

THREE-DIMENSIONAL IMAGING OF ARBITRARY ORBITAL ANGULAR MOMENTUM POLARIZED FIELDS BY VECTORIAL PTYCHOGRAPHY

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Orbital angular momentum (AOM) beams are special kinds of beams possessing a phase transverse distribution that rotates with time. Their ability to generate novel light-matter interactions opens new exciting perspectives in non-linear and quantum optics. Although they are relatively easy to be made in the laboratory, their complete characterization is challenging, involving commonly an interaction with a calibrated diffractive element. [1]

Here we propose to extend vectorial ptychography, a recently developed reference-free quantitative imaging method [2,3], to the full characterization of arbitrary polarized field distributions. We succeed in mapping at a microscopic resolution the phase, amplitude and state of polarization of an arbitrary AOM beam. This exhaustive knowledge allows to monitor precisely any defect present in the experimental beam, and to reconstruct its 3D structure (Fig. 1)

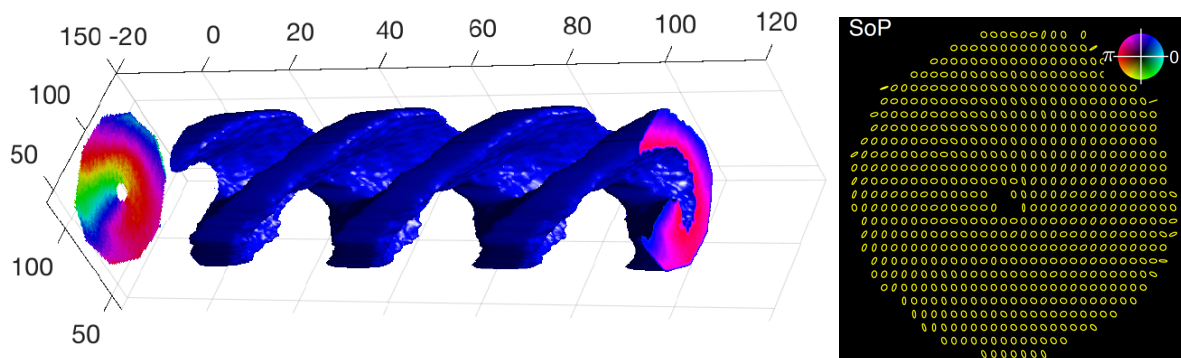


Figure 1. Left: Reconstructed phase front of an experimental OAM beam, as measured by vectorial ptychography (units in μm). **Right:** Corresponding map of its state of polarization. From [4]

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[1] A. M. Yao, M. J. Padgett, "Orbital angular momentum: origins, behavior and applications", *Adv. Opt. Photon.*, **3**, 161 (2011).

[2] P. Ferrand, A. Baroni, M. Allain, V. Chamard, "Quantitative imaging of anisotropic material properties with vectorial ptychography", *Opt. Lett.* **43**, 763 (2018).

[3] A. Baroni, M. Allain, P. Li, V. Chamard, P. Ferrand, "Joint estimation of object and probes in vectorial ptychography", *Opt. Express*, **27**, 8143 (2019).

[4] A. Baroni *et al.*, *submitted* (2020).