Spiral bandwidth of four wave mixing in rubidium vapour

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Structured light, and in particular orbital angular momentum (OAM), is an important tool for optical manipulation, processing, imaging and both classical and quantum communication. We explore the transfer of OAM in an efficient four wave mixing process in rubidium vapour [1]. Conservation of OAM determines the total OAM carried by the two generated fields - at 420 nm and 5.2 μm - but not how it is distributed between them [2,3]. A small pump OAM is transferred almost entirely to the 420 nm light, allowing efficient OAM frequency conversion and addition [4]. For larger pump OAM, the OAM spectrum of the generated light becomes broadened, indicating that the two generated fields, which have widely disparate wavelengths, are OAM entangled. We infer the available spiral bandwidth of this state by performing a full mode decomposition on the 420 nm light for a range of pump OAM [5].

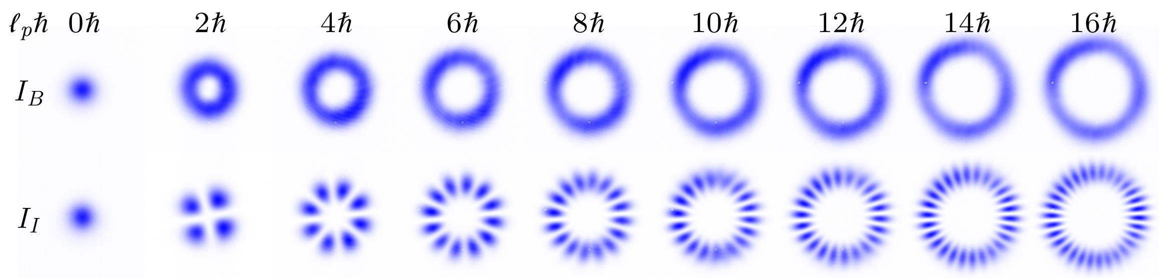

Figure 1. Intensity profile, I_B, and interferogram, I_I, of the generated 420 nm light for increasing total pump OAM, $\ell_p\hbar$. As ℓ_p increases, the visibility of the interference fringes along the vertical axis of the interferogram decreases, indicating broadening of the OAM spectrum.

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