Erwan Lucas
Su-Peng Yu, Jizhao Zhang, David R. Carlson, Travis C. Briles, Scott B. Papp

Photonic Crystal Ring Resonators as Enabling Tools for Microcomb Generation

Microcombs, that is optical-frequency combs generated in driven Kerr resonators [1], are versatile light sources that can offer unique properties for applications and integration of frequency-comb systems to a silicon chip. Indeed, microcombs have progressed through experimentation from a theoretical framework for Kerr-nonlinear optics [2] to fully self-referenced systems [3]. Integrated photonics not only allows for the miniaturization of large-scale systems, but also much richer, potentially arbitrary degrees of freedom to control guided modes of light. Photonic crystal ring resonators (PhCR) constitute an important step toward flexible tailoring of optical cavities [4]. They consist in a ring resonator in which a corrugation is added to the inner wall of the waveguide. This allows a targeted and independent control of the resonance frequencies of a cavity mode, while maintaining the ring's high quality factor (Q).
We investigate the benefits of this added control for the control and generation of microcombs in the normal dispersion regime and to implement a 'meta-dispersion' resonator by selectively controlling the resonance of multiple modes. Along with their modeling, we present some newly observed dynamics in these cavities.
The ultimate goal aims to enable more complex cavity dispersion and to tailor the nonlinear state to the needs of a targeted application, such as directly flattening the comb state for optical telecommunications.

References

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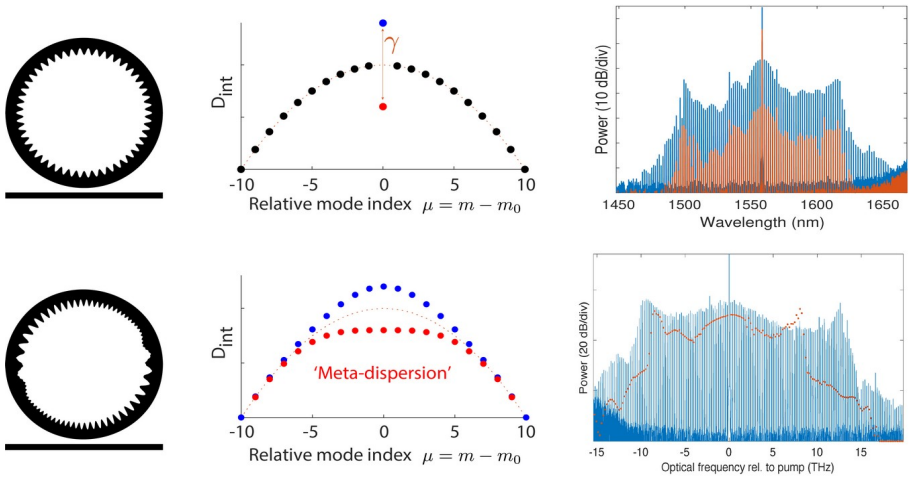

Figure 1: Comb generation in photonic crystal ring resonator. Top: single mode manipulation in normal dispersion. Bottom: meta dispersion for comb flattening.