Hot rubidium atoms for optical vortex conversion

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The interplay between optical vortex beams and a vapor is studied in order to understand the exchange of the orbital angular momentum (OAM) of light with the atomic medium.

The OAM being associated to the helical phase of the optical vortex, a phase-dependent interaction is chosen. We use the non-degenerate four wave mixing (FWM) in a rubidium vapor, which coherently converts two incident red beams into a beam pair, one being infrared, the other blue (Fig1.). We examine the OAM of the blue wave versus the OAMs written in the input beams and show the rules of the conversion. Depending on the relative handedness of input OAMs the blue output is single OAM or OAM-entangled due to phase-matching [1,2].

The work will be presented in a general context of FWM with vortex beams including degenerated FWM previously realized on cesium atoms [3].

The OAM is a quantum photon variable taking many values (signed integers) beside the Spin Angular Momentum. Processes which entangle OAMs are of interest for quantum technologies.

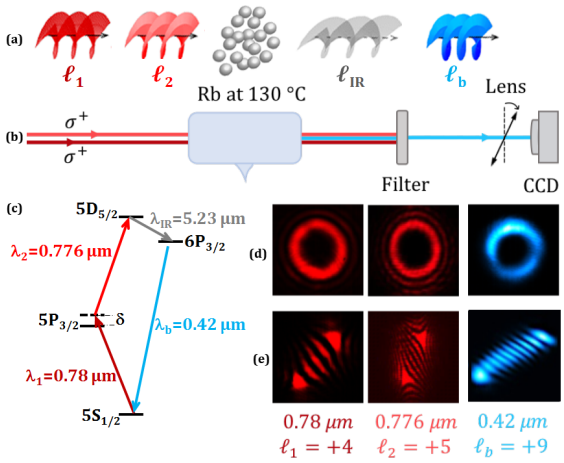

Figure 1. (a) FWM principle in a rubidium, (b) experimental scheme, (c) involved atomic levels, (d) intensity profiles of red and blue beams, (e) OAM-signatures by auto-interferences.

[1] A. Chopinaud, M. Jacquey, B. Viaris de Lesegno, L. Pruvost, High helicity vortex conversion in a rubidium vapor, Phys. Rev.A **97**, 063806, 2018.

[2] A. Chopinaud, M. Jacquey, B. Viaris de Lesegno, L. Pruvost, Vortex handedness role in the conversion by four wave mixing in a rubidium vapor, in revision.

[3] A. J. F. De Almeida, S. Barreiro, W. S. Martins, R. A. De Oliveira, D. Felinto, L. Pruvost, J. W. R. Tabosa, Storage of orbital angular momenta of light via coherent population oscillation Opt. Lett. **40** , 2545-2548, 2015.