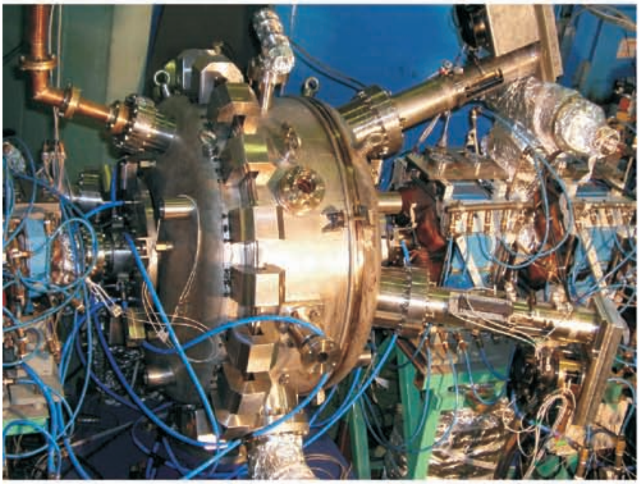

Fig.A.1.2 : Photograph of the RF cavity

volume on a linear path, changing the inductance of the cavity, and thereby its resonant frequency. Movement is transmitted inside vacuum using edge-welded bellows. Its actuator unit consists of ball screw, linear slide, timing belt drive, stepper motor, and electromagnetic brake. Linear potentiometer is used for taking feedback of its position. An integrated mounting table for the cavity and its sub-systems with provision for alignment is made. Thermocouples are mounted on the cavity for knowing temperature during baking.

A power of 1200 W is fed to the cavity to generate a gap voltage of 25 kV. Its thermal detuning is 80 kHz and it can be tuned to required frequency with an accuracy of 10 Hz using the on-line tuners. The cavity is cooled using a dedicated chiller system. The system supplies the low conductivity water at any constant temperature in a range from 10°C to 35°C and with a stability of ± 0.5°C. The usual input cooling water temperature is 27°C.

The installation of the cavity, in Indus-1 SRS ring, was accomplished in May 2007 and it is operating successfully, at a vacuum of 2×10^{-8} mbar. A photograph of the installed RF cavity is shown in Fig.A.1.2

Contributed by :
J. Dwivedi (jishnu @ cat.ernet.in)

A.2: TL-2 optics design for the CTF-3 (CERN)

Compact LInear Collider (CLIC) is an upcoming project at CERN, Geneva. CLIC Testing Facility 3 (CTF3) is a sub-project to demonstrate the generation of high power RF at 12 GHz by means of an electron beam. The RF generation scheme developed at this facility will be used for electron acceleration in the CLIC.

In CTF3, a 150/300 MeV electron beam with a bunch length of 8.3 ps and normalized emittance of 100 π mm-mrad (both planes), after the extraction from the Combiner Ring (CR), will be transported to the CLIC experimental (CLEX) area with a compressed bunch length of ~1.6 ps. This beam transport, accompanied by bunch compression keeping the emittance dilution less than 10%, will be done in a transfer line named as TL-2. The optics design of this line has been done at Indus Operations and Accelerator Physics Design Division of RRCAT under DAE-CERN collaboration.

This line will be installed in the existing LEP pre injector complex, CERN. An additional constraint was that the TL-2 was to be designed using some spare quadrupole and sextupole magnets available at CERN. CTF3 being a test facility, this line is also required to have a capability to vary the bunch length over a wide range. Designing a line to meet the stringent requirement of bunch compression over a wide range, keeping very low emittance dilution, using the magnets with pre-defined specifications, and its installation in the existing building geometry was a major design challenge.

In magnetic optics, the path length of a particle depends on its momentum. The R_{56} parameter connects the deviation in the path length of a particle with the relative deviation of its momentum with respect to the central value. Therefore by controlling this parameter, a bunch with a certain momentum spread can be compressed. R_{56} is a function of the dispersion, which is a measure of the displacement of an off momentum particle from the design trajectory. Therefore by shaping the dispersion function along the line, R_{56} can be controlled. The TL-2 line is capable of tuning the R_{56} parameter from -0.30 m to +0.30 m.

Besides R_{56}, the second order aberration known as T_{566} can also have a large effect on the bunch length. In the design of this line, the second order aberration has been suppressed with the help of sextupole magnets. The sextupoles also have a detrimental effect on the emittance due to their nonlinear magnetic field. In the whole tuning range, the emittance dilution due to sextupoles magnets has been kept successfully below 10%.

