Noise spectrocopy with large clouds of cold atoms

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(Dated: 4 mai 2016)

Random lasing with cold atoms has been recently obtained in our team [1]. However its observation and characterization is still a challenging issue. To access its coherence properties, we want to perform intensity correlations of the light emitted on both sides of the threshold. But the first step towards this characterization is the study of the frequency noise of the light in the absence of gain. To do so, the incident frequency noise of the light is converted in a measurable intensity noise, taking advantage of the resonance of the atoms. The obtained frequency noise spectrum gives information on the light source and on the light-matter interaction.

I will present the recent measurements made with the atoms, or with a Fabry-Pérot cavity, as a frequency filter. The noise spectra will be compared showing the influence of the atoms in the conversion of noise. In particular, new features appear in the noise spectrum when the light is sent through the cloud. An analytical study will be presented showing that, at low Fourier-frequency we retrieve the conversion by the atomic transition or the Fabry-Pérot cavity, and at high Fourier-frequency new features appear in the frequency noise spectrum.

Reference

[1] Q. Baudouin, N. Mercadier, V. Guarrera, W. Guerin, and R. Kaiser, Nat. Phys. 9, 357 (2013)