Reconfigurable High-Power Vectorial Beams Based on Disordered Optical Metasurfaces

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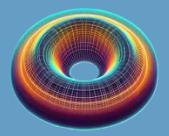

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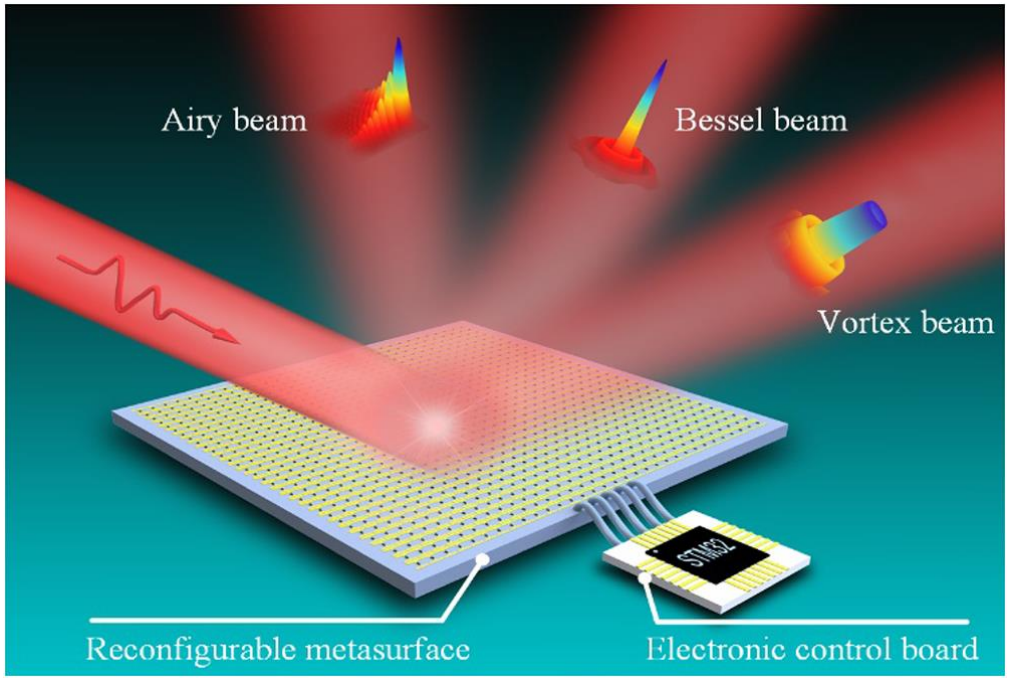
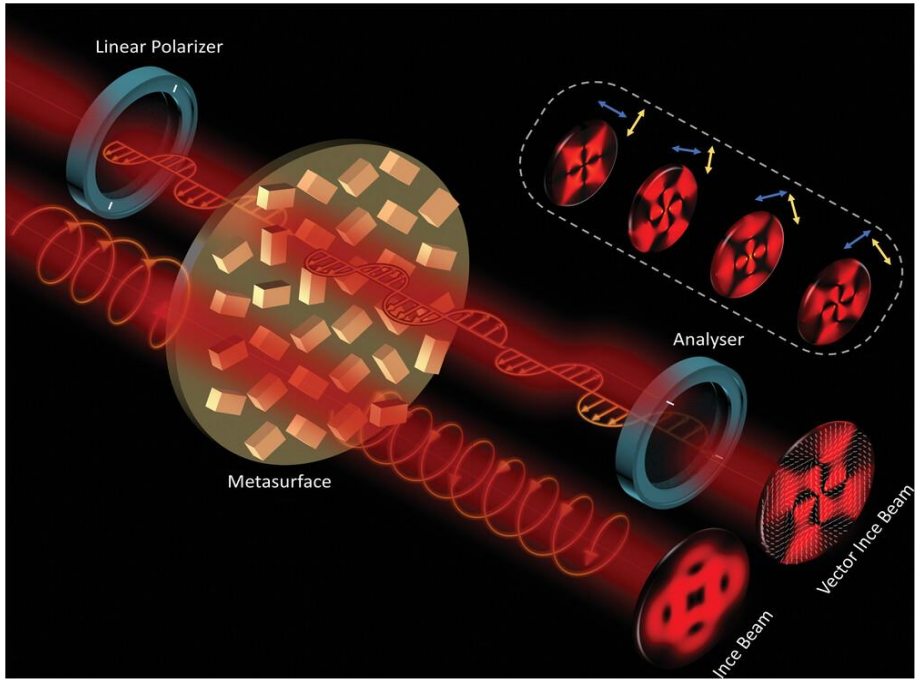
Solution: Reconfigurable metasurface

