First Cool-down of Cryogenic System for ADS Injector Ⅰ in CHINA

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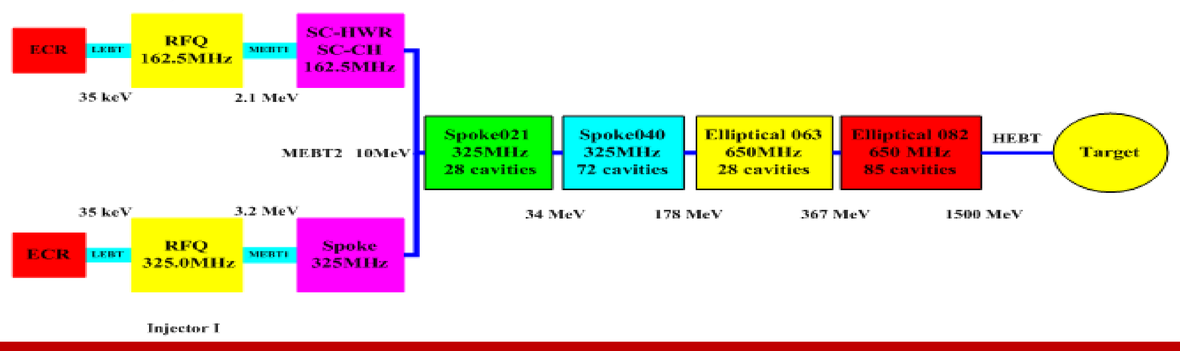
Background

Accelerator driven sub-critical system（ADS）in China is a kind of transmutation machine to minimize the nuclear wastes. The roadmap of the project is shown in Fig.1.

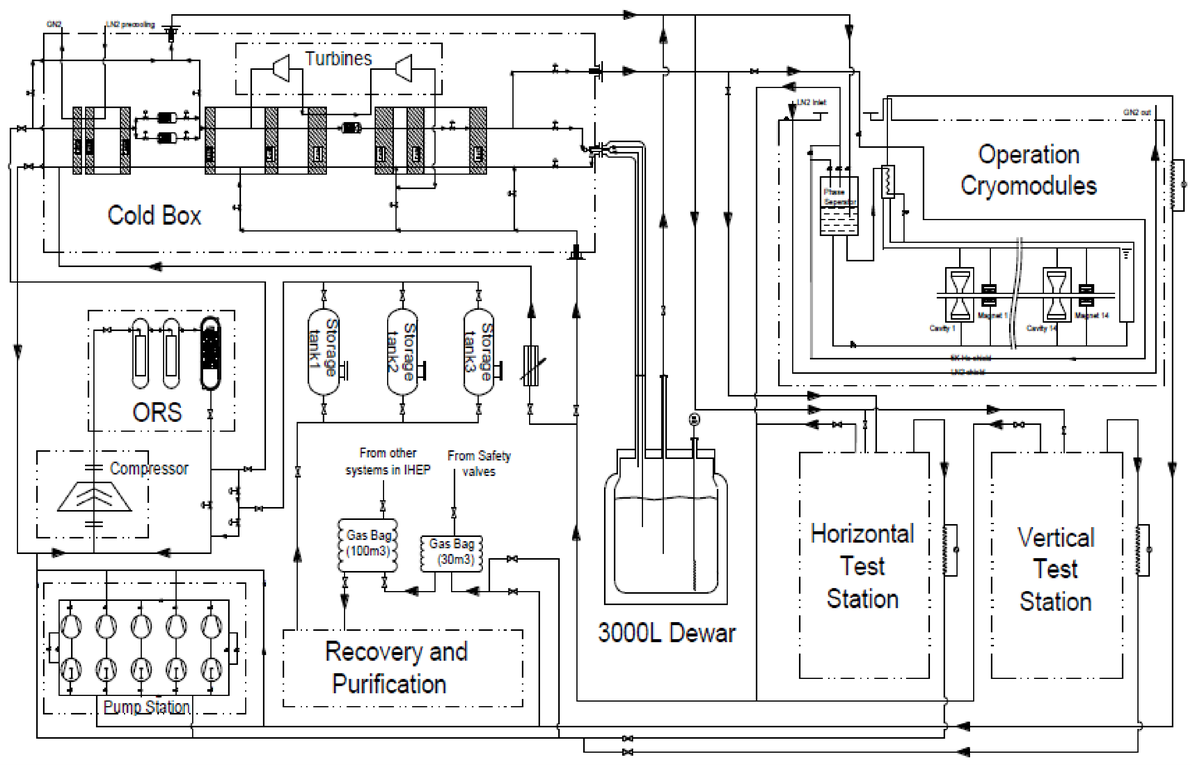
As one of the important parts in ADS injector Ⅰ which is been built in IHEP, CAS, it needs two cryomodules operate at 2K cryogenic environment to realize 10MeV proton beam energy. Each cryomodule includes seven Spoke-012 cavities and seven solenoids.



