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Theoretical comparison of SHG and SFG efficiencies for visible light generation

Knud Palmelund Sørensen[1], Peter Tidemand-Lichtenberg[1], Martin Thalbitzer Andersen[1], Preben Buchhave[1] and Christian Pedersen[2]

[1]DTU Physics, Technical University of Denmark, DK-2800 Lyngby, Denmark
[2]DTU Fotonik, Technical University of Denmark, Risø, DK-4000 Roskilde, Denmark
tidemand@fysik.dtu.dk

Abstract: Theoretical results comparing the conversion efficiencies of intra-cavity second harmonic generation and single-resonant sum-frequency generation are presented. Previously most visible solid-state light sources have been based on SHG of diode-pumped NIR solid-state lasers. Simple linear cavity designs using intra-cavity SHG have resulted in high conversion efficiencies. However, power fluctuations coursed by "green noise" have significantly limited the applications of these devices. It has also been know for many years, that "green noise" is eliminated in singly-resonant systems. In this poster it is shown theoretically that power conversion efficiencies exceeding those found in intra-cavity SHG systems can be reached using singly-resonant sum-frequency generation between two coherent light sources. Using realistic values for the non-linear materials it is possible to generated output powers in the visible exceeding those obtained from intra-cavity SHG based systems and at the same time overcome the problem of "green noise". The simulations do, however, indicate a new type of instabilities occurring at high nonlinear coupling efficiencies even in singly-resonant configurations.

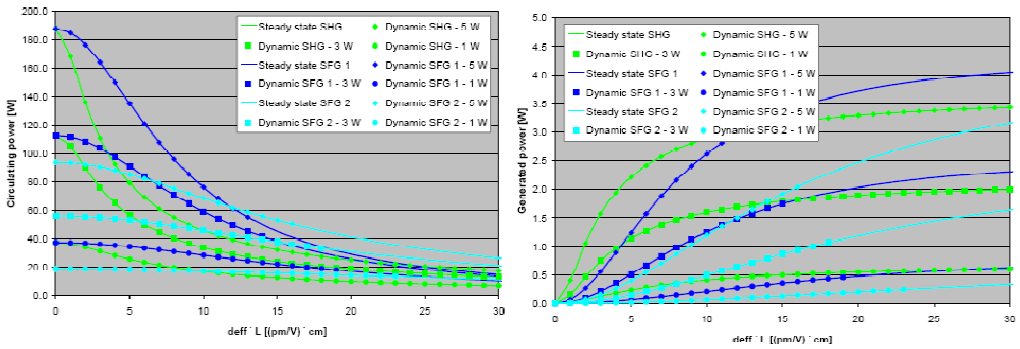

Fig. 1. The left graphs show the circulating power in the high finesse cavity as a function of non-linear crystal parameter. The right set of graphs show the generated power in the visible (SHG 532 nm and SFG 460 nm). The three different colors correspond to SHG (green graph), SFG with on pump passed through non-linear crystal and then used as pump for the laser (blue graph) and SFG using two separates pumps for the non-linear and laser crystal respectively each with half the power (turquoise graph). The points on the graphs indicate stable points of operation.