- Static birefringent metasurface capable of multifunctional vectorial shaping



[1] R. Feng, B. Ratni, J. Yi, H. Zhang, A. de Lustrac, and S. Burokur, "Versatile metasurface platform for electromagnetic wave tailoring," Photon. Res. 9, 1650-1659 (2021).

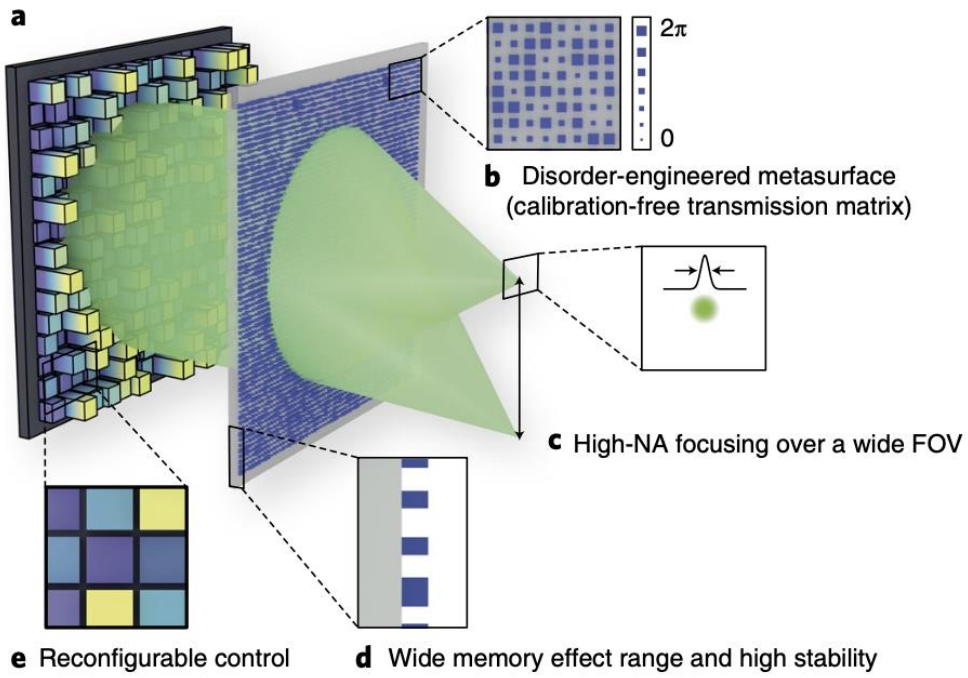


[2] Ahmed, Hammad et al. "Metasurface for Engineering Superimposed Ince-Gaussian Beams." Advanced materials (Deerfield Beach, Fla.) vol. 36,21 (2024): e2312853. doi:10.1002/adma.202312853

- Random profile of metasurface makes it able to transform a scalar input beam into an arbitrary vectorial output

