**Nonlinear optics in 3D χ(2) structures**

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Based on quasi-phase matching (QPM) theory, 3D χ(2) structure in nonlinear photonic crystals (NPCs) can provide abundant reciprocal vectors to modulate the frequency, amplitude and phase of the light. It thus shows exciting potential for effective control of light field in a nonlinear way. Take nonlinear beam shaping as an example. Nonlinear beam shaping in 2D NPC is generally realized via nonlinear Raman-Nath process, in which the conversion efficiency is limited by the longitudinal phase mismatch. In 3D case, the transvers and longitudinal phase matching conditions can be satisfied simultaneously to enhance the nonlinear beam shaping efficiency. Another example is nonlinear holography, in which the capacity used to be severely limited by traditional multiplexing schemes. The nonlinear holography based on 3D NPC can be designed by utilizing the concept of nonlinear Ewald sphere. The reciprocal vectors located on the sphere are used to fulfil the QPM condition and to enhance the corresponding second-harmonic wave generation. By storing the image into various nonlinear Ewald spheres, one can realize nonlinear multiplexing holography in the second harmonic wave based on complete QPM condition.

**Short Bio:**

Yong Zhang received his PhD degree in Condensed Matter Physics from Nanjing University, China. He is a Professor at College of Engineering and Applied Sciences and National Laboratory of Solid State Microstructures, Nanjing University. He has been dedicated to the researches on lithium niobate micro/nano structures and their applications in nonlinear and quantum optics. He has published more than 100 journal papers including Nature, Nature Photon., Phys. Rev. Lett., Light Sci. Appl., Nature Commun., etc.