SRF TECHNOLOGY AT ACCEL FOR WORLDWIDE ACCELERATOR PROJECTS

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Abstract

Within the last two years activities at ACCEL for international accelerator projects using superconducting cavities have steadily increased. We report on our production work for CERN (HOM couplers for LHC cavities), DESY (TESLA cavities and couplers), Forschungszentrum Jülich (turn key low beta SRF module), SRRC, CLS and Cornell (turn key 500 MHz SRF modules. The production a superconducting Landau accelerator module for BESSY has started recently. In addition studies are under way for a superconducting 40 MeV proton/deuteron linac and for superconducting low beta multi gap structures.

1 CAVITY AND ACCELERATOR MODULE FABRICATION

1.1 Superconducting Cavities for the TESLA Test Facility

A series of 24 TESLA type cavities (1.3 GHz, 9 cell cavities) has been fabricated and delivered by ACCEL. The test results after chemical preparation and high pressure water rinsing at DESY achieve or even exceed the target values. All cavities showed an E_{acc} > 25 MV/m with a quality factor above $5*10^9$.

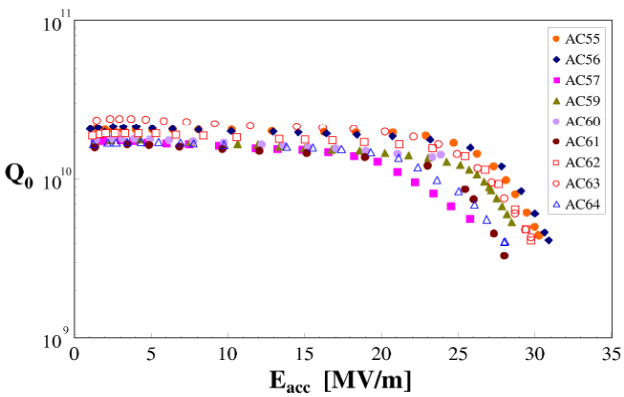

Figure 1: Performance of TESLA cavities delivered by ACCEL

1.2 Superconducting Cavities for the Spallation Neutron Source

In August 2001 ACCEL was awarded with the contract for manufacturing all cavities for the superconducting part of the SNS project. The contract covers the production of 35 medium beta cavities (β=0.61) and 75 high beta cavities (β=0.75) with a frequency of 700 MHz. The production scope includes the rf tuning as well as the internal and external chemical preparation (removal of surface damage layer). Prototypes of the cavities have been manufactured by Jefferson Laboratory and shown performance well above the design values. The specified values are shown in table 1.

Figure 2: Prototype of medium beta cavity for SNS produced by JLAB (courtesy Jefferson Laboratory)

Table 1: Design Values SNS Cavities

Cavity β	E_{acc}(@ 2.1K)	Q_0
0.61	10.1 MV/m	$5*10^9$
0.75	12.5 MV/m	$5*10^9$

1.3 Superconducting Modules for Storage Rings

Up to now six cavities of the Cornell design have been produced by ACCEL. First cryogenic rf tests of the cavities have been completed.

Figure 3: Cornell type cavities fabricated by ACCEL

Meanwhile ACCEL was awarded with contracts for building six turn key 500 MHz SRF modules for SRRC (Taiwan Light Source), CESR (Cornell University) and

CLS (Canadian Light Source). The last cavity test results show a performance above the target values for the all of these projects [1].

1.4 Medium Beta Superconducting Accelerator Module for the ESS Project

Within the R&D effort for the European Spallation Neutron Source (ESS) Forschungszentrum Jülich has received an accelerator module with a reduced beta (β=0.75) five cell cavity (500 MHz) [2]. The Q versus E_{acc} is shown in fig. The performance of the accelerator module has been widely improved recently. The maximum E_{acc} increased up to 12 MV/m after rf processing.

Figure 4: Superconducting Accelerator Test Module for ESS

1.5 Landau Accelerator Module for BESSY II

ACCEL recently started the fabrication of a Landau accelerator module for BESSY II. The module will be used at BESSY to increase the bunch length. This shall effect an improvement of the beam lifetime by lowering the intra beam scattering (Touschek effect). The module is operating at 1.5 GHz, which is the 3rd harmonic of the storage ring fundamental frequency. The total length of the module is 80 cm (flange to flange) due to very rigid space limitations in the BESSY II straight section.

1.6 HOM and RF Power Coupler for Superconducting Cavities

After having delivered all cavities for LHC we also provided the necessary 90 HOM couplers. The manufacturing includes special technologies as brazing of Niobium to stainless steel and EB welding. For the 500 MHz cavities for the storage ring we provide also high power couplers. Power tests of two such windows were done recently. The results are 220 kW cw and 400 kW (30% duty cycle), both in travelling wave mode and 64 kW and 100 kW (15% duty cycle) in full reflection mode at all phases.

2 DESIGN STUDIES

2.1 A Superconducting 40 MeV Proton/Deuteron Linac

ACCEL is currently working on a design study for a superconducting Proton/Deuteron linac, which is based on the concept of an independently phased cavity linac. The linac consists of an ECR ion source followed by a normal conducting RFQ, which injects into the superconducting cavity section. The transition energy between RFQ and superconducting cavities will be between 1.5-2 MeV/u. The superconducting section will be built up by fourteen cryomodules each containing four cavities. For the low energy part 176 MHz $\lambda/2$ coaxial cavities are foreseen. For energies above 20 MeV 352 MHz $\lambda/2$ coaxial cavities or spoke type cavities will be used.

2.2 Superconducting CH Mode Cavities

For future applications like spallation neutron sources or accelerator driven transmutation efficient accelerator cavities for energies below 150 MeV/u are desirable. An alternative to normal conducting cavities are superconducting CH mode cavities [3], which are designed by the group of Prof. Ratzinger at the University of Frankfurt. ACCEL investigates the manufacturing technologies for a cost efficient fabrication of this cavity type.

3 REFERENCES

[1] S. Bauer et al., ”Latest Results from the Production of 500 MHz SRF Modules for Light Sources and CESR Upgrade”, this conference

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[3] R. Eichhorn, U. Ratzinger, “Superconducting H-mode structures for Medium Energy Beams”, Proc. of the Linear Accelerator Conference 2000, Monterey, USA