FABRICATION, TEST AND FIRST OPERATION OF SUPERCONDUCTING ACCELERATOR MODULES FOR STORAGE RINGS

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Abstract

The production of 6 superconducting 500 MHz modules for Cornell University, the Taiwan Light Source and the Canadian Light Source is almost finished. We summarize the vertical cavity test results and report on cold module tests. Operational experience with the delivered modules is also presented. Furthermore a 1.5 GHz superconducting Landau module is under production at ACCEL. The status of this project will be discussed

1 INTRODUCTION

ACCEL is currently producing superconducting 500 MHz modules for Cornell University [1], the Taiwan Light Source SRRC [2] and the Canadian Light Source CLS [3]. The design of that module was developed at Cornell. The possibility to accelerate high current at high gradients together with a very effective damping scheme of the higher order modes makes them attractive for all kind of high current storage ring applications [4].

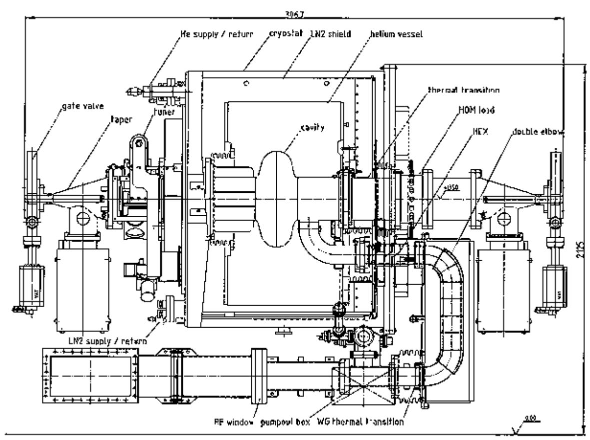

Figure 1: Schematic view of the superconducting module

ACCEL also supplies the SRF Electronics and the cryogenic distribution boxes to SRRC and to CLS.

Figure 2: First superconducting accelerator module for the Taiwan Light Source with valve box (left) and SRF electronics (right)

2 STATUS OF PRODUCTION

- All single components are produced
- All cavities passed successfully the vertical test.
- All RF windows have been successfully tested.
- One module for Cornell University has been successfully tested with high power RF and is operating in the synchrotron CESR successfully for more than 8 months. The second module for Cornell University is delivered and will be tested with high power RF within the next month.
- One module for Taiwan Light Source has been tested at Cornell University with high power RF. The gradients reached during this test exceeded the design specifications by more than a factor of two. However it was discovered, that this module can not be operated with sufficient high power, because it has the wrong external Q factor of the input coupler. We are currently investigating the source for the wrong external Q.
- One module for the Canadian Light Source was recently delivered and is currently under test at the CLS.
- The electronics for all the 6 modules are finished.
- The valve boxes for the Taiwan Light Source and the Canadian Light Source are delivered.

Figure 3: Assembly area of the SRF modules at ACCEL. In the upper right part the clean room class 100 can be seen where the modules need to be assembled in whenever the cavity vacuum is touched.

3 CAVITY TESTS

The infrastructure at ACCEL allows state of the art cavity preparation. A closed loop chemistry plant (BCP 1:1:2) and a high pressure water rinsing system is available and shown in Fig. 4.

Figure 4: Preparation of a 500 MHz cavity for a vertical test at ACCEL. Up left: closed loop BCP, up right: high pressure rinsing, below: clean room assembly

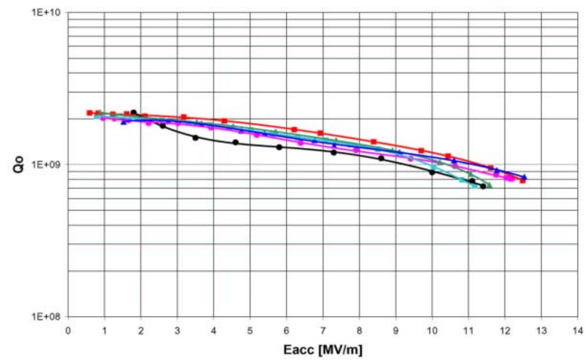

Figure 5: Cavity test results

Figure 5 shows the test results of the six cavities produced for Cornell, SRRC and CLS. All Cavities reached more than 11 MV/m. The highest field observed was 12.6 MV/m. All cavities were limited by available RF power (200 W). No quenches were observed. It is remarkable that the results were achieved consecutive without a unsatisfactory result in between. This indicates a very reliable cavity preparation.

4 MODULE SHIPMENT

For the transportation of the modules from ACCEL to our customers overseas a special shipping frame was designed. It protects the modules from shocks and vibrations during transportation by air and truck. Additionally all transports are controlled by shock detectors attached to the module.

