RF SYSTEM FOR VEPP-5 DAMPING RING

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Abstract

RF system with operating frequency 700 MHz was developed for the damping ring of the VEPP-5. The block diagram and elements descriptions are presented. Calculated and measured parameters of the accelerating cavity are given.

1 INTRODUCTION

The damping ring of the VEPP-5 facility [1, 2] was designed to provide accumulation, cooling, and extraction of electron and positron beams at energy 510 MeV with particle production rate $2 \cdot 10^{10}$ per second. Preinjector is a 510 MeV linear accelerator (f=2856 MHz). Compensation of synchrotron radiation energy losses is provided by a 700 MHz cavity. RF frequency is 64-th harmonic of the particle revolution frequency. Block diagram of the RF system is shown in Fig.1. It consists of RF power source, circulator, transmission waveguide, and RF cavity.

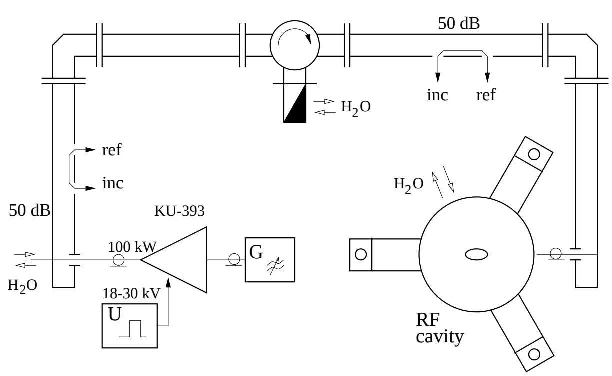

Figure 1: Block diagram of damping ring RF system.

2 RF POWER SOURCE

RF power source is a CW 100 kW klystron KU-393. Main operating parameters of the klystron are listed in Table 1.

The klystron is powered by 200 kW six-phase rectifier. The voltage is controlled by thyristors. A resistor is incorporated into the cathode circuit to prevent damage of the klystron by discharges. Klystron solenoid consists of five coils each powered by individual power source. Coils are placed into the same shield to decrease scattered magnetic field. General layout of the klystron section is shown in Fig.2.

Table 1: RF source parameters

Frequency, MHz	700
Beam voltage, kV	27
Beam current, A	5.4
Output power, kW	65
Efficiency, %	45
Gain, dB	46
Perveance, μA/V$^{3/2}$	1.23

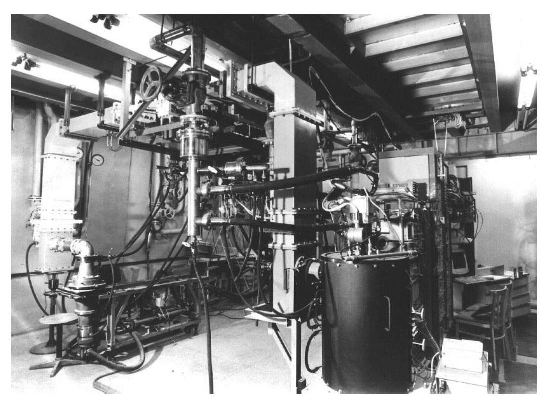

Figure 2: General view of klystron section.

3 WAVEGUIDE AND CIRCULATOR

RF power is transmitted through a rectangular aluminium waveguide WR-1150 (292.1×146.05). Attenuation of the waveguide is about 0.0035 dB/m. Waveguide section contains E and H turns. Since the klystron output and cavity input have a coaxial design waveguide-to-coax transition has been produced (see Fig.3). A frequency dependence of VSWR of the transition is shown in Fig.4. Directional couplers in the transmission section are used for high power RF measurements.

A CW 100 kW circulator developed in RSC “Domen” was incorporated into waveguide section to decouple the

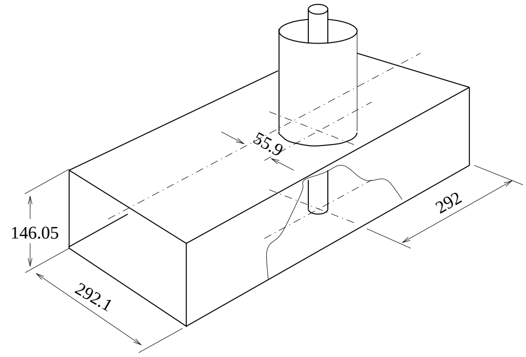

Figure 3: Waveguide-to-coax transition.

