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DEVELOPMENT OF HIGH POWER S-BAND KLYSTRON

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Abstract

The design and scheme of the model of the S-band klystron model developed at Budker Institute of Nuclear Physics are described. The results of simulation and preliminary results of the tests are presented. Parameters of the klystron: operating frequency is 2856 MHz, output power is about 50 MW, pulse length is 3.5 μs. The tests of the output vacuum windows were carried out. The cathode node and collector are tested at a voltage of 200 kV and beam current of 140 A. A klystron buncher is prepared for measurements and tuning.

INTRODUCTION

Taking into account the necessary to develop new linear S-band accelerators in BINP SB RAS, the development of the own klystron is very important. Presently, the klystrons 5045 (SLAC) [1] are used at BINP injection complex VEPP-5 [2], and the lifetime of these klystrons is coming to the end. We are planning that new klystrons will replace old klystrons 5045 produced at SLAC. So new klystron should have the same main characteristics: frequency is 2856 MHz, pulse input RF power is not more than 350 W, pulse output RF power is about 50 MW, pulse duration is 3.5 μs, pulse repetition rate is not less than 25 Hz.

SIMULATION

To calculate the basic parameters of the geometry of the klystron elements and klystron characteristics the CST Studio software package was used [3]. Figure 1 shows the beam dynamics and the energy spectrum of the electron beam in the klystron. Figure 2 shows the signal from the output waveguide of the klystron.

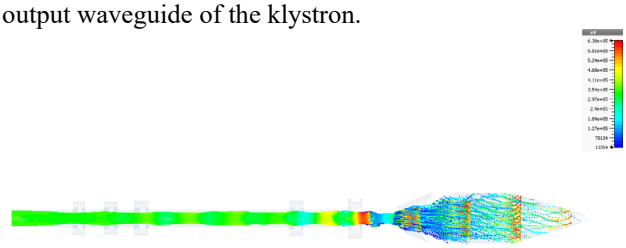

Figure 1: Dynamics of a beam in a klystron.

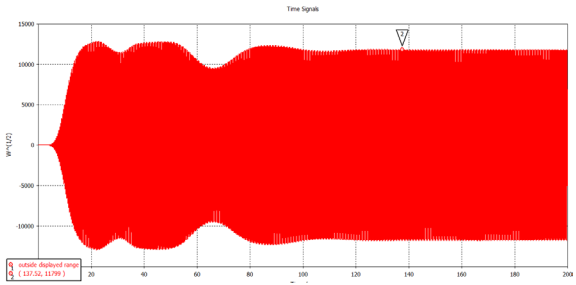

Figure 2: Output signal.

The initial energy of the electron beam is 350 keV, current is 400 A. The output RF power is about 69 MW.

COMPONENTS

The model without bunching cavities was created to test the cathode node and the collector (Fig. 3).

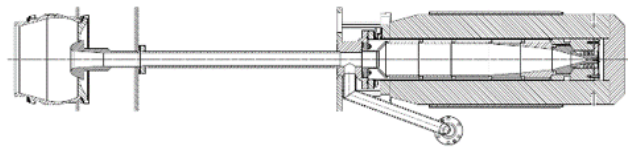

Figure 3: Model for testing the cathode node and collector.

A working version of the solenoid for focusing the electron beam was also created. Figure 4 shows the measured magnetic field on the klystron axis.

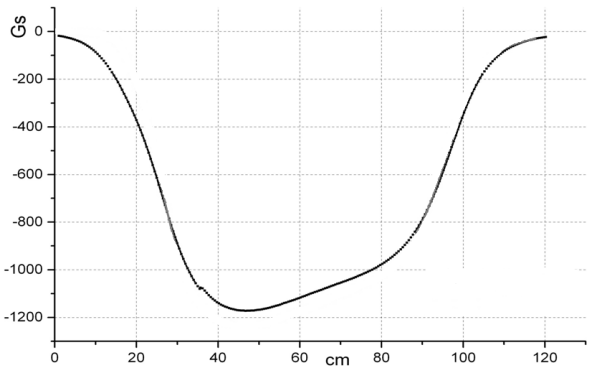

Figure 4: Magnetic field on the axis of the solenoid.

Dispenser cathode with a peak current density of 7.8 A/m^2 is shown on Fig. 5.

Figure 5: Cathode.

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The 350 kV klystron modulator (Fig. 6) is made of a linear type scheme with a full discharge of the forming line [4].

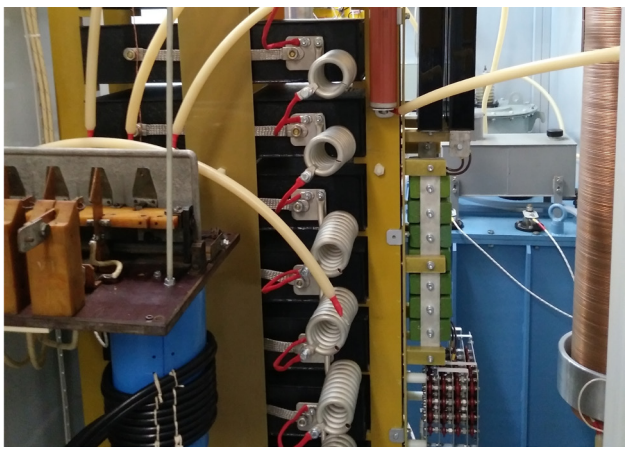

Figure 6: Modulator.

The output window of the klystron was developed, manufactured and tested at BINP [5]. A photo of the RF windows is shown in Fig. 7.

Figure 7: RF windows.

To reduce the power flow through the output window of the klystron a power divider (Fig. 8) is used, in which the power is divided in two times. RF power passes through two RF windows and then is again summed.

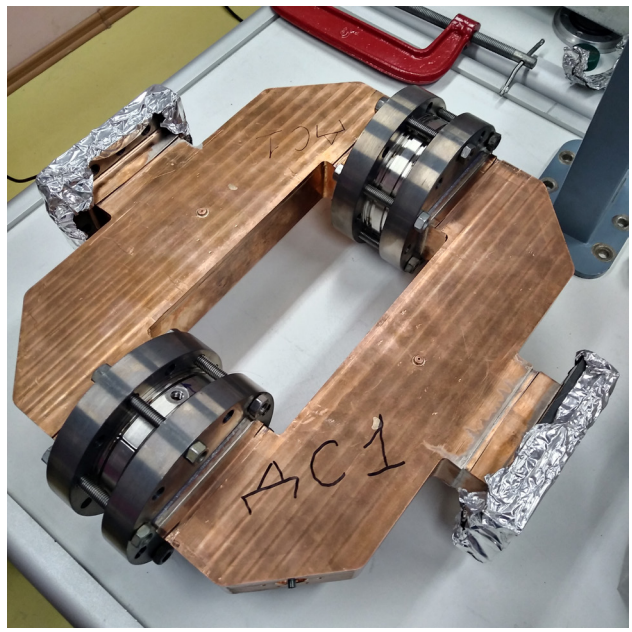

Figure 8: Power divider.

Figure 9 shows the photo of the cathode-collector model before the tests.

Figure 9: The cathode-collector model

CONCLUSION

In Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences the klystron prototype, which is consisted of the cathode node and the collector,

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is under testing. The achieved energy and current of the electron beam are 200 keV and 150 A now, respectively. The pulse repetition frequency is 2 Hz. In parallel with the tests, the manufacturing of input, output and bunching cavities of the klystron is being completed. When the production of the cavities will been completed, the set will be measured and adjusted and then full-scale tests with the maximum output power of the klystron will be carried out.

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