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TESTING OF THE NEUTRAL BEAM INJECTOR IN A LONG PULSE MODE WITH UPGRADED PLASMA SOURCE *)

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An atomic injector for plasma heating is described in [1] with a neutral beam power of 1.7MW and a duration of 30 ms. Cold cathode arc generators are used in the plasma source of the injector. The 150A plasma emitter for the ion-optical system (IOS) of the injector is formed by the addition of plasma jets of 4 arc generators, which can be placed within the area of the beam aperture, due to their compactness. However, at high arc discharge power, the generator life decreases, which limits the period of non-stop operation of the injection system to ~ 2 years in a typical experimental mode and with an injector operating pulse duration of 30ms.

There is a need for injectors with similar parameters with increased duration, in particular for the planned gas dynamic multi-mirror trap (GDMT) and other open traps of the next generation. Thermomechanical deformations of peripheral cooled IOS electrodes were evaluated, which showed the possibility of increasing the pulse duration to ~0.3 s. In addition, earlier in [2], the modernization of plasma generators was described, which provided the possibility of increasing the duration of operating pulses to 0.3-0.6 s. According to the tests carried out, it was possible to save the service life of the generators for ~ 1 year or more, depending on the selected duration of the operating pulses. However, the question remains about the really permissible maximum beam duration when using the existing IOS.

This paper describes the results of testing an injector similar to [1], with a plasma source based on upgraded arc generators and with a power supply system with a duration increased to 0.5-1 s. The working vacuum was maintained by high-speed cryogenic pumping.

Under the conditions of the tests carried out, the thermomechanical deformations of the IOS grids seem to be a critical factor limiting the pulse duration. During the tests, the beam current density profile was measured at a given distance in the beam path. This made it possible to control the change in focal length, as well as the deviation of the IOS perveance from the optimum, which are sensitive to thermal deformations of the spherical grids used. In [3], the energy loss on the most loaded first grid was about 0.7% of the beam power, and this value was weakly dependent on the perveance. Using these data and the results of the conducted studies, the possibilities of increasing the beam duration were experimentally determined when working with the repetition frequency of "shots" ~ once every 15 minutes.

The composition of the beam and the evolution of the content of molecular fractions as the pulse lengthens were measured by Doppler spectroscopy.

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*) abstracts of this report in Russian