Four-wave mixing in hot atomic vapours for quantum optics

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The advent of efficient four-wave mixing in a hot rubidium vapour, shown in Fig. 1, has led to a rebirth of quantum optics with hot atomic vapours [1]. The method is characterised by a strong nonlinearity which enables the production of light fields which are squeezed or entangled in many spatial modes [2], a feature of interest for multichannel quantum information and quantum sensing protocols, and for quantum imaging applications. In addition, the emitted quantum light is naturally (near) resonant with an atomic transition and is therefore well suited for applications based on atom-light interaction. Starting from our improved understanding of the nonlinear mechanism, we show how the simplicity of the technique makes it possible to envision using a broader class of vapours to generate quantum light at various frequencies, and how the method could be combined with other techniques associated with hot vapours to create more powerful quantum devices. This includes guided or structured light, e.g. interacting with atoms in hollow-core fibres, magnetic tuning, and atomic sensing, e.g. magnetometers.

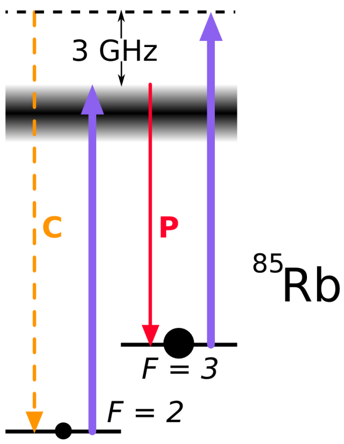

Figure 1. Double-lambda four-wave mixing scheme for rubidium.

[1] C. F. McCormick, V. Boyer, E. Arimondo, P. D. Lett, Strong relative intensity squeezing by 4-wave mixing in Rb vapor, Optics Letters **32**, 178 (2007).
[2] V. Boyer, A. M. Marino, R. C. Pooser, and P. D. Lett, Production of entangled images by four-wave mixing, Science **321**, 544 (2008).