Motivation

SLM + Disorder-engineered metasurface

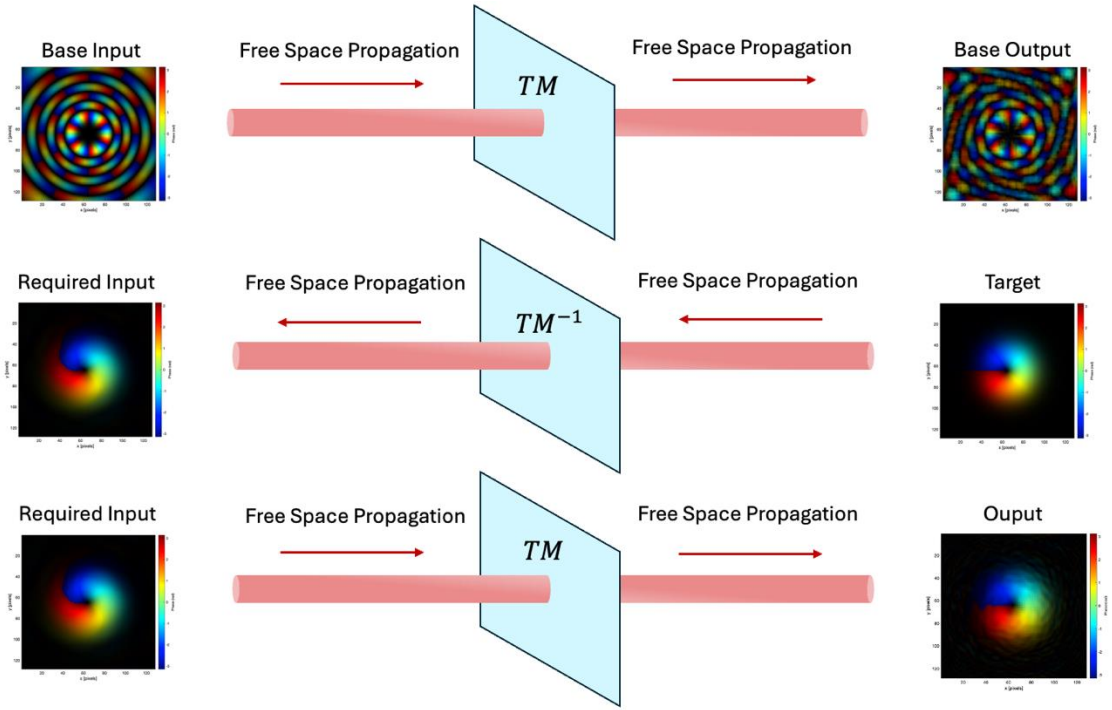


Grayscale plate + Metasurface

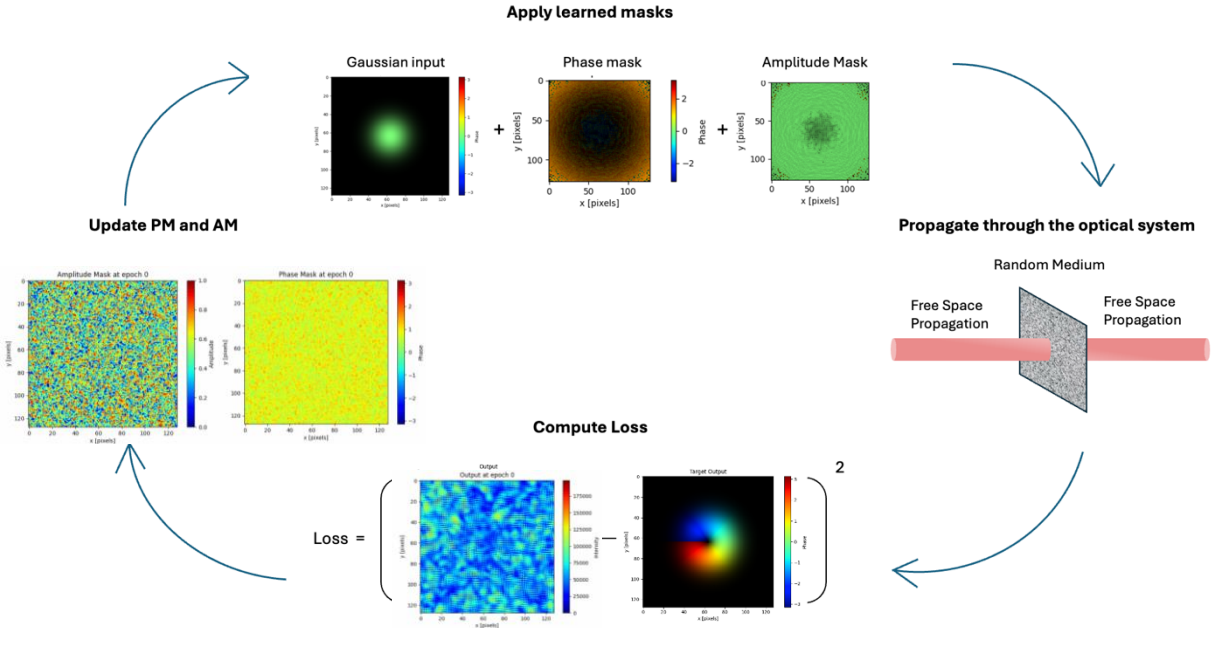
[3] Jang, M., Horie, Y., Shibukawa, A. et al. Wavefront shaping with disorder-engineered metasurfaces. Nature Photon 12, 84–90 (2018). https://doi.org/10.1038/s41566-017-0078-z