The designed transfer line (shown in Fig.A.2.1) is 44.5 m long and has 37 magnets : 7 dipole magnets, 26 quadrupole magnets and 4 sextupole magnets. The line can be broken in the three modules. The first module is an achromatic arc from the extraction point of the CR to the first dipole magnet of the line. The second module acts as a matching section

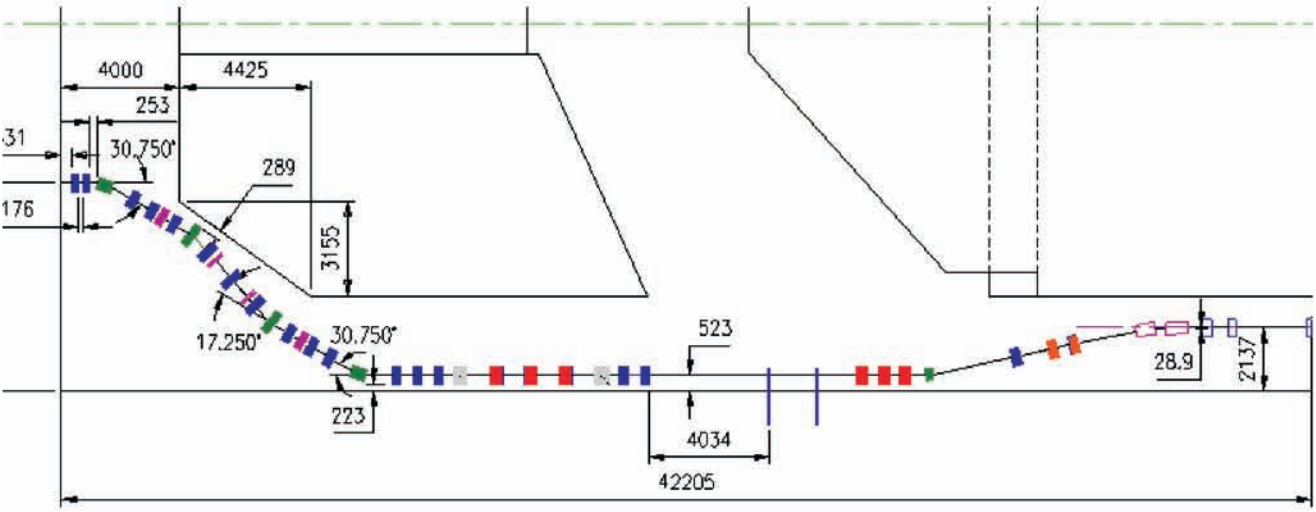

Fig.A.2.1: Schematic layout of TL-2

between the module-1 and module-3. This module has a clear dispersion free space of nearly 4 m for placing the tail clippers, another clear space of nearly 3 m to facilitate the operation of the emergency gate, and a vertical achromat for sending the electron beam 50 cm downwards.

The third module, the most complex of the three, is a R_{56} tunable achromatic arc. It also has a final matching quadrupole doublet to send a beam with proper parameters to the CLEX area. There are four dipole magnets in the arc, out of which two will be used to make the arc achromatic, and other two for tuning R_{56}. For controlling the T_{566}, there are four sextupole magnets in this module. Wide tuning of R_{56} is obtained by varying the dispersion distributions. A consequence of this is that, there is a drastic variation in betatron phase advances as R_{56} is varied from -0.30 m to +0.30 m, and this causes a large change in the lattice parameters at the location of the sextupoles. So, any standard sextupole scheme, such as *-I* transformer scheme, cannot be applied for the entire tuning range to minimize the effects of sextupoles on emittance dilution. These difficulties have been overcome with a computer program developed for optimizing the lattice parameters at the location of sextupole magnets.

The optics design of this line, meeting all the required specifications, has been done and communicated to CERN in July 2007.

Contributed by :
A. Sharma (amalendu @ cat.ernet.in) and G. Singh

A.3 : Imaging of dynamics of a first order magneto-structural transition using magnetic force microscopy

Fe-Rh alloy is an interesting system showing giant magnetocaloric effect (change in temperature of the sample due to applied magnetic field), giant elastocaloric effect (change in temperature due to external stress), giant magnetostriction (change in volume due to applied magnetic field) and giant magnetoresistance (change in resistance due to applied magnetic field) occurring close to room temperature. Such wide range of functionality of this alloy system arises due to a first order magneto-structural transition (FOMST) from an antiferromagnetic to ferromagnetic state which takes place both as a function of temperature and magnetic field. While most of the attention has been focused on the microscopic origin of the transition, the possible role of phase coexistence across the FOMST in tuning the functional properties of this material has largely gone unnoticed. Magnetic and Superconducting Materials Section of RRCAT in collaboration with Laser Systems Engineering Division of RRCAT have directly imaged the time evolution of the magnetic and the accompanying structural transition in Fe-Rh alloy at room temperature using magnetic force microscopy (MFM).

Figure A.3.1 shows a 6 µm x 6 µm area of the Fe-Rh sample. The sample, which is in the antiferromagnetic state in the temperature region below 290 K, was brought back to room temperature after exposing to liquid nitrogen (77 K). With this temperature history, the sample is mostly in the superheated antiferromagnetic state at room temperature. This can be seen from MFM image (M0) where there is