THE PULSED HIGH VOLTAGE POWER SUPPLY FOR THE NICA BOOSTER INJECTION SYSTEM

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Abstract
Three pairs of electrostatic deflecting plates will be used in the injection system of booster ring. The electric circuit and design of the power supply system for one plate are presented in the report. The experimental results of testing are also presented.

INTRODUCTION
The NICA ion collider [1] is currently under construction at Joint Institute for Nuclear Research. The booster of the main accelerator NUCLotron is used for initial acceleration and cooling of ion beams.

Electrostatic septum and three deflecting devices will be used in the booster injection system [2]. Electric plates are used as actuating elements. Hydrogen thyatrons are used as switches.

PARAMETERS OF ELECTRIC PULSES
The number of supplied plates and amplitude of applied voltages depend on type of injection [2]. All electrical plates are supplied with identical pulses that differ in amplitude of the applied voltage. Main parameters of electric pulse with maximum amplitude are shown in Table 1.

Table 1: Main Characteristics of Electric Pulse

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Maximum electrical potential on the plate</td>
<td>60 kV</td>
</tr>
<tr>
<td>Duration of pulse plateau at least</td>
<td>30 us</td>
</tr>
<tr>
<td>Nonuniformity of voltage on the plateau</td>
<td>≤ 1%</td>
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<td>The discharge time</td>
<td>≤ 0.1 us</td>
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<tr>
<td>Residual voltage</td>
<td>≤ 0.5 kV</td>
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The parameter values given in Table 1 are generally achieved without major difficulties except for residual voltage value.

To reduce residual voltage and improve reliability of high voltage components, it was decided to use a pulse charging.

The conceptual version of such scheme was tested and results were published [3]. Then the parameters of main elements were optimized and device was designed and manufactured.

THE POWER SUPPLY SCHEME AND DESIGN
PSPICE model of the power supply circuit is presented in Fig.1.

The initial pulse of the thyristor generator is applied to the primary winding of the step-up transformer. We use industrial measuring transformer GE-36. Thyatron is triggered near the top of the pulse when the current in the primary winding of the transformer crosses zero value.

The discharge chain C1, R2-R3 maintains the discharge current through the thyatron in a few tens of microseconds, thereby preventing fast afterpulses. Slow processes are suppressed by leakage of charges through the secondary winding of the transformer. Besides that the reversal magnetization of the transformer produces negative potential of several tens of volts at the diode set.

Figure1: PSPICE model of the power supply circuit.
C3-equivalent load, R6-R7 – divider VD-60

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This variant of scheme was designed and manufactured. The view of device is presented in Fig.2.

Figure 2: The photo of device at testing bench.

This pulse power supply was tested at different output voltages up to maximum working parameters. The oscillograms are presented in fig.3.

Figure 3: Measurement results. Voltage (10 kV/div) at the equivalent capacitance (green), input current (40 A/div) of the transformer (blue) and voltage at C2 (50 V/div).

CONCLUSIONS

The pulse power supply for deflecting plate was developed, manufactured and tested at working parameters. The test results put in a strong performance. The device is ready to use at booster injection system.

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REFERENCES