# Efficient nonlinear frequency conversion scheme for cladding-pumped fiber lasers

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High-power visible laser sources have a diverse range of applications. For the continuous-wave operating regime the most popular approach for generating visible output is via intracavity frequency doubling in a 'bulk' solid-state laser. However, this approach is limited by the effects of heat generation to relatively modest power levels. Fiber lasers have a geometry that is relatively immune to thermal effects and hence offer the prospect of much higher power in the visible regime. Unfortunately, the technique of intracavity second harmonic generation is not well-suited to fiber lasers due to their high resonator losses.

Here we present a simple scheme for efficient frequency doubling in cladding-pumped continuous-wave fiber lasers. Our approach employs a fiber laser resonator containing an internal resonant enhancement cavity with a nonlinear crystal for frequency doubling. The fiber laser automatically lases on axial modes which are simultaneously resonant in the enhancement cavity and main cavity. As a result, the power in the enhancement cavity is increased to many times the extractable continuous-wave power, leading to high second harmonic conversion efficiency. In contrast, to external resonant frequency doubling, our approach does not require a single-frequency source and there is no need for active cavity length stabilization. Using this scheme we have generated ~19W of stable green output at 540 nm from an Yb doped fiber laser cladding-pumped with ~90 W of diode power at ~975 nm. The prospects for further improvement in performance in terms of output power, conversion efficiency and wavelength coverage will be discussed.

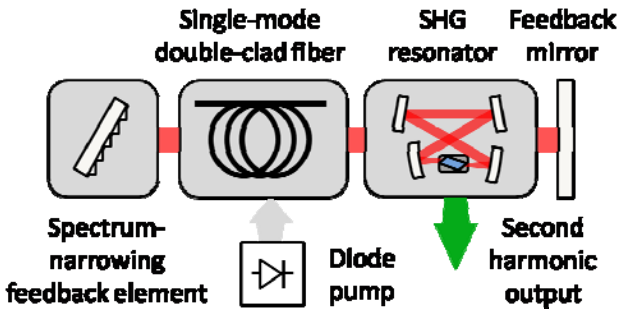


Fig.1: Internal resonantly-enhanced frequency doubling in a fiber laser.