Overall Design of Cryogenic system

Cryogenic system of ADS injector I mainly includes: the refrigerator, distribution boxes, transfer lines,cryomodules, 2K pumping system , recovery &purification system.

- **Three modes of the cold box**: refrigeration mode, liquefaction mode and mixed mode;
- **Refrigerator capacity**: 1000W @ 4.5K at refrigeration mode and 284L/h at liquefaction mode with LN2 precooling ;
- **Three outputs**: 300K&40K mixture output, supercritical helium output and two-phase helium output;
- **Capacity of the 2K pumping system**: 8000m3/h@31mbar;
- **Recovery and purification system**： purification pressure 20MPa and purification flow rate 105Nm3/h;
- **The purity of helium after purification**: 99.999%



Cryomodule

Three stages of Cryomodule type：

First stage—TCM (Test Cryomoudle)**—TEST**

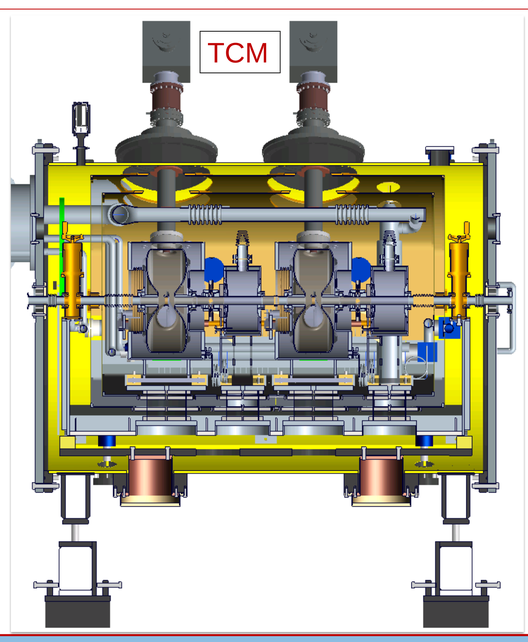
2 cavities, 2 solenoids, 2 BPM Φ1400 L=2115

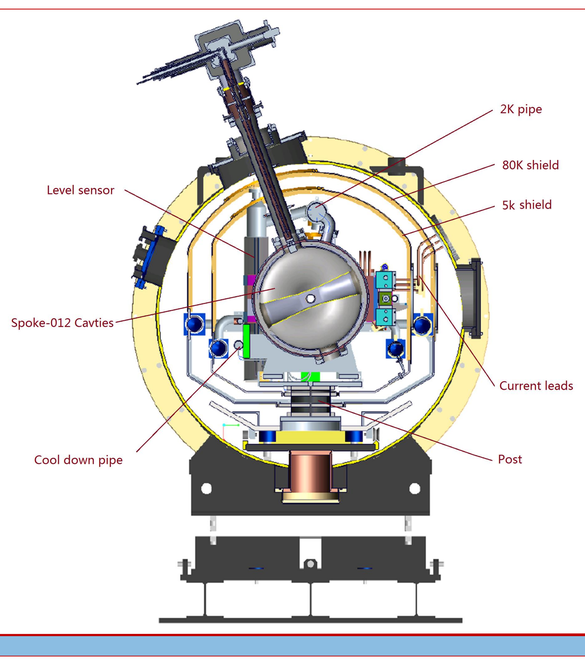
Second stage—CM-01 (Cryomoudle-01) **—5MeV**

7 cavities ,7 solenoids, 7 BPM Φ1400 L=5485

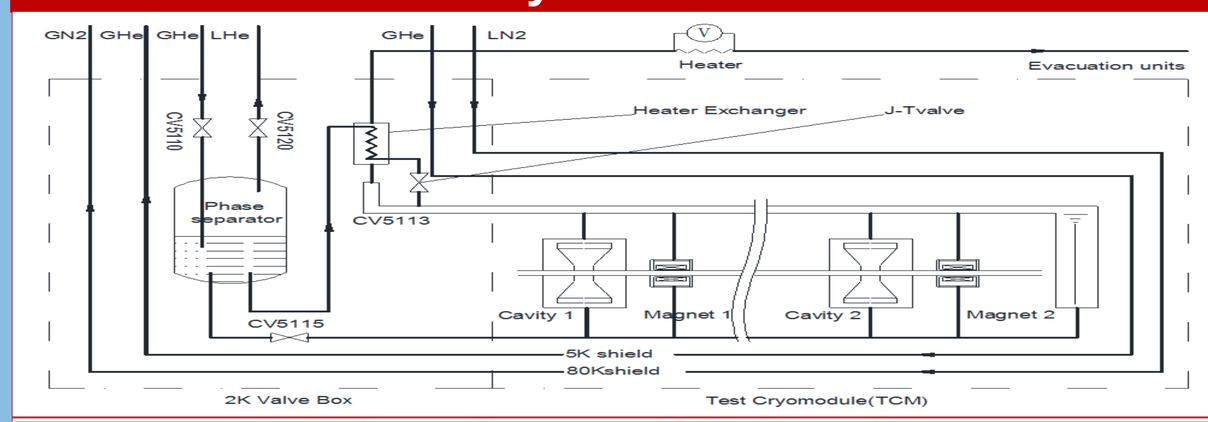
Third stage—CM-01+CM-02 (Cryomoudle-01+02) **—10MeV**

