Tuning dipole-dipole interactions in atomic vapours via cavities

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When resonant atoms are confined inside a volume smaller than the transition wavelength λ cubed, they couple via strong dipole-dipole interactions. These interactions cause density dependent line shifts and line broadenings which have recently been studied in dense thermal vapours confined in nano-cells [1, 2]. Here we present a microscopic simulation of these experiments using the coupled dipole approach. For the first time we include the influence of the nano-cell environment on single atom properties (Casimir-Polder and Purcell effect) and atom-atom interactions. We discuss possibilities to tune the dipole-dipole interactions by design of the cavity environment. This technique may facilitate the discrimination of collisional and dipole-dipole induced shifts and provide new insights on the emergence of macroscopic vapour properties from microscopic atomic properties [3].

References

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[2] T. Peyrot et al., arXiv:1801.01773v2 (2018).

[3] J. Javanainen et al., Phys. Rev. A **96**, 033835 (2017).