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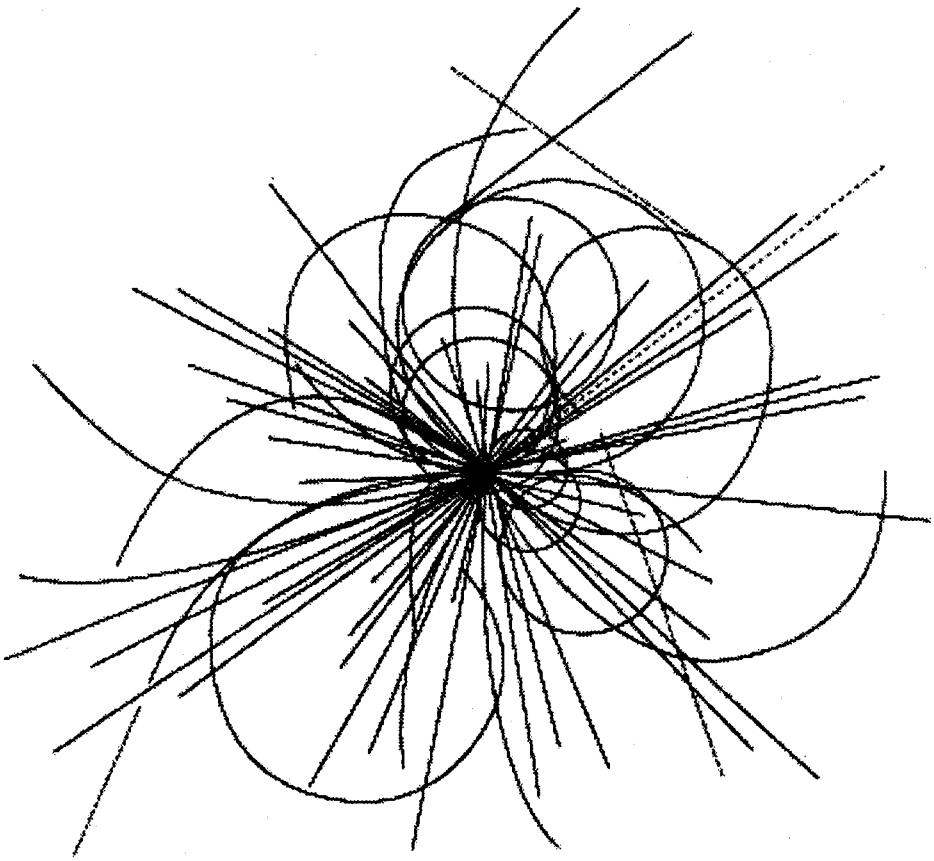

Superconducting Super Collider Laboratory

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TECHNICAL STATUS OF SSC RF AMPLIFIER AND ACCELERATING CAVITY SYSTEMS

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ABSTRACT

An overview of the design status of each RF amplifier system is presented and potential opportunities for industry involvement are identified. Specifically, brief descriptions of the LINAC, LEB, MEB, HEB, and Collider RF Amplifier systems are presented, as well as the LEB and MEB cavities. Status in the LINAC ranges from an RFQ Amplifier being operational at the SSC to procurement of subsystems still pending. The LEB prototype system is in tests at SSC, and the MEB prototype system is in construction. Preliminary design of the Collider RF system has begun, and design of the HEB RF system will begin in 1994.

LINAC RF SYSTEMS

The SSC LINAC is comprised of an ion source, Radio Frequency Quadrapole (RFQ), two bunchers, a four tank Drift Tube LINAC (DTL), two more bunchers (driven by a single amplifier), a nine-module Coupled Cell LINAC (CCL), and a compressor (located in the transfer line between the LINAC and Low Energy Booster).

The RFQ system for the LINAC operates at a frequency of 427.617 MHz through the DTL and at 1282.51 MHz for the following bunchers, CCL, and compressor. The LINAC pulse repetition rate is 10 Hz with RF pulse lengths from 65 to 90 μs depending on cavity fill time.