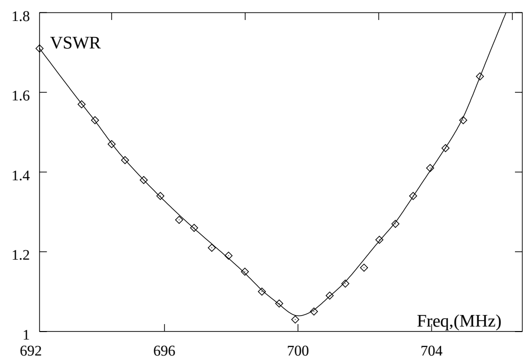

Figure 4: VSWR versus frequency for the waveguide-to-coax transition.

klystron from the cavity. The circulator parameters are listed in Table 2.

Table 2: Circulator parameters

Direct power, kW	100
Direct power losses, dB	0.4
Reverse attenuation, dB	>40
Input VSWR while load VSWR is 3	<1.2
Dissipated power, kW	<15

4 RF CAVITY

Figure 5 presents a schematic drawing of the cavity.

To avoid coupled-bunch instabilities, Q-values of higher order modes should be less than 700. HOMs are extracted through three waveguides attached to the cavity [3] and dissipated in absorbers [4]. The waveguide (165.1mm×12.5mm) cutoff frequency is 908 MHz. Waveguides are placed symmetrically upon rotation to 120^o on extension of the cavity wall (see Fig.5). The cavity at workbench is shown in Fig.6. Measurements show that 5% of RF power dissipates in absorbers at operating frequency of 700 MHz.

Simulation of the cavity has been carried out by SuperLANS 2D computer code [5]. It should be noted that syn-

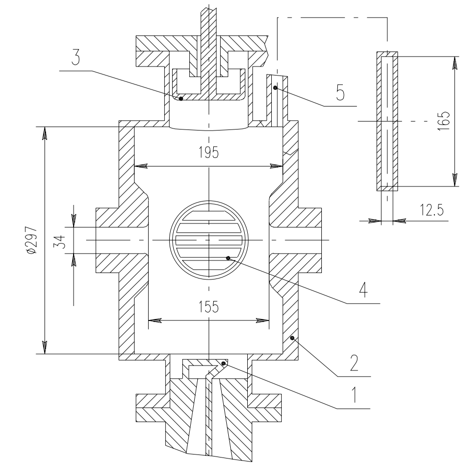

Figure 5: Cavity schematic drawing: (1) input power loop; (2) copper wall; (3) tuning contactless plunger; (4) pumping slots; (5) waveguides for HOM damping.

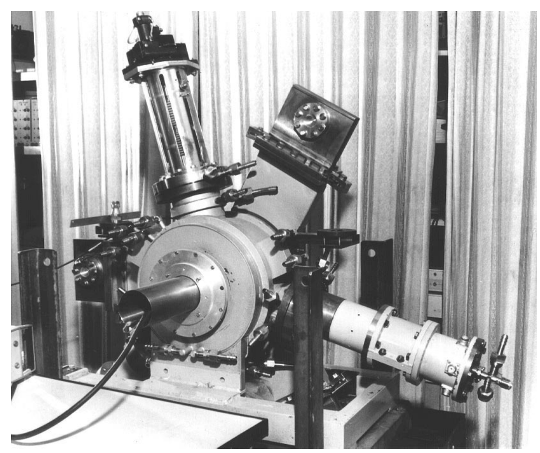

Figure 6: Cavity at the cold tests workbench.

chrotron radiation energy loss is 5.3 keV per turn. So for 40 mA beam current the loss power is ∼200 W.

The main parameters of the cavity are listed in Table 3.

Table 3: Cavity parameters

Operating frequency, MHz	700
Frequency tuning, MHz	±0.8
Shunt impedance / Q, Ohm	212
Q-value	≈2100
Shunt impedance, MOhm	4.45
Transit time factor	0.72
Accelerating voltage, kV	200÷400
Maximum dissipated power, kW	35

5 SUMMARY

At present time 65 kW power has been obtained on a RF load. That power is enough even for two cavities operation. Computer control of the RF system is provided by PC and transputer based CAMAC controller. RF cavity is produced, cold tests was carried out at the operating frequency. HOM damping measurements is under way. The cavity is prepared for installation into the damping ring.

6 REFERENCES

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