Tunable Fano Resonances in Colloidal Photonic Structures

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Asymmetric resonances can occur in many different experiments belonging to different fields and the way we describe them is by using a special shape U. Fano found in 1935 analysing the Rydberg absorption lines in noble gases [1]. These line-shapes are the result of two interacting resonances and the final asymmetry depends on the strength of that interaction. In photonics, they often appear in many systems like plasmons, photonic crystals or meta-surfaces, to name just a few. In this field, Important applications such as sensors, switchers or lasers are envisioned where, taking advantage of Fano line-shapes, their performance can be controlled and enhanced [2]. However, in many situations identifying the different interacting resonances is not trivial and thus, the desirable control of their interaction turns impossible.

In this talk, I will give some examples, all of them performed in colloidal photonic crystals, where such interaction can be tuned by different means. I particular, I will discuss how by controlling the number of vacancies present in a self-assembled photonic crystal one can finely tuned disorder and through it, the optical response of the system. This response can be easily correlated using the Fano formula to the interaction between band gap and the continuous provided by Mie Scattering. Further and interestingly, Fano parameter q vanishes when the system crosses the percolation threshold for vacancies [3].

References

[1] Fano, U. Il Nuovo Cimento, 12, 154 (1935) (ArXiv:cond-mat/0502210v1)
[2] Limonov, M.F. et al. Nat. Photon. 11, 543 (2017)
[3] J. A. Pariente, et al. (submitted) Preprint at ArXiv:1607.08890 (2016)

Figures

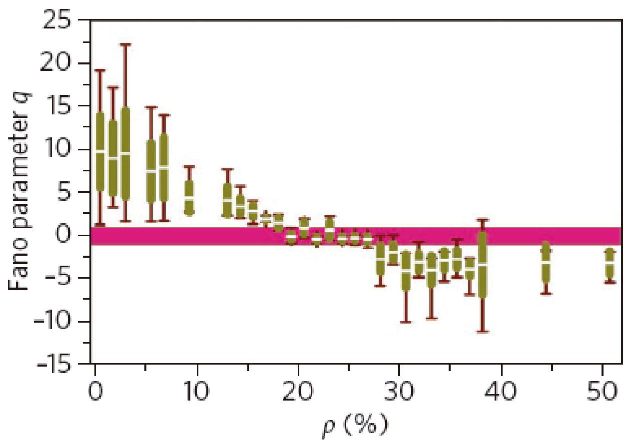

Figure 1: Fano parameter q as a function of the density of vacancies randomly included in a colloidal photonic crystal.