Issues and mitigation methods with FPC during 1.3GHz Cryomodule assembly

Wei Chen, Yonghu Yun

Institute of Advanced Light Source Facilities, Shenzhen

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Outline

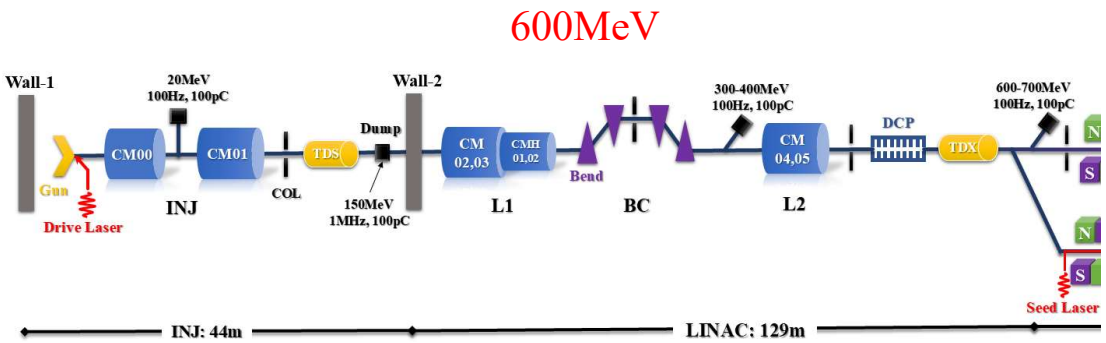
深圳先进光源研究院
Institute of Advanced Light Source Facilities, Shenzhen

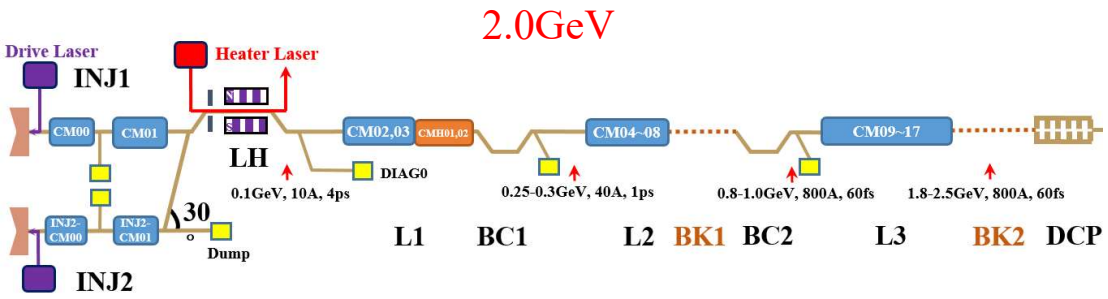
TESLA TECHNOLOGY TTC COLLABORATION

Background

S^{3}FEL: Shenzhen Superconducting Soft x-ray Free Electron Laser

Construction unit: Institute of Advanced Light Source Facilities, Shenzhen (IASF)





	Prototype	600MeV	2.0GeV	Total
1.3GHz 1×9cell CM	/	1	2	3
1.3 GHz 8×9cell CM	1	5	18	24
3.9 GHz 8×9cell CM	1	2	2	5
Total	2	8	22	32

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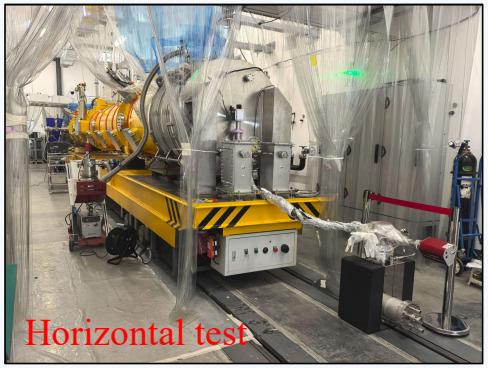
Cavity String


Cold mass insertion


1.3GHz Fundamental Power Coupler


Final assembly


Horizontal test

1.3GHz Prototype Cryomodule Assembly

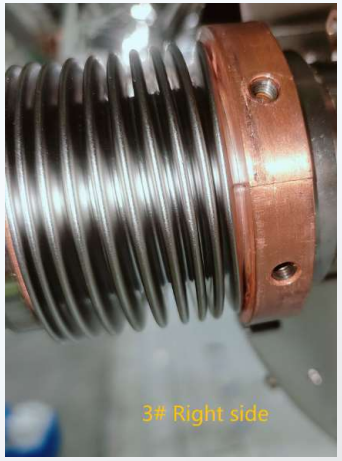
AIR
中国科学院空天信息创新研究院
Aerospace Information Research Institute, Chinese Academy of Sciences