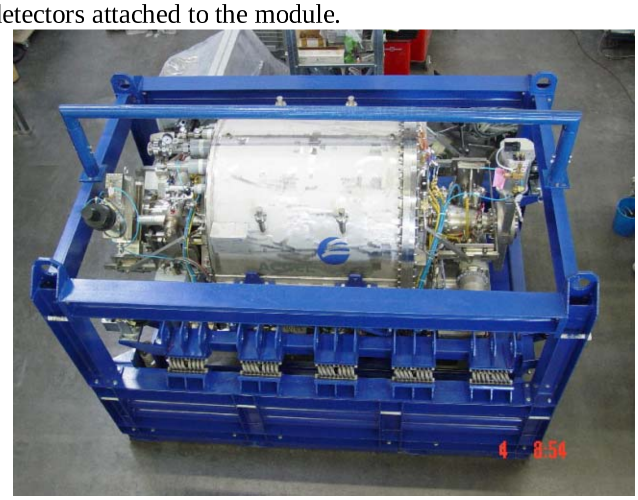

Figure 6: Completed module installed into shipping frame.

5 MODULE TEST AND OPERATIONAL EXPERIENCE

The first delivered module for Cornell University was tested at Cornell University with high power RF in a dedicated test area before installation into the storage ring. After movement to the processing area the module was cooled down and the RF power was increased continuously. By measuring the cryogenic losses of the module, the quality factor could be calculated for different field levels. The test result is summarized in figure 7 and compared to the vertical test result of the cavity. A field of 9 MV/m was measured with a Q above 1E9. In pulsed mode fields up to 13.3 MV/m were measured.

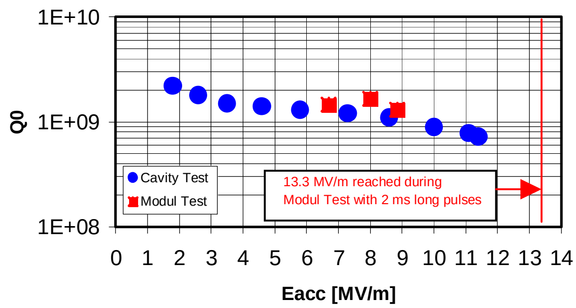

Figure 7: Test result of Cornell module #1

The module performance was comparable with the vertical test result. Due to safety reasons, the fields were limited to below 9 MV/m in cw operation with high power RF. After high power RF test the module was installed into the storage ring and is working there for more than 8 months now without any problems.

6 SUPERCONDUCTING LANDAU ACCELERATOR MODULE

ACCEL currently fabricates a superconducting 3rd harmonic accelerator module for BESSY II [5]. The cavity design is based on a scaled CESR Phase- II cavity operating at 1.5 GHZ.

Figure 8: Landau Cavity in handling frame

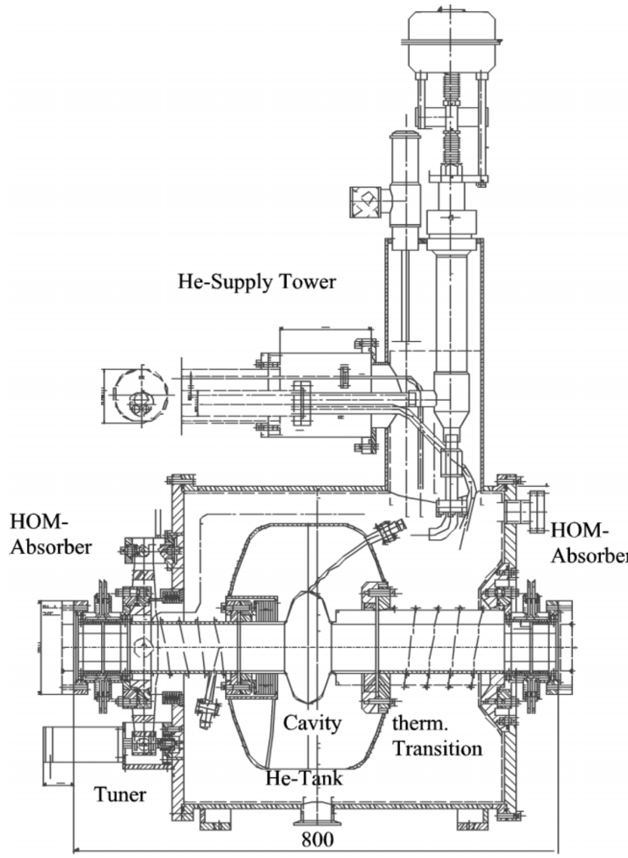

Figure 9: Layout of the Landau Module

The cavity provides strong damping of higher-order modes by ferrite loads on the beam tubes. A new module, constrained to fit into a very limited space at BESSY, was designed.

Meanwhile the fabrication of all major subcomponents is finished. The reworked cavity (s. fig. 8) was submitted to a cold test at DESY reaching 7 MV/m limited by rf power.

REFERENCES

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