First steps: polarization-independent light modulation

Method 1: Inversion of the transmission matrix

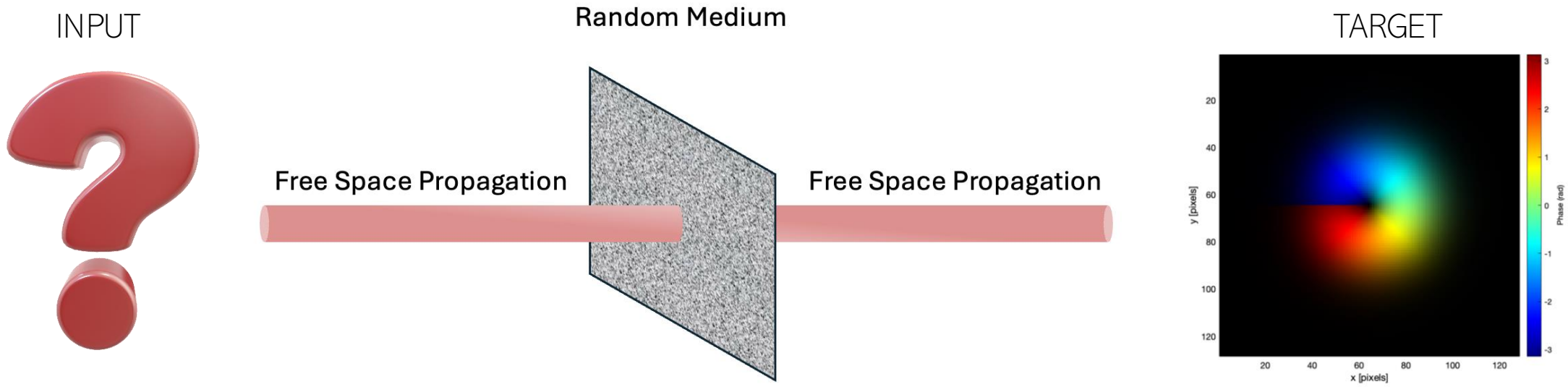


Method 2: Machine learning for input characterization



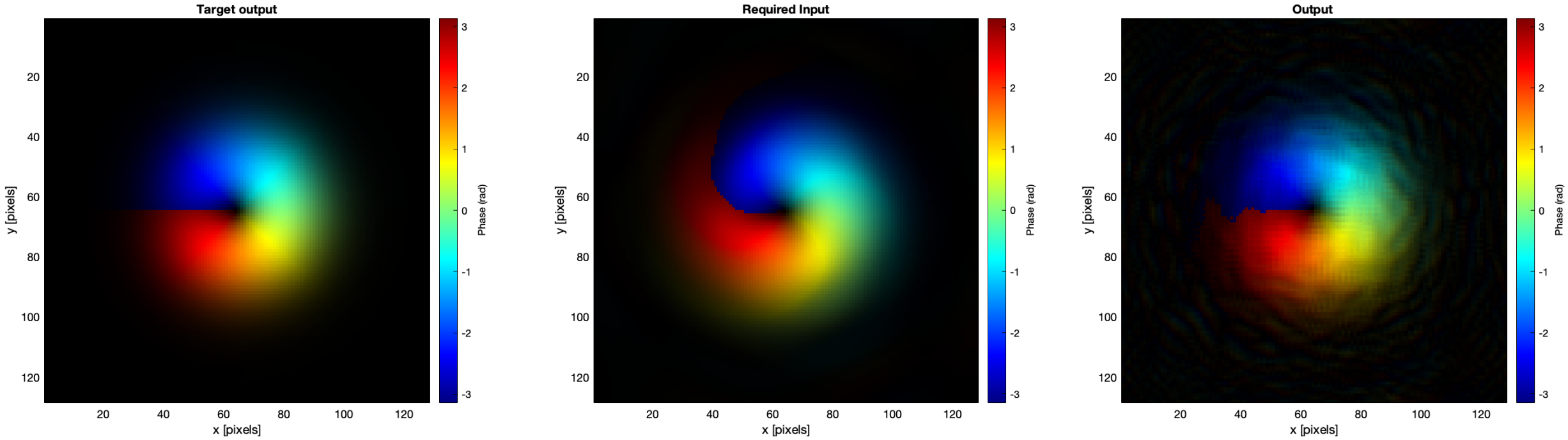
Inversion of transmission matrix method

Goal: find the necessary input to give to the optical system to get an arbitrary output.



