

# Near-field Interference for Local Field Shaping

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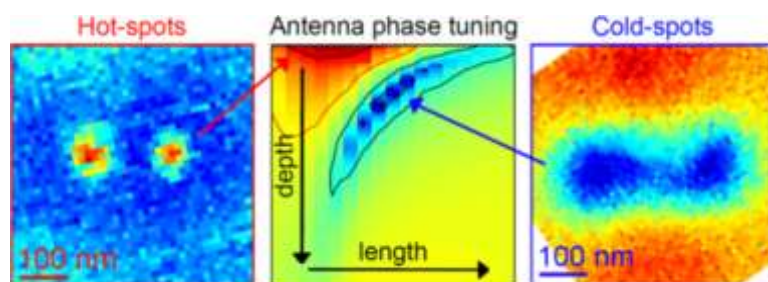
Abstract:

Optical nanoantennas are well-known for the confinement of light into nanoscale hot-spots, suitable for emission enhancement and sensing applications. Here, we show how control of the antenna dimensions allows tuning the local optical phase, hence turning a hot-spot into a cold-spot [1]. We manipulate the local intensity exploiting the interference between driving and scattered field. Using single molecules as local detectors, we experimentally show the creation of subwavelength pockets with full suppression of the driving field. Exploiting the local interference we demonstrate position control of the localised field i.e. the plasmonic hotspots in the near-field of a nanoantenna [2]. Remarkably, together with the cold excitation spots we observe inhibition of emission by the phase-tuned nanoantenna. The fluorescence lifetime of a molecule scanned in such volumes becomes longer, showing slow-down of spontaneous decay. In conclusion, the spatial phase of a nanoantenna is a powerful knob to tune between enhancement and inhibition in a 3-dimensional subwavelength volume. Moreover, the interference effect can be exploited to shape the nanoantenna near-field to produce a tailored optical response such as polarization-controlled nanoscale hotspot switching, as we show here [1-3].

## REFERENCES

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- [2] Anshuman Singh, James T. Hugall, Gaetan Calbris and Niek F. van Hulst, "Far-field Control of Nanoscale Hot-spots by Near-field Interference", *ACS-Photonics* **7**, 2381–2389 (2020); DOI: 10.1021/acsphotonics.0c01039
- [3] Nicola Palombo Blascetta, Matz Liebel, Xiaobo Lu, Takashi Taniguchi, Kenji Watanabe, Dmitri K. Efetov, Niek F. van Hulst, "Nanoscale Imaging and Control of hexagonal Boron-Nitride Single Photon Emitters by a Resonant Nano-antenna", *Nano Lett.* **20** (3), 1992-1999 (2020); DOI: 10.1021/acs.nanolett.9b05268

## FIGURES



**Figure 1:**

Hot and Cold Spots: from Enhancement to Suppression by Nanoscale Phase Tuning of Optical Nanoantennas