The optical atom: A bridge between atomic physics and optics

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The models used to describe the properties and behavior of atoms are based on several parameters fixed by nature, such as the elementary charge or Plank's constant. Ideally, we would like to be able vary these parameters and observe how the properties of the atoms changes. In this contribution we show how the optical properties of an evaporating droplet can be used to mimic an atom with a varying radius. We measured the Directional Mie Scattering of the evaporating droplets, thus cleaning the spectrum and selecting the TM modes. We observe a series of Fano resonances arranged in a comb structure, as the droplet evaporates. The explanation uses an analogy between electromagnetic light scattering and the Schrödinger equation. The effective potential in the water droplet can be described as an attractive square well potential where the step in the potential occurs at the radial boundary of the droplet. The angular momentum of the electron in an atom is here replaced by the angular momentum of light rotating inside the droplet. In the experiment we sweep in droplet size, equivalent to atom size, as the droplet evaporates. Each comb structure is related to different excited states and the resonances inside a comb are given by consecutive angular momentum numbers ℓ. The Fano nature is a consequence of tunneling through the potential barrier. From this point of view, we generate an experimental simulator that represents an atom with a knob to control its size.

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