Synchrotron SOLEIL superconducting RF status

SOLEIL cryomodule status
Cryogenic plant

C.THOMAS-MADEC
ESLS 7th - 16/10/2003
Design:

- 600 kW total power transferred to the beam (4 cavities)
- Cell interconnecting tube diameter (400 mm) increased compared to Cu cavities ⇒ propagation of the HOM modes, HOM power extracted
- HOM damping with loop type HOM couplers optimized for HOM extraction and fundamental mode rejection
- No need for ferrite absorbers in the beam tube ⇒ possible vacuum contamination avoided
Design cont’d:
For HOM frequency higher than the cutoff frequency of D 400 mm tube damping in Glidcop tapers
First application of CERN technology of Nb plated Cu to a cavity with high beam loading

Open structure ⇒ efficient pumping through the end sections
4 K results at ESRF

- Passive operation with a 200 mA beam: No HOM driven instability ⇒ HOM power effectively absorbed in the dampers
- RF voltage conditioning:
  - 5 MV achieved with short RF pulses
  - 4 MV achieved in CW, with some problems:
    - High fundamental power coupling probably due to dipolar HOM couplers close to accelerating cells and notch filters not correctly tuned on fundamental frequency
    - Overheating and some quench-like events with pressure bursts in LHe circuit, HOM couplers not sufficiently cooled by LHe
4 K results at ESRF cont’d

- Cryogenic losses 140/117 W (total/static) / the calculated losses : 100/40W

- At high gradient, some multipacting observed in the main RF couplers, eventually leading to some vacuum trips

- Acceleration of 150 mA of beam and 30 hours lifetime with 3 MV from SC SOLEIL cavity and 360 kW of beam power achieved

- Successful run test at 170 mA => 380 kW beam power : no thermal run-away, stable behavior, no beam loss

- **300 K results**: SC cavity transparent to the beam
Cryomodule refurbishment

- Reduce static losses: add a copper shield cooled by liquid N\textsubscript{2} and thermal straps anchored on cold shield to draw heat from HOM couplers, tuning system, coaxial lines, etc...

- Improve the dipole HOM couplers tuning of notch filter: single wave bellow for better fundamental mode rejection and machining

- Improve HOM coupler cooling: by feeding LHe from bottom of the cryomodule and thermal straps

- HFSS calculation for the need of 4 HOM couplers: no need
Refurbishment cont’d
Refurbishment cont’d

- Replace instrumentation: radiation-proof cables and sensors with a wider temperature range to follow up cool-downs
- Modify LHe circuitry to accommodate N₂ screen and HOM LHe feeding
- Mechanical studies of the cryomodule finished
- SOLEIL beam specs revised (500mA, 2.75GeV, 1150keV radiation losses) and installation of the 2nd cryomodule ⇒ only 3 MV/cryomodule

Lengthen main coupler antenna to increase coupling:
- \( Q_{\text{ext}} \): \( 2.10^5 \rightarrow 1.10^5 \) (for better matching)
- Calculation: 10 mm
- Measurements: 9.8 mm
Milestones

- Modifications planned partly at CEA, partly at CERN (clean room and power test-stand)
- Collaboration agreement SOLEIL - CEA, SOLEIL – CERN should be signed within the next weeks
- Time schedule:
  - July 2003: Cryomodule moved from ESRF to CERN
  - December 2003: Disassembly of Cryomodule at CERN
  - Other steps: Rinsing and vertical RF test of the cavities
  - April 2004: Delivery of the two first HOM couplers
  - November – December 2004: Power and cryogenic tests at CERN
  - Beginning 2005: Start commissioning of the cryomodule on SOLEIL ring
Milestones

• Cryogenic source: call for tender will be issued in October 2003, commissioning with cryomodule beginning 2005

• Fabrication of a 2nd Module based on improved specs including modifications listed above
  - Early 2004: Placing orders
  - Year 2006: Installation on SOLEIL in order to reach full performance