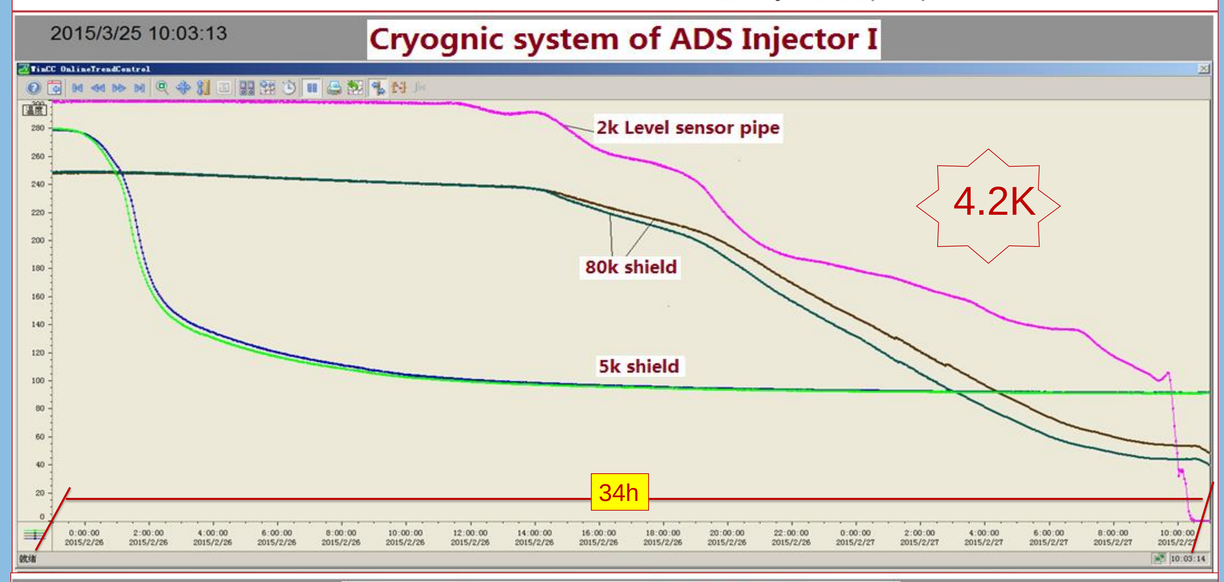
14 cavities ,14 solenoids, 14 BPM Φ1400 L=10773

