Complex photonic systems: From nonlinear physics to physics for development

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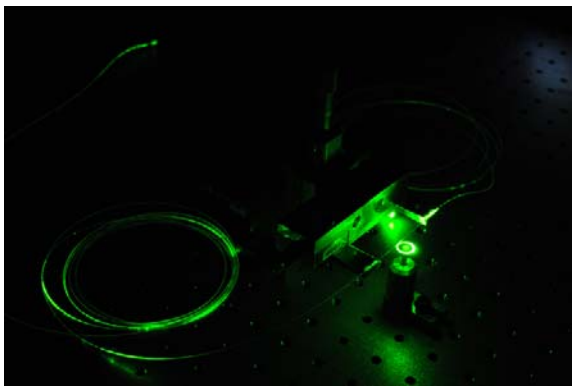

Millimeter-size whispering-gallery mode resonator coupled with a green laser. The photons, which interact quantum-mechanically, are trapped for about a microsecond inside the cavity and perform around 10000 round-trips before being annihilated.

Whispering-gallery mode resonators are optical cavities that can trap photons by total internal reflection for durations that can be exceptionally long, of the order of few microseconds. When pumped by a resonant laser, the confined and long-lifetime photons do mutually interact via the intrinsic nonlinearities of the resonators, such as Kerr, Raman or Brillouin. As a consequence, they populate the quantized eigenstates of the resonator and form optical frequency combs in the spectral domain. Whispering-gallery mode resonators can therefore be viewed as compact components able to perform all-optical information processing, thereby circumventing the bandwidth limitations induced by usual optoelectronic components. In this communication, I will present some of our latest results on this topic, at the intersection of nonlinear, stochastic and quantum phenomena in photonics.

In the second part of my talk, I will give an overview of the impact that photonics research can have in developing countries. Within the framework of the International Year of Light 2015 (IYL 2015), I have had the opportunity in recent years to collaborate intensively with African researchers on the topic of physics for development, or more precisely, photonics for development. I will provide some insights into the collaborative research we are undertaking along these lines, mostly in relation with our efforts to set up experimental laser laboratories in Africa. I will explain how international societies such as EPS, IEEE, SPIE, OSA, or ICTP are playing a key role in sustaining this research through targeted grants and financial/logistic support to student chapters. I will finally present some of the scientific results that have been obtained so far in the area of optoelectronic microwave oscillators and optical fiber systems. I will discuss as well the connection between these results and the initial objective, which was to contribute to bridge photonics research and development.