

Efficient Harmonic Generation and Frequency Conversion in Multi-Mode Cavities

Technology #12482

Applications

Efficient harmonic generation and frequency conversion scheme is useful in high-frequency sources, ultra-compact coherent optical sources, imaging, and spectroscopy.

Problem Addressed

In nonlinear frequency conversion, light at one frequency co-propagates with the generated light at the harmonic frequency. Previous experimental and theoretical work on second-harmonic generation in cavities has largely focused on cavities with a single resonant mode at the pump frequency. Such structures require high input power. Second-harmonic generation in a doubly resonant cavity, with a resonance at both the pump and harmonic frequency, has previously been analyzed only in the limit where nonlinear down-conversion can be neglected. Previous work on third-harmonic generation in cavities, similarly, considered only singly resonant cavities; moreover, past work focused on the case of $\chi^{(2)}$ materials where 3ω is generated by cascading two nonlinear processes (harmonic generation and frequency summing). Furthermore, the previous theoretical work, with a few exception, focused on one-dimensional Fabry-Perot cavity geometries, in which the problem of obtaining cavity modes with the correct frequency ratio was posed as a problem of phase-matching, and addressed by methods such as using off-normal beams.

Technology

This invention is a doubly-resonant cavity structure having a plurality of resonant modes. The invented cavity allows total frequency conversion for second or third-harmonic generation using $\chi^{(2)}$ and $\chi^{(3)}$ nonlinearities between the cavity structures. The total frequency conversion is efficiently optimized by determining a critical power for the process of the total frequency conversion, and this critical power depends only on parameters of the cavity structure. The invention can achieve 100% frequency conversion with milliwatts of power, and can have intense light in cavity, without the phase-matching problem.

Advantages

- No frequency conversion saturation point; frequency conversion peaks at 100%
- Efficient harmonic generation and frequency conversion

Categories For This Invention:

Photonics

Data Communications

Telecommunications

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Intellectual Property:

Efficient harmonic generation and frequency conversion in multi-mode cavities
Issued US Patent
7,768,694

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Publications:

χ (2) and χ (3) harmonic generation at a critical power in inhomogeneous doubly resonant cavities
Optics Express
Vol. 15, Issue 12, pp. 7303-7318 (2007)

External Links:

Photonics and Modern Electro-magnetics Group
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