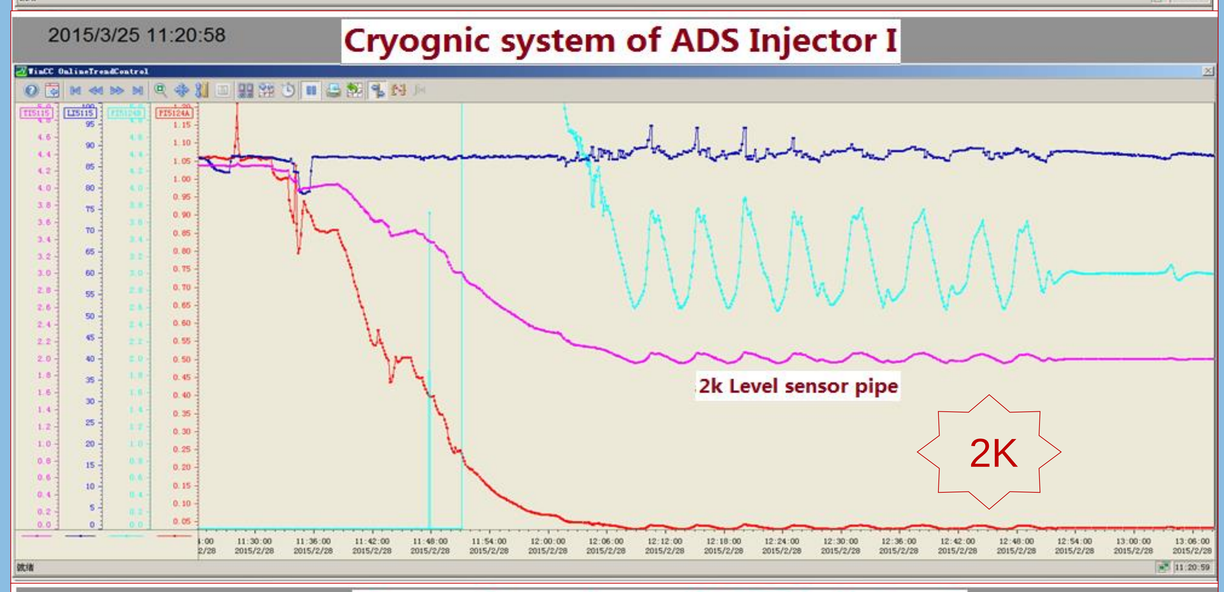


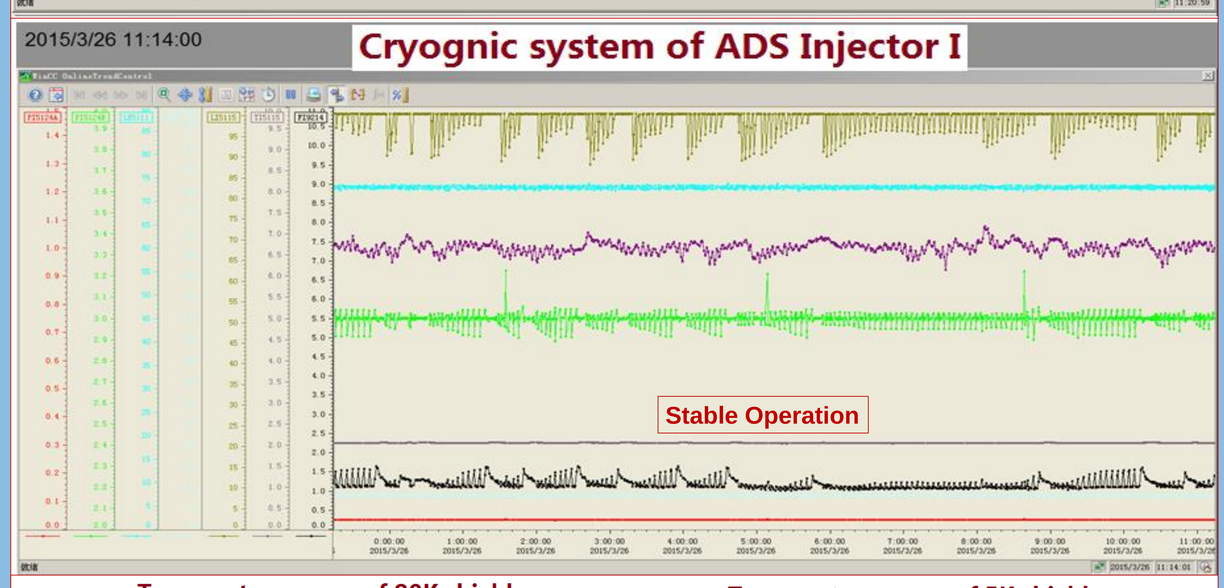


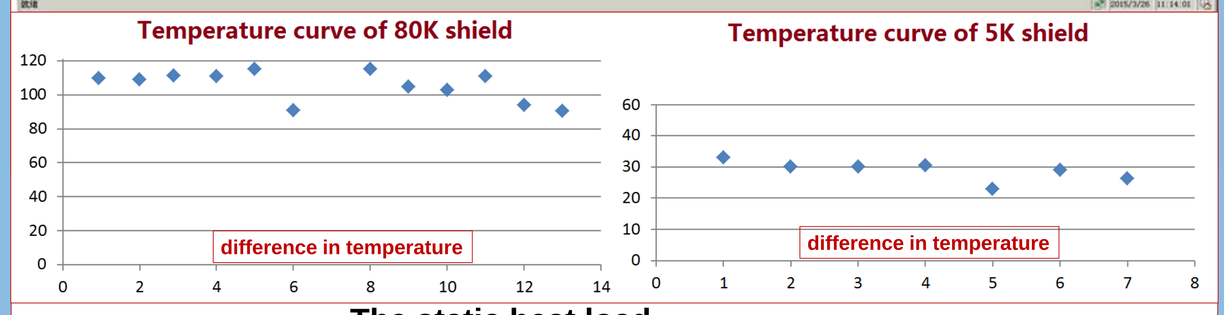
Cool-down of Test cryomodule and 2K Valve Box











The static heat load

TCM (Test Cryomoudle) @ 4.5K

Q1=0.59 g/s×20.4 J/g =12.036W

TCM +2K valve box @4.5K

Q2=1.07 g/s ×20.4 J/g =21.828W

TCM (Test Cryomoudle) @ 2K

Q3=0.697 g/s ×23 J/g =16.000W