Improved Defocus Stability in Laser-Induced Breakdown Spectroscopy via Microlens Array Beam Homogenization

Author(s): Zixuan Li a†, Xuechen Niu a†, Xinrui Pan a , Wei Guoª, Chen Niu*b and Lianbo Guo*b

S1. Plasma Diagnostics under Defocus Conditions

The plasma temperature (T) and electron density (Ne) presented in this section were calculated using the spectral data acquired in the experiment shown in Figure 5 of the main text. This experiment was conducted under both beam-shaped (MLA) and unshaped (Lens) configurations, with a laser energy of 120 mJ and defocus distances varied in steps of 0.75 mm. The collected spectra, which included the Mn I lines among others, served as the direct input for the subsequent plasma parameter calculations..

Calculation Methods:

1. **Plasma Temperature**: Determined using the Boltzmann plot method with six Mn I lines (293.31 nm 293.93 nm 294.92 nm 403.08 nm 403.46 nm 403.45 nm) and NIST atomic parameters, assuming Local Thermodynamic Equilibrium (LTE).
2. **Electron Density**: Estimated from the Stark broadening of the Mn I 403.08 nm line.
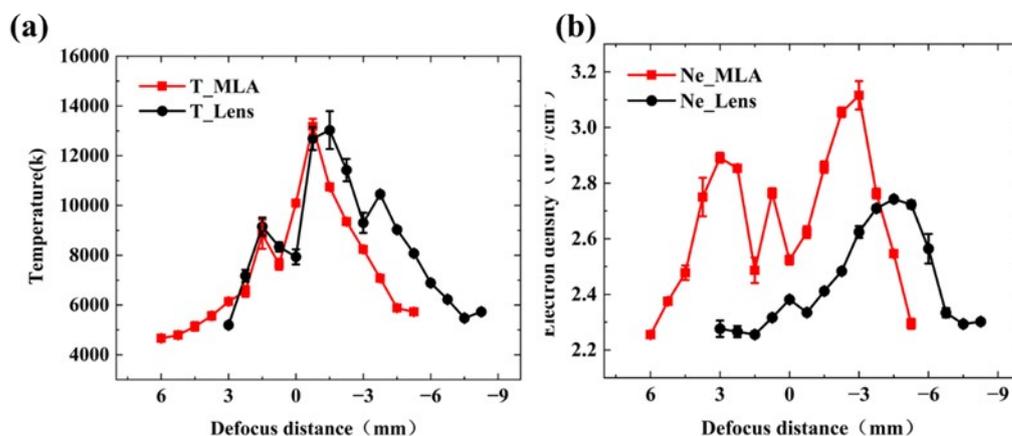
Results:

Fig. S1. Variation of (a) plasma temperature and (b) electron density with defocus distance for the unshaped (Lens) and shaped systems(MLA)