RF CAVITY OF KEK-PF STORAGE RING

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The synchrotron radiation loss in the KEK-PF storage ring with the wiggler will be 513 keV per turn for the 2.5 GeV electron. The peak cavity voltage of 2.84 MV is necessary to obtain a reasonable quantum life time. Here, the accelerating frequency is 499.99 MHz and the harmonic number h is 312. A set of four re-entrant single cell cavities will be used to produce this cavity voltage. Each of four klystrons will feed the power to each cavity.

The computer program SUPERFISH[1] was used to design the inner structure of the cavity.[2,3] The shunt impedance $R_{sh}$ of the cavity was approximately optimized (the $R_{sh}$ used here includes the transit-time factor). The calculated results were $R_{sh}$ = 9.87 MΩ and Q = 44,000 for each cavity made of copper. From now on we assume the Q-value of the actual cavity becomes 90 % of the calculated value. Then the klystron power $P_g$ = 125 kW generates the necessary cavity voltage 0.71 MV in the beam-loaded cavity (500 mA). The coupling coefficient of the input coupler should be 2.1 to minimize the reflected power. The wall loss is 60 kW for each cavity. The detailed RF parameters are presented in Ref. 3.

Model cavities were made of aluminum prior to making a final design. In the model cavity which is axially symmetric and, thus, corresponds to the calculated one the resonant frequency and field distributions of the fundamental (accelerating) TM0 mode were in excellent agreement with the SUPERFISH calculation. Then, the 120 mmϕ opening was bored for the input coupler. The coupling coefficient β = 0 to 3.0 was obtained by rotating the coupling loop situated at 31 mm from the cavity surface. The coupling loop with the opening reduced the resonant frequency by 1.0 MHz. This frequency shift was taken into account in the final design of the cavity.

The tuner is necessary to make an appropriate detuning of the cavity depending upon the strength of the beam loading. It is also used to compensate the temperature increase effect and the machining inaccuracy. The tuning plunger with 70 mm diameter inserted into the cavity by 40 mm increased th resonant frequency by 1.3 MHz, which is enough for the above purpose.

The ceramic vacuum window for the input coupler is situated at the transition unit from the wave guide to the coaxial line. The similar structure was already used in the 180 kW klystron, and gave rise to no problem.

The final design of the cavity is shown in Fig. 1. Additional two openings are bored for the higher-order mode damping couplers. The necessity of the damping couplers is discussed in Refs. 4 and 5.

The cavity is now under construction. Three main components of the cavity body are machined from OFHC copper separately. Cooling channels are milled into each component and inner surfaces are then machined. The three components thus prepared are silver-brazed each other. Here, water cooling jackets and nickel-coated stainless transition pieces are also silver-brazed to the cavity body. Finally stainless vacuum flanges are helium-arc welded to the transition pieces.


1) K. Halbach and R.F. Holsinger, Particle Accelerators 7 (1976) 213.
2) K. Batchelor and Y. Kamiya, KEK Report, KEK-79-25, 1979.
3) Photon Factory Design Handbook, § 4 (1979).
4) Y. Yamazaki, K. Takata and S. Tokumoto, KEK Report (to be published).
5) Y. Yamazaki, K. Takata and S. Tokumoto, present Proceedings.


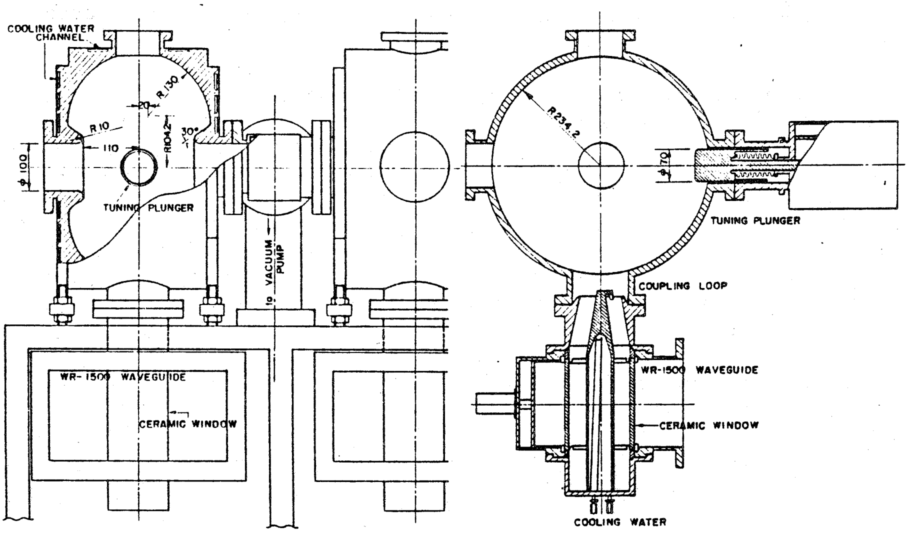


Fig. 1 RF cavity for the KEK-PF electron storage ring. Two openings will be used for the higher-order mode damping couplers.