Inversion of transmission matrix method results

Target: LG beam with $l = 1$ and $p = 0$

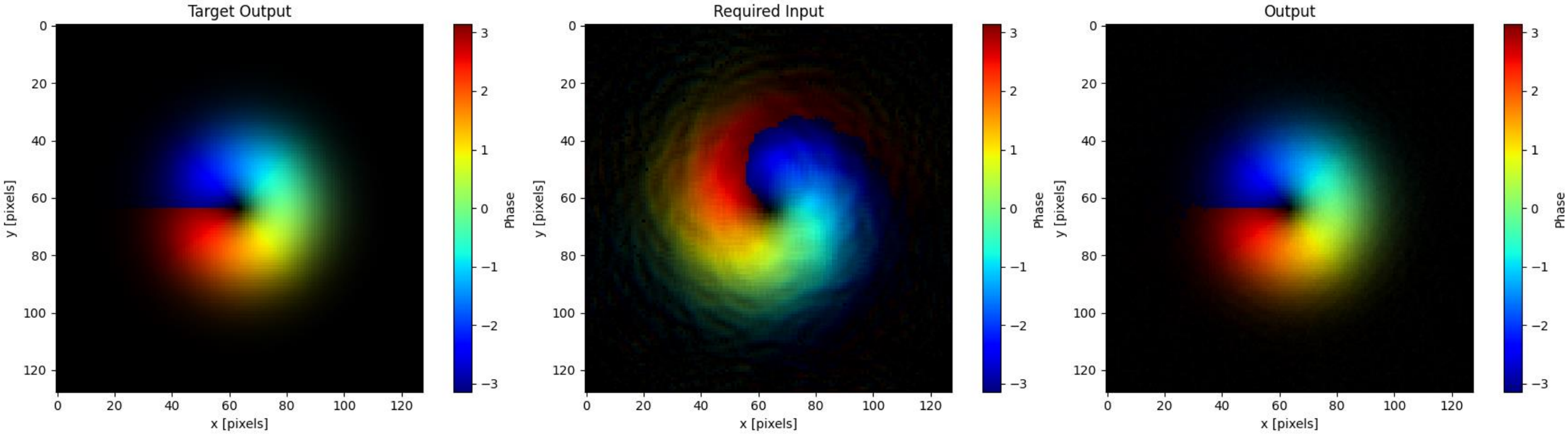


Overlap between output and target: 0.98