The 600-kW, 427-MHz RFQ amplifier utilizes a tetrode final amplifier and is presently in test at the SSC. Bunchers #1 and #2 will utilize identical 50-kW amplifiers that have triode amplifiers. These units are presently being manufactured. The 4-MW, 427-MHz DTL amplifiers are cathode-modulated klystrons. The klystrons have been manufactured, and the modulators are being manufactured now. The 20-MW, 1282-MHz CCL amplifiers are also cathode-modulated klystrons. Several klystrons have been manufactured, and the

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modulators are in fabrication. Bunchers #3 and #4 will be driven by a single CCL klystron operated at reduced cathode voltage to achieve 2.5-MW output.

The 100-kW, 1282-MHz compressor amplifier will be a cathode-modulated klystron as well. Procurement documents for this unit are in work.

LOW ENERGY BOOSTER (LEB) RF SYSTEM

The LEB RF system is required to provide a circumferential accelerating peak voltage of 765 KV. The RF frequency varies from 47.51 to 59.78 MHz over the acceleration cycle. The accelerating cycle is 50 ms long at a 10-Hz repetition frequency. The accelerating voltage will be provided by at least 8 and no more than 12, quarter-wave, ferrite-tuned cavities. Figure 1 is a simplified diagram of the LEB cavity design. Two prototype cavity designs have been fabricated that differ primarily in the ferrite-cooling technique. One cavity utilizes conduction cooling of the ferrites, while the other uses direct liquid cooling of the ferrites. The conduction-cooled design has been tested with mixed results to date. The frequency range was found to be adequate, but the prototype design suffered ferrite damage due to arcing. The liquid-cooled version is presently in test.

MEDIUM ENERGY BOOSTER (MEB) RF SYSTEM

The MEB RF system is required to provide a circumferential accelerating peak voltage of 1600 KV. The RF frequency varies from 59.78 to 59.96 MHz over the accelerating cycle of 4.5. The accelerating voltage will be provided by at least 8 and no more than 12 quarter-wave, ferrite-tuned cavities. Figure 2 is a simplified diagram of the MEB cavity design. The tuner design utilizes conduction cooling of the ferrites. The prototype cavity is presently being fabricated.

HIGH ENERGY BOOSTER (HEB) RF SYSTEM

The HEB RF system is required to provide a circumferential accelerating peak voltage of 1250 KV. The RF frequency is 59.96 MHz and varies only a few hundred Hz over the accelerating cycle of 100. Design of the HEB RF system is in the very preliminary stages and will commence in earnest in 1994. As presently conceived, the cavity will be similar to the Fermilab Tevatron cavity design. Seven cavities are planned to achieve the accelerating voltage. The power amplifier will be located at the surface.

COLLIDER

The RF systems for the SSC Collider are required to furnish a peak circumferential voltage of 20 MV per ring at a frequency of 360 MHz. The RF system design has concentrated so far on the use of superconducting versus normal-conducting cavities and whether to locate the amplifiers on the surface or at the beam-line level. A decision has been reached to locate the amplifiers at the surface. The power required per klystron is dependent on the cavity choice. Possible cavity choices include normal-conducting single cell, normal-conducting multi-cell, and superconducting single cell cavities. The cavity choice is still being studied, but is expected to be made shortly.

COMMON RF SYSTEMS

The SSC RF systems are planned to have a high degree of commonality. The low-level RF and control systems will be very similar for all machines and will be based on VME/VXI technology. The booster systems will all utilize the same power supplies, driver amplifier, and power amplifier tube.