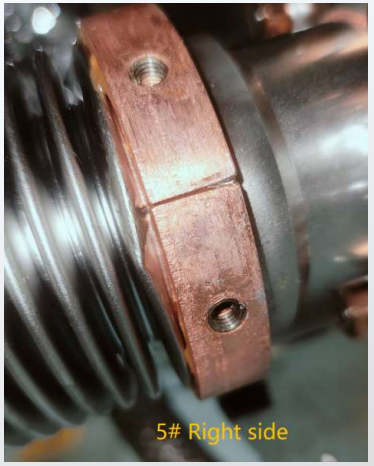
Anhui East China Opto electronic Technology Research Institute

Two FPC Suppliers

IASF

Cold end coupler bellows deformation and its mitigation methods





1. Change the connection way between copper briad and 5K thermal shield
2. Severe deformation on cold end coupler bellows were found, especially on FPC 2#, 3#, 5#
3. The 5K thermal shields were torqued to 7.4N·m, no experiments before assembly.

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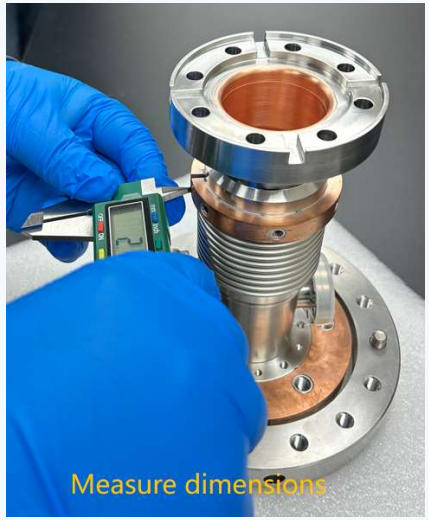
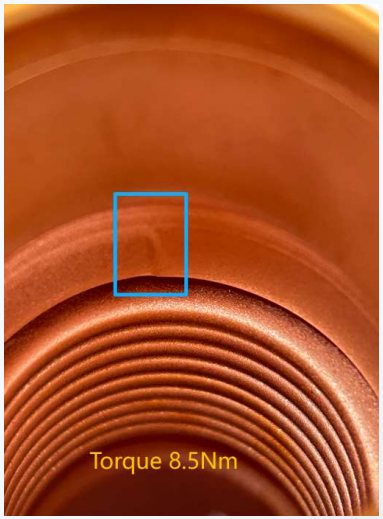
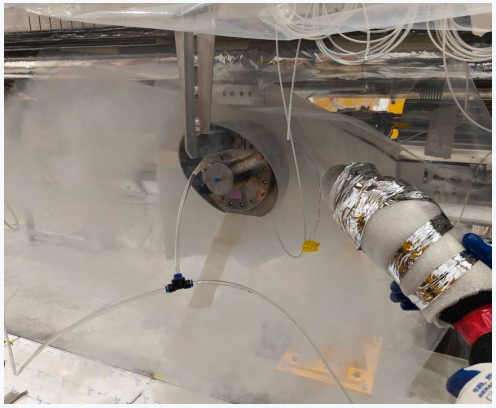
Cold end coupler bellows deformation and its mitigation methods



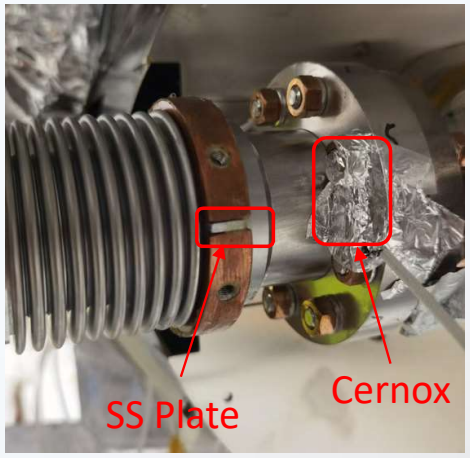


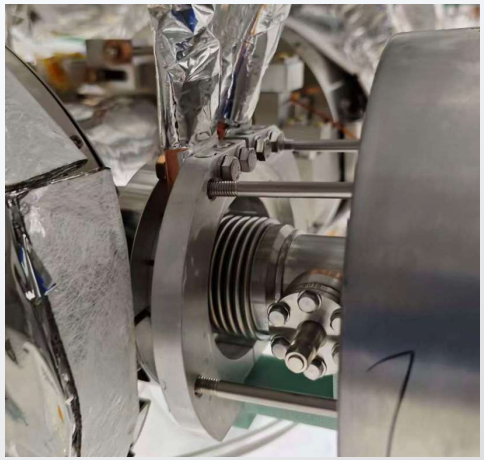
4. Carry torque application test on a new AIR cold end coupler bellow, torque ranges from 2.5N·m to 10N·m, no severe deformation occurred.
5. The space of 5K thermal shield pins changes significantly from torque 5.5N·m. Even there is no severe deformation, obvious protrusion appears on the inner bellows due to the squeezing effect of 8.5N·m.

