

§7. Development of Supersonic Molecular Beam Source for Fueling

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The prototype of the supersonic beam source has been installed in LHD and is used as a “direct gas puff” (DGP) system. Apart from the LHD experiments, we tested a new type of source, which is planned to be installed in LHD next year.

Figure 1 compares the cross sections of a throat of a) original and b) new sources. The fueling gas is introduced from the left hand side of the figure, where a Piezo valve is attached. Narrower region is added in the new source so that the conductance is partially limited here and thus the gas plume is formed, while the present one has a straight cylinder with 2 mm in diameter.

The experimental setup is shown in Fig. 2. An ionization gauge was placed against the source to detect a component of the plume, in addition to the other gauge located aside. The time evolution of the pressures detected these gauges were clearly different from each other. The pressure detected by the gauge faced to the source increased and then decreased quickly after the pulse injection, and then merged to the decay detected by the other gauge (Fig. 3b)). The difference in waveform was much smaller with the original source. A computer simulation on the pressure evolution, corresponding to the experiment is shown in Fig. 3a). The component of the gas directly entering to the gauge facing to the source was estimated to be four times more with the new source than the original.

The improvement of the directivity of the gas from the source was also confirmed by the visualization of the plume, using a set of transparent electrodes and an inverter power supply, as shown in Fig 4.

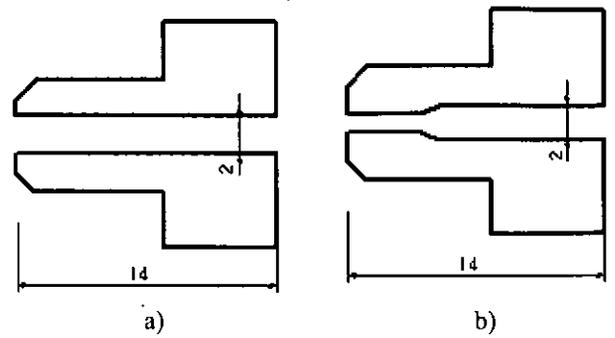


Fig. 1. Cross sectional views of a throat of a) original and b) new sources (not in scale).

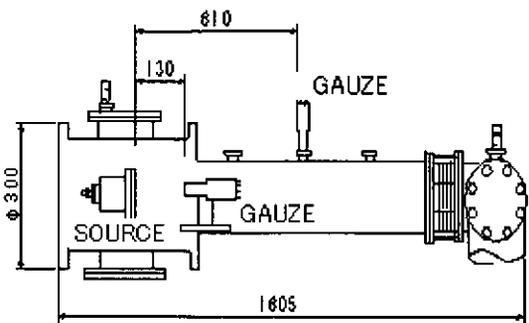


Fig. 2. Experimental setup.

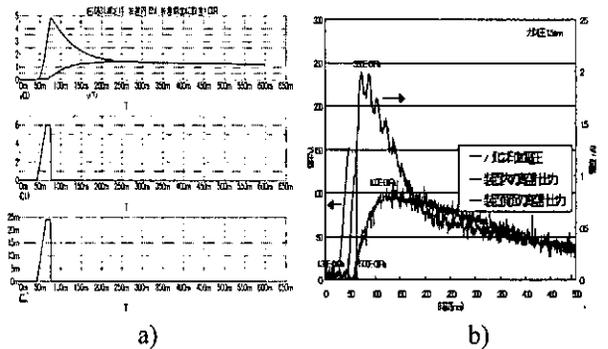


Fig. 3. Time evolution of the pressures; a) computational and b) experimental results.



a)



b)

Fig. 4. Visualization of the plume; a) original and b) new sources.