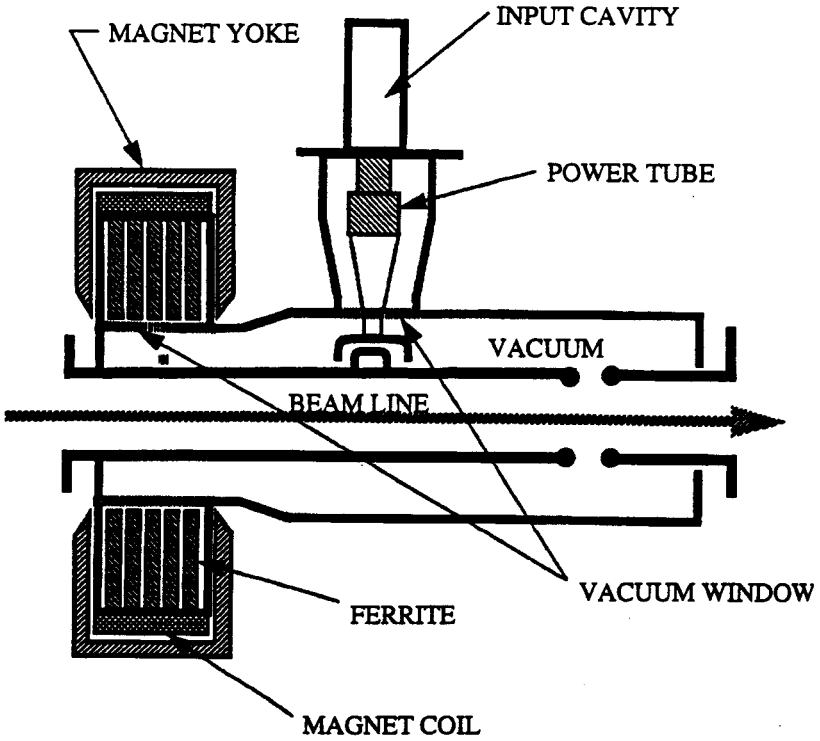

Figure 1. LEB cavity simplified diagram.

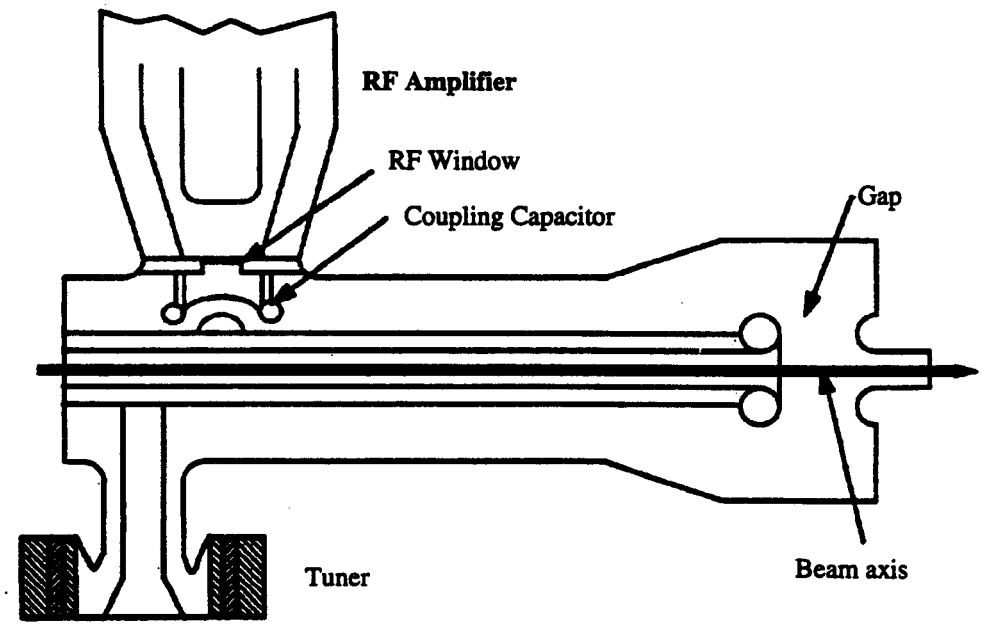

Figure 2. MEB cavity simplified diagram.