STATUS OF "SIBERIA-2" SR SOURCE PREINJECTOR

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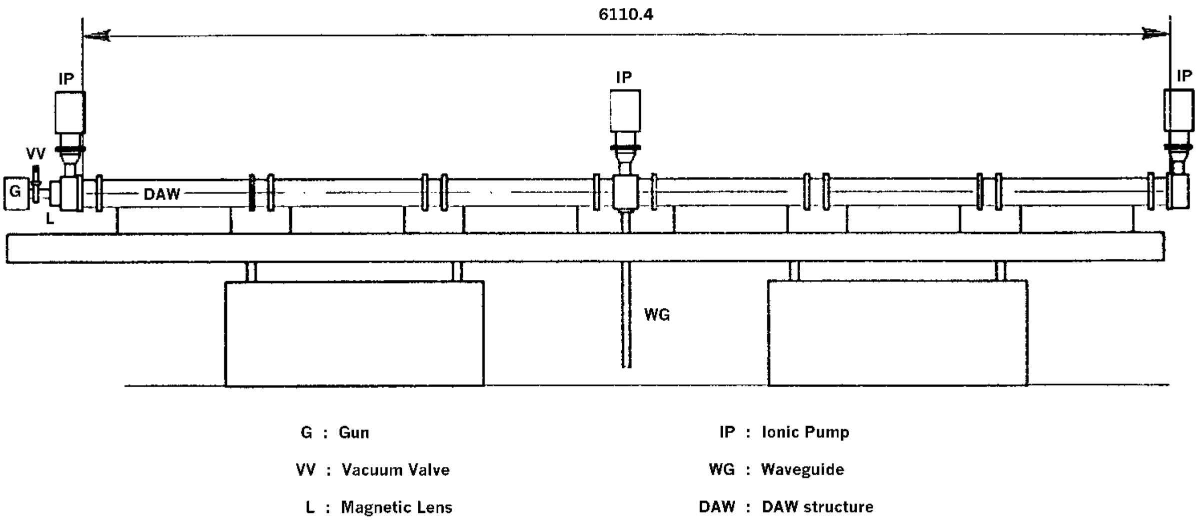

Fig. 1: Preinjector layout.

INTRODUCTION

The linac-preinjector for "Siberia-2" SR source [1,2,3] was commissioned at Kurchatov Institute in 1992. A 6 meters long disk-and-washer (DAW) accelerating structure [4] with high shunt impedance operates at 2797 MHz (see Fig.1). It consists of 6 brazed regular sections connected to one another by indium seals. Due to the strong resonant coupling between its cells the accelerating structure is a single- resonant volume with a high Q-factor. The main structure parameters are listed in Table 1.

Table 1

Operating frequency, MHz	2797.2±0.1
Shunt impedance eff, MOhm/m	95±3
Q-factor	28000±100
Characteristic impedance, kOhm/m	3.4±0.1
Overvoltage factor	5.5
Group velocity (β)	0.4

The accelerating structure is driven through a special coaxial cell located in the center of the linac.

Reliability of the linac was significantly improved. A plane ceramic window was designed, manufactured, and installed into the waveguide. An independent thermostatic system for the accelerating structure has been commissioned. A frequency auto-tuning system for the master oscillator has been modernized.

TWC-TYPE CERAMIC WINDOW

The RF power transmission into the accelerating structure is carried out via a waveguide (90x45 mm^2) which consists of vacuum and gas sections divided by a ceramic window. At the first stage of works the window design was based on the ceramics of KIU-53A klystron power output. That window could not be warmed up because of the waveguide design which used indium seals. So, the service life of the window was limited by several hundreds hours. Ceramics was broken down due to a RF discharge. The window configuration because of complexity did not allow us to make a uniform spraying of the ceramics by titanium nitride TiN. Thus the decision was made to install a plane window with travelling wave in ceramics (TWC-type) proposed by S.Yu. Kazakov [5]. Its concepts are as follows. Two waveguide irises produce the special field distribution, when in window material a pure travelling wave exists at a local overvoltage in the waveguide between the window and the iris. As a result, the value of electric field on the ceramics surface and inside it is reduced. The structure of an S-band TWC-type window is presented in Fig.2 [6].

