Test results in DLA experimental chamber

Summary of the experimental setup:

The experiments were done in the DLA chamber in vacuum condition. The chamber can be pumped downed to $4.3 \times 10^{-5}$ mbar ($\sim 3.3 \times 10^{-5}$ torr) after 5 hours. The $\text{N}_2$ gas is used for producing of gas target by the pulse valve with 1 mm nozzle. The gas valve opening duration is set as 1 ms. The gas backing pressure is controlled by the regulator on the gas tube. The interferometer and the side scattering image system were used to observed the generated nitrogen plasma.

Test of gas valve delay time

Parameter:
pulse energy: 5.5 mJ
backing pressure: 700 psi

The gas valve delay time is fixed at 99.4 mJ after the test.
Test of $N_2$ gas backing pressure with 1 mm nozzle

Parameter:
pulse energy: 5.5 mJ

According to the results of the interferometer, the operational range of the gas valve is up to 900 psi with $N_2$ gas.
**Generation of N₂ plasma by radially polarized pulse**

The beam is large as compared to the aperture size of the polarization converter. The energy of the radially polarized pulse was limited in 2.3 mJ with the current setup. For comparison, the energy of the linearly s polarized pulse is also reduced to 2.3 mJ.

Parameter:
pulse energy: 2.3 mJ
backing pressure: 700 psi

**By linearly s polarized pulse:**

- interferogram
- side scattering image

**By radially polarized pulse:**

- interferogram
- side scattering image

It can be observed from the interferogram that the plasma density is much lower by the radially pulse. For parameters of 2.3 mJ, 40 fs and 10 μm diameter, the peak intensity is estimated as $4.8 \times 10^{16}$ W/cm² for a linearly polarized pulse and $1.754 \times 10^{16}$ W/cm² for a radially polarized pulse. Therefore, the reduced plasma density as generated by the radially polarized pulse should be reasonable.