

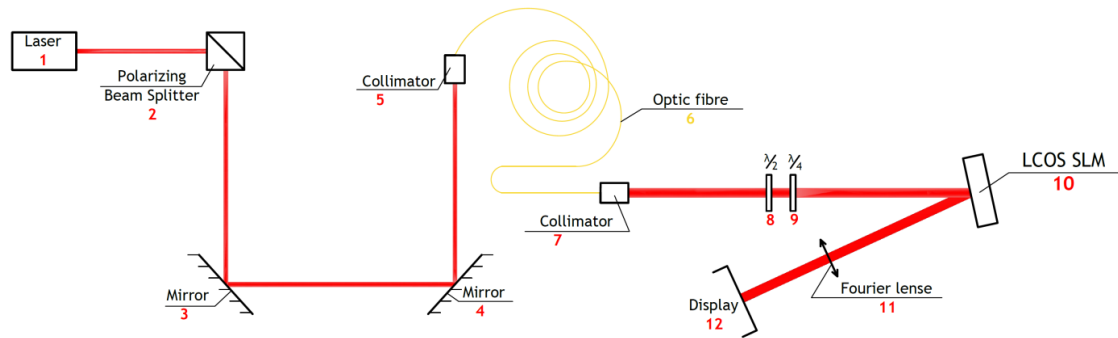
# Light Control via Spatial Light Modulator

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Spatial light modulators are a valuable tool for controlling the properties of the optical field. They have a wide range of applications including optical microscopy, holography, etc. In addition, they can be used for the creation of the optical dipole traps with the ability to quickly change the field properties. The purpose of the current work is to develop and experimentally test a Matlab toolbox for the SLM Hamamatsu X13138 for the future development of the SLM-based optical dipole trap.



**Fig.1:** Experimental setup

SLM affects the incident beam as a matrix of discrete pixels where each pixel changes the phase and the amplitude of the incident beam. The SLM considered in this work changes only the phase, and its action can be described as

$$A(\mathbf{r}) = A_0(\mathbf{r}) \cdot e^{i\varphi(\mathbf{r})}, \quad (1)$$

where  $A_0(\mathbf{r})$  is a complex amplitude of the input beam, and  $\varphi(\mathbf{r})$  is an SLM's phase shift. The field distribution in the Fraunhofer zone is determined by the free field propagation.

The developed toolbox allows to create the wavefronts of various shapes in the Fraunhofer zone using SLM. In particular, it provides the wavefronts similar to those of the standard optical elements such as echelette, axicon and cylindrical lens. Also, more complicated shapes can be created, for example, logotypes and small text fragments. To obtain these wavefronts, the SLM phase shifts are represented as an  $1272 \times 1024$  array (same as the resolution of the SLM) which is converted to a BMP image and then loaded to the SLM with special software. The values of the phase shifts are calculated either analytically or using Gerchberg-Saxton iterative algorithm.

The author assembled an experimental setup (see Fig. 1) that allows to observe the intensity distribution in the Fraunhofer zone on a screen (12), located in the focal plane of Fourier lens (11). To evaluate the performance of the toolbox, the author compared the images obtained with SLM with the images obtained with the simulated optical elements. The more complicated field distributions were also created. The reached results demonstrated the ability of the developed toolbox to obtain a high degree of control of the optical field in the Fraunhofer zone. Also, it allows to create the ring-shaped beam required for a dipole trap for capturing neutral atoms.