Cold end coupler bellows deformation and its mitigation methods




6. Three cycles from room temperature to liquid nitrogrn to those deformations, movable cleanroom was built, beamline connected to SVSP with Particle-free procedures.
7. Pumped down the beamline vacuum, and leak check those deformations, no leak was found.
8. Reassemble all the 5K thermal shields with 6N·m, and insert a SS filler plate to the gap between the half rings.
9. At last install the copper briads.





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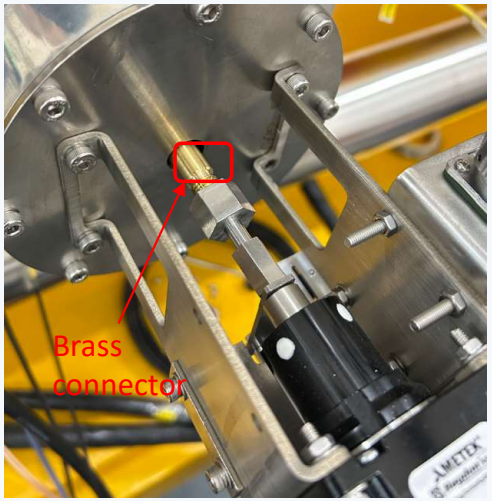
Cold end coupler bellows deformation and its mitigation methods

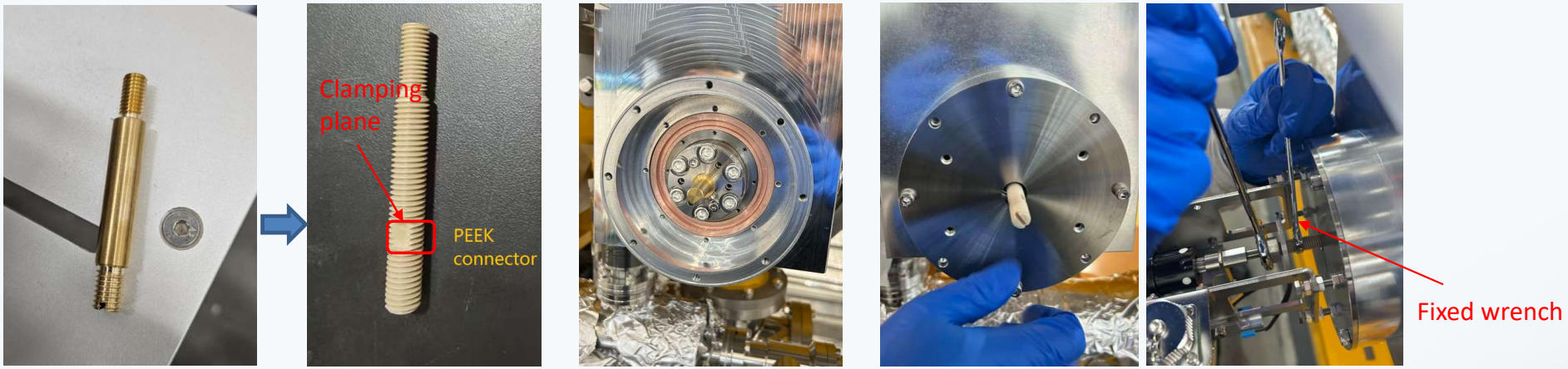
10. All FPCs operated at 5 kW for 24 hours continuously, and temperatures at the 2K flanges remained below 9K.
11. Indicates the torque of 6N.m to 5K thermal shields is effective.

Damage to tuning rod bellows and its solution



1. Before coupler drive motors installation, warm coupler vacuum was OK and the ion pump was on.
2. After motors connected to brass connectors, we found the ion pump stopped automatically, and the vacuum pressure rised sharply to 10^4Pa.
3. At last, 7 out of 8 tuning rod bellows were found damaged, indicating a high failure rate likely due to brass connector rotating during the motors installation.

Damage to tuning rod bellows and its solution



4. Change the connector material from brass to PEEK, and machining two parallel planes on the PEEK connector.
5. Hand tighten PEEK connector to the tuning rod.
6. Use a wrench to hold the PEEK connector, and another wrench to rotate the end nut of motor. Be careful not to rotate the PEEK connector.
7. Well done! No damage again!

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深圳先进光源研究院
Institute of Advanced Light Source Facilities, Shenzhen

深圳市光明区新湖街道
荔湖西路618号

No. 618, Lihu West Road, Guangming District,
Shenzhen, Guangdong, P.R.China