Not using a **fully** random medium

Machine Learning for input characterization results

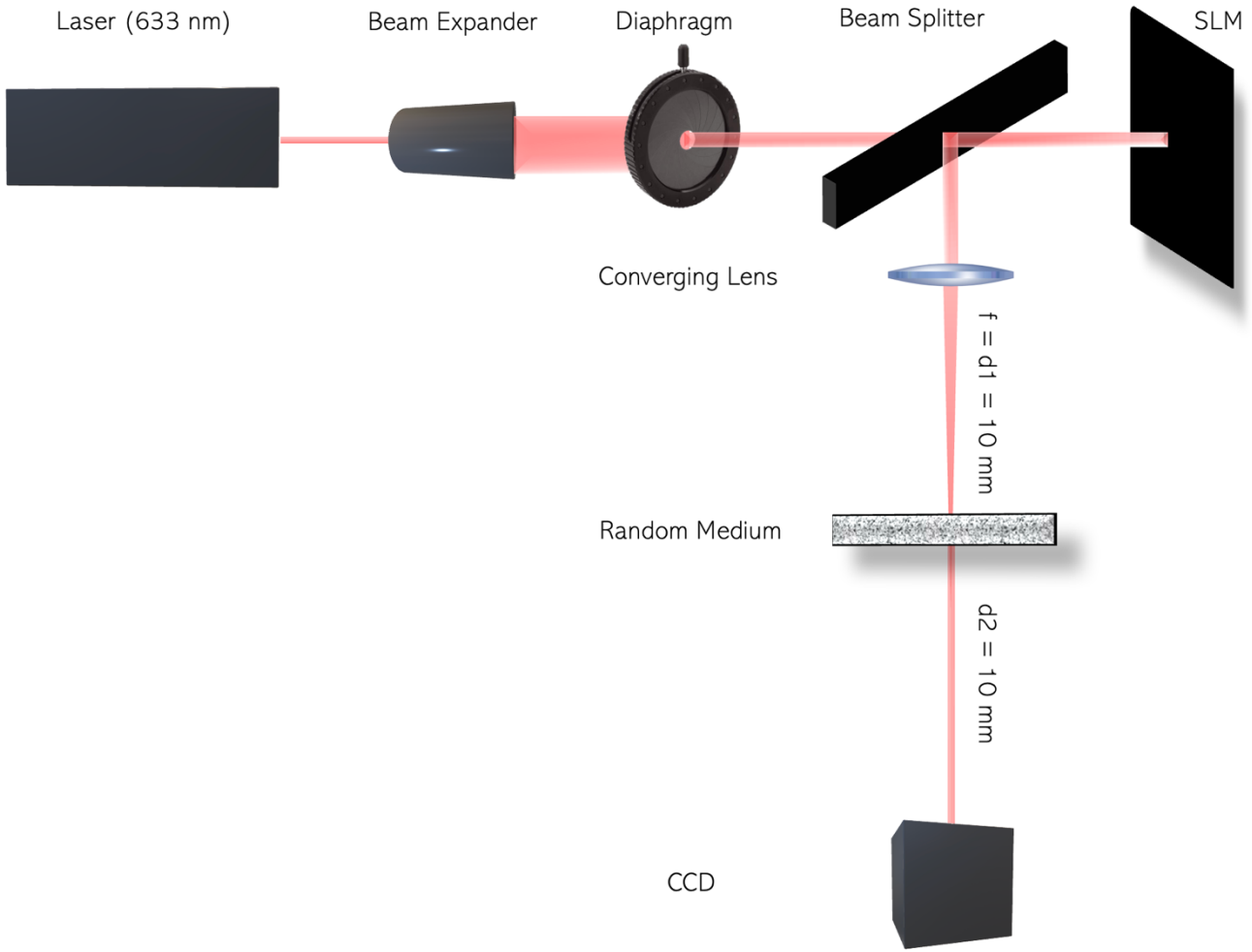
Target: LG beam with $l = 1$ and $p = 0$



