KAGRA Cryogenics

Cryostat, 4K Cryocooler Unit, Shield Duct and Cryopayload

2012.02.03

f2f meeting
**Status of KAGRA Cryogenics**

**Cryostat**
- 4 Cryochambers with shields
  - Contract with Toshiba in 2011fy.
  - Preparation of bidding in 2012fy.
- Mechanical analysis done.
- Thermal analysis done.
- Machining components in progress.

**4K Cryocooler Unit**
- 7 units in 2011fy and 9 units in 2012fy.
  - Contract with Jecc Torisha in 2011fy.
  - Preparation of bidding in 2012fy.
  - Prototype test finished.
  - Design for production done.
  - Assembling in progress.

**Shield Duct**
- Two ducts on both sides of each cryostat
  - Basic studies for thermal radiation protection.
  - Designing thermal radiation baffle configuration.
  - Prototype design in progress.
  - Completion will depend on a success of Budgetary request.

**Cryopayload**
- Test mass suspension and cryogenic part of the vibration isolation system
- K. Yamamoto will present details.
  - Preparatory works for test equipment.
  - Design in progress.
cryochamber
φ2600
H4300

Toshiba

4K Cryooler unit J Torisha

Shield duct v.0
o.d. φ1000/800 L17m

Mozumi Y-end

Atotsu Center

Sakonishi X-end
• Four 4K cryocooler units.
• Two way 8K cooling path.
  2 of 5N8 Al bars -> inner shield
  other 2 -> cryopayload
• φ2400 top flange.
• φ900 connection flange to SAS-A.
• φ2200 service port flange on the sides.
• φ800 small service port on the side cap.

• Double layer radiation shield.
  outer 80K, inner 8K
• φ500 aperture on outer and φ250 aperture on inner for main beam.
• Al alloy frames, Al walls and 5N8 Al cooling path.
• View ports with shutter
• Hinged doors on radiation shields
Cryostat (Cryochamber)
Cryostat (Radiation shield)

- Size of inner shield: D1020xW1620xH1720
- M8 tap with 200 pitch on the top plate.
- φ10 holes with pitch 50 on the frame.
- Four horizontal support rods on the top of each shield.

Toshiba
Cryostat  Bottom plate  SUS 304 t70

Daiwa Shearing  Kasuga Factory

Toshiba  Keihin Factory
Cryostat  Service port flange, side cap and tube

Shimoda Flange Aioi Factory

Flange  φ2200

Side cap  φ1970

Toshiba Keihin Factory

Tube  φ1970
Cryostat components

Ribs inside cryostat

Pipes

Connection port to cryocooler unit

Welding on the connection port

Toshiba Keihin Factory
4K Cryocooler unit

Cooling power on the connection.
  8K path: 2.5W or more at 9K
  80K path: 35W or more at 70K

Vibration amplitude at the connection.
  8K path: 100nm or less
  80K path: 100nm or less
4K Cryocooler unit
Prototype test

- Performance test
  - Load map
  - Vibration measurement

Prototype

Real machine

- Thicker 80K conductor.
- Fix connection hoses.
- Thicker upper plate.
- Increase number of bolt for conductor connection.
- Shorter conduction paths.
- Strengthen support posts.
4K Cryocooler unit
Assembling in Jecc Torisha Kawagoe factory

Work progress in clean room with JIS class 7 (US class 10000)
4K Cryocooler unit
Assembling in Jecc Torisha Kawagoe factory

80K thermal conductor

8K thermal conductor

Vespel support rod
• Length : 17m
• Vacuum duct : o.d. φ1000 / φ800.
• Baffles with gradually narrowing aperture stop 300K radiation and enable to introduce an optical lever from the 300K arm.
• Cooled by three PTC (150W at 80K, single stage)
Y. Saito 2012.01.23

Installation scenario

Apr. 2014 Carry in chambers from Atotsu entrance
Transport 2 cryostats to both ends
Synchronize to 300K chambers and ducts.

Jul 2014 to Mar 2015

Y. Saito 2012.01.23

carrying tubes from ATOTSU pithead
Schedule

2011fy  Cryostat : Purchase and machining of components.  
Assembling 4K Cryocooler unit (7)  
Performance test of Cryocooler units.

2012fy  Assembling Cryostat (4) and 4K Cryocooler unit (9)  
Performance test of Cryostats and Cryocooler units.  
Design and trial manufacture a prototype shield duct.

2013fy  Storage Cryostats and 4K cryocooler units.  
Manufacture outer tube of shield ducts.  
(Manufacture cryogenic components if additional budget will be approved.)

2014fy  Start carry in and installation.  
Two Cryostats install to the center room.  
Other two install to each end.