Dynamics of coupled nonlinear cavity systems

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Different materials and geometries will be employed to realize coupled nonlinear optical cavity systems, which will be studied for their complex nonlinear optical spatio-temporal dynamics. Starting from our experience with the theoretical treatment, the micro- and nanofabrication, and the experimental investigation of different highly integrated cavity concepts, the proposed research will comprise whispering gallery microdisc resonators providing ultra-high Q factors and photonic crystal cavities with ultra-small cavity volumes as well as ultra-high nonlinearities. Materials for the realization of such nonlinear cavities will include lithium niobate and fused silica. The goal of our explorative research will be the identification of ultimate limits in terms of cavity parameters, like the smallest mode volume at highest Q, and the corresponding fundamental scaling laws. Further interest lies in the development of concepts to selectively control the channels by which the cavity modes couple to the outside radiation field or couple among each other. This control will give rise to new schemes and geometries towards efficient coupling of light into and out of the cavity, being essential for any application scenario. Eventually spatio-temporal dynamics will be investigated, which result from coupling together several cavities, when different types of nonlinearity (second order and third order) are employed.