Overlap between output and target: 0.99

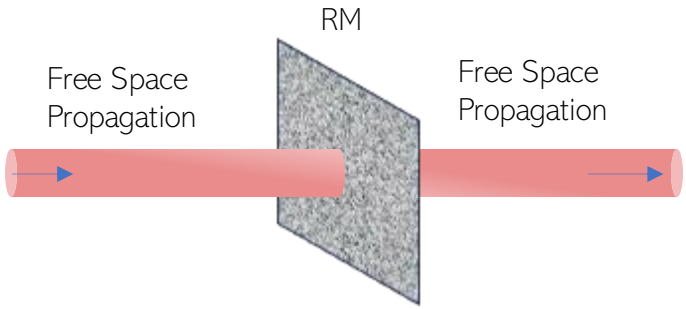
Using a fully random medium the overlap is 0.95

Experimental setup

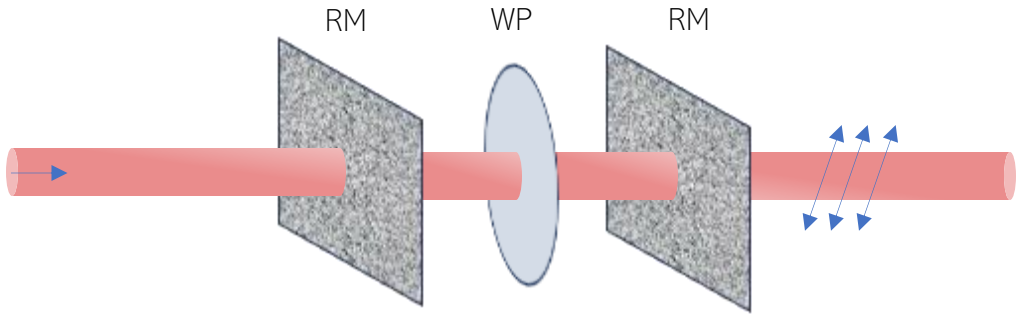


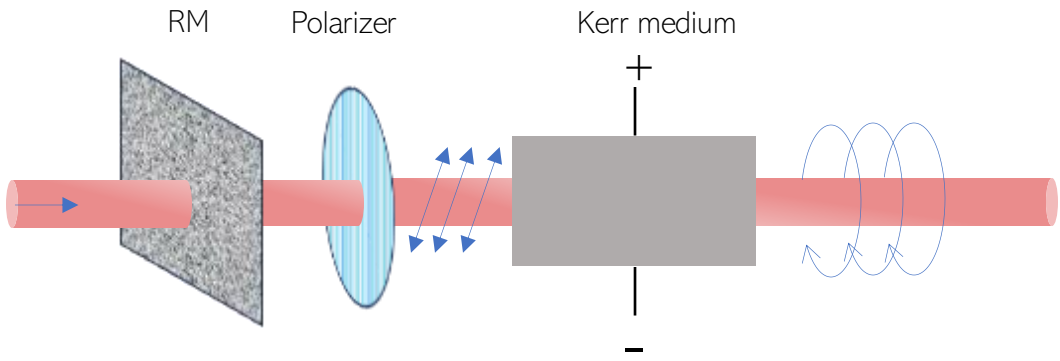
Future work

Scalar input – Scalar output



Scalar input – Vectorial output





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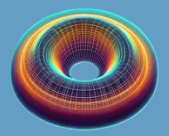

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