To reduce a secondary emission, the ceramics was covered by the TiN film of 1.5 nm thickness. At present, the window successfully operates.

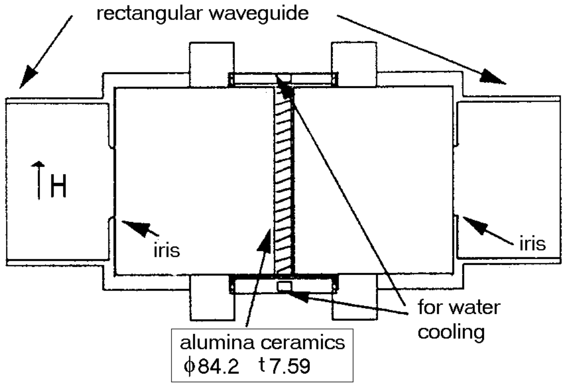

Fig. 2: Structure of a TWC-type window.

LINAC TEMPERATURE CONTROL SYSTEM

Linac frequency instability caused by temperature variations was many times reduced due to a temperature stabilization feedback loop. The existing system of temperature measurement was used.

The system contains about 550 of preliminary tested sensors and three 256-cnannel ADC with memory for data acquisition. ADC has a flexible scale from 8 up to 16 bit under computer control, so every channel has its individual resolution.

Six sensors for linac were taken with the relative difference of order of 0.05^{o} C and 14 bit scale was used for them. A desirable linac temperature is hold by a water flow heating, which is provided by a 3-phase 20 kW thyristor amplifier driven by a digital phase regulator under computer control. Feedback is closed through software, therefore nonlinear dependence of an output power of thyristors ignition phase was easy eliminated. Loop stability was designed with computer simulation. Temperature stability of 0.2^{o} C is achieved.

LINAC FREQUENCY CONTROL SYSTEM

Linear accelerator as a part of the complex operates as a preinjector in pulse mode with a repetition rate of 1 pps. The resonant linac operating frequency is tuned by the master oscillator frequency re-tuning either by an operator or by a pulse AFC system. The optimal frequency tuning corresponds to the maximum accelerating voltage in the structure at the minimum reflected wave in the waveguide. That mode of operation is shown in Fig.3. A beam is injected into the linac at the end of RF pulse in a time interval that corresponds to matching with the waveguide, when the transient process of filling the linac structure with RF power is almost completed. This interval of 1÷2 μs is also used for obtaining an information about tuning from the pulse phase probes after gating in the AFC system. The shape and amplitude of incident and reflected waves, as well as signals from linac probes are read out into PC to analyze a quality of linac operation. All the tuning systems are rather slow because all signals are read out one time per second. Linac resonant frequency drift during warming is 50kHz/ ^{o} C, that greatly changes the accelerating field in the structure from pulse to pulse. The linac is especially heated up to a temperature of 33^{o}C with further temperature stabilization to equalize the temperature gradient along the linac. Installation of the thermostabilization system has made the AFC system operation considerably easier and allows us to stabilize the beam acceleration regime for both the particle energy and the beam current.

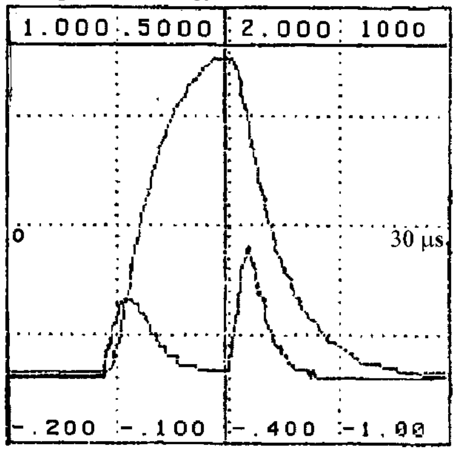

Fig. 3: RF signal oscillograms.

SUMMARY

Improvements made in linac systems have significantly increased the reliability of its operation. At present time the linac injects an electron beam with an energy of 75 MeV, beam current of 65 mA (ΔE/E=1%), with a pulse duration of 18 ns at a repetition rate of 1 pps.

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