UE de Communication et Approfondissement Thématique

Sujet : Thermal emission in the near field of a hot surface

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Descriptif :

The Blackbody radiation (BBR) spectrum was at the origin of quantum mechanics at the onset of the 20th century. BBR is obtained by considering photons as a bosonic gas that occupy the modes of the electromagnetic field according to Bose-Einstein statistics. At the dielectric-vacuum interface, the electromagnetic field also supports evanescent surface modes (so called plasmon or polariton modes), described by a *local* density of states that rapidly decreases away from the surface of the dielectric [1]. At the onset of the 21st century, it was shown that thermal population of evanescent modes gives a strong 'color' to thermal emission spectrum in the *near field* of the surface compared to *far-field* BBR. It was recently demonstrated, in our group, that the unusually coherent properties of near field thermal emission can be probed by measuring the energy level shifts of cesium atoms ~100 nm away from a sapphire surface [2].

The student is expected to understand the origins of the near field thermal spectrum of dielectrics [1], describe different methods that can be used for its experimental observation [1] and discuss its effects on atomic energies and lifetimes [2].

[1] A. V. Shchegrov, K. Joulain, R. Carminati, and J.-J. Greffet, "Near-Field Spectral Effects due to Electromagnetic Surface Excitations," *Phys. Rev. Lett.*, vol. 85, no. 7, pp. 1548–1551, Aug. 2000. A. Babuty, K. Joulain, P.-O. Chapuis, J.-J. Greffet, and Y. De Wilde, "Blackbody Spectrum Revisited in the Near Field," *Phys. Rev. Lett.*, vol. 110, no. 14, Apr. 2013.

[2] A. Laliotis, T. P. de Silans, I. Maurin, M. Ducloy, and D. Bloch, "Casimir–Polder interactions in the presence of thermally excited surface modes," *Nat. Commun.*, vol. 5, Jul. 2014 ; A. Laliotis and M. Ducloy, "Casimir-Polder effect with thermally excited surfaces," *Phys. Rev. A*, vol. 91, no. 5, May 2015.