

# Storage and Non-Collinear Retrieval of Orbital Angular Momentum of Light in Cold Atoms

R. A. de Oliveira<sup>1</sup>, L. Pruvost<sup>2</sup>, P. S. Barbosa<sup>1</sup>, D. Felinto<sup>1</sup>, D. Bloch<sup>3</sup>, and J. W. R. Tabosa<sup>1</sup>

<sup>1</sup> *Departamento de Física, Universidade Federal de Pernambuco, 50.670-901 Recife, PE, Brazil*

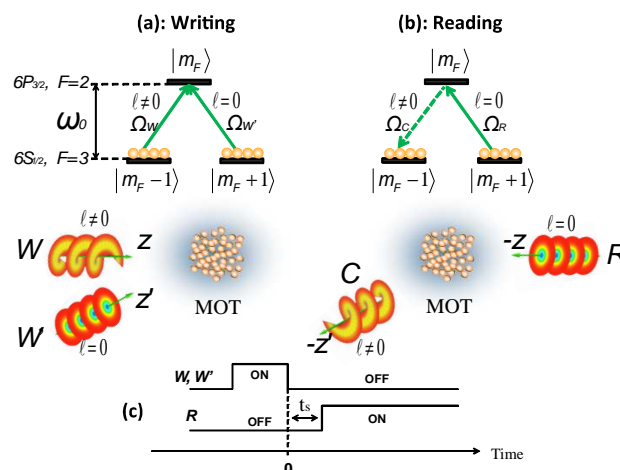
<sup>2</sup> *Laboratoire Aimé-Cotton. CNRS, Univ. Paris-Sud, ENS-Cachan F-91405, Orsay, France*

<sup>3</sup> *Laboratoire de Physique des Lasers, CNRS, Université Paris 13, F-93430 Villetaneuse, France*

Laurence.pruvost@u-psud.fr

Light beams carrying orbital angular momentum (OAM) are in great interest because of their applications, ranging from the macroscopic particle manipulation to the encoding of quantum information [1]. OAM beams are specified by a topological charge  $\ell$ , and have a helical phase structure corresponding the OAM per photon equal to  $\ell\hbar/2\pi$ . The nonlinear interaction of OAM beams with atomic systems via four-wave mixing (FWM) processes has demonstrated the OAM storage and the OAM conservation in the FWM process [2,3,4,5].

Differently from the previous observations, in this work we demonstrated that the stored OAM beam is retrieved along a non-collinear direction as shown in the figure. The experiment is performed in cold Cs atoms from a MOT, using a delayed FWM configuration with a writing beam  $W$  with topological charges  $\ell=0,1,2,3$ . The phase structure of  $W$  is stored into the Zeeman coherence grating induced by the incident writing beams  $W$  and  $W'$  and is restored when the reading beam  $R$  is switched on. The retrieved beam  $C$  is monitored by a CCD camera and shows the transfer and conservation of OAM.



[1] M Padgett, J. Courtial and L. Allen, Phys. Today, 57(5), 35, (2004)

[2] S. Barreiro and J. W. R. Tabosa, Phys. Rev. Lett. 90 133001 (2003)

[3] W. Jiang, Q. F. Chen, Y. S. Zhang, and G. C. Gao, Phys. Rev A 74, 043811 (2006).

[4] D. Moretti, D. Felinto, and J. W. R. Tabosa, Phys. Rev. A, 79, 023825 (2009)

[6] R. A. de Oliveira, L. Pruvost, P. S. Barbosa, D. Felinto, D. Bloch, and J. W. R. Tabosa, submitted to opt. Lett.