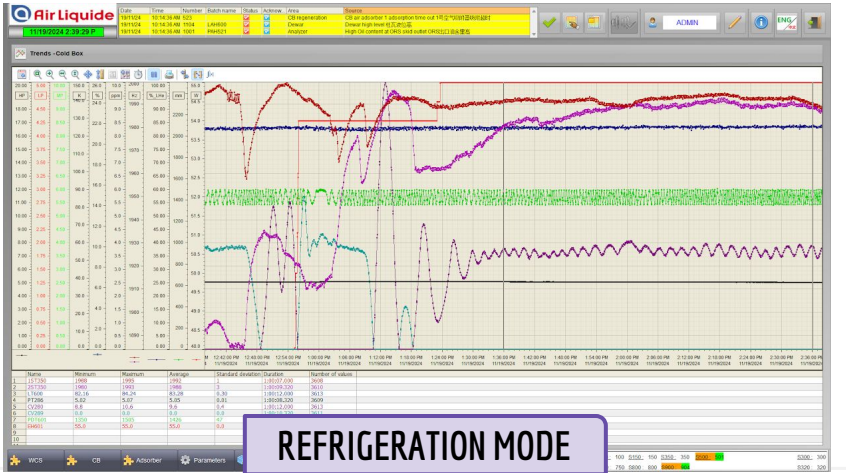
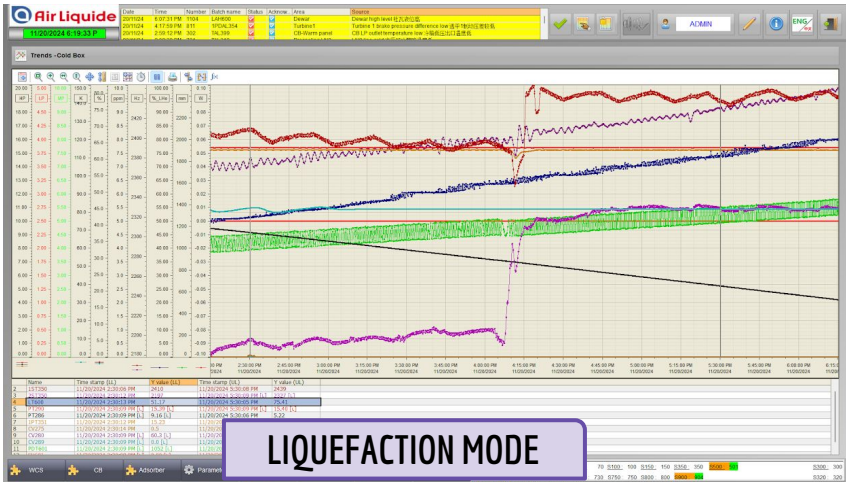
# Helium Refrigerator

## Measured Performances



# Helium Refrigerator performance

Tested Mode	Performance Guaranteed	Results	Balance
Liquefaction Mode	$\geq 280 \text{ l/h @ } 4.5\text{K}$	283 L/h	101%
Refrigeration Mode	$\geq 1000 \text{ W @ } 4.5\text{K}$	1011 W	101%



# Conclusions

- The new Helium Refrigerator for IHEP was successfully designed and manufactured by ALCCS in China based on ALAT gas bearing expanders.
- The System was installed and start-up in the IHEP BEPCII cryogenic infrastructure by the ALCCS team with the support of ALAT.
- The expected performances were reached within the schedule timeline.

***Many Thanks for IHEP, ALCCS and ALAT teams for this collaborative success***



# Q&A

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# Thank you