ICFO

the ultraviolet

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PhD Thesis Defense High-Power, fiber-laser-pumped frequency conversion sources for the ultraviolet

ENRIQUE SANCHEZ BAUTISTA

November 26, 2015

Thursday, November 26, 11:00. ICFO Auditorium
ENRIQUE SANCHEZ BAUTISTA

Optical Parametric Oscillators

ICFO-The Institute of Photonic Sciences, SPAIN
High-power, stable, high-repetition-rate, picosecond ultraviolet (UV) sources are of crucial importance for a variety of applications, such as atmospheric sensing, spectroscopy or optical data storage. Further, precise material processing or laser patterning requires high energy sources with ultrashort pulses for increased accuracy.
Nonlinear, single-pass, frequency conversion sources present a highly effective and simplified approach to cover the UV spectral regions inaccessible to lasers, offering potential

solutions for many of the applications mentioned above. The development of high-average-power UV sources through third- and fourth-harmonic generation (THG and FHG, respectively) of 1064 nm fiber lasers in nonlinear crystals is of particular importance due to their compact footprint, high efficiency, long lifetime, excellent stability and cost-effective design. The features of these sources are strongly dependent on the choice of the nonlinear crystal. For UV generation, this choice is particularly challenging when low-intensity picosecond pulses at high repetition rates are involved. Borate-based birefringent crystals are the most viable candidates for UV generation in the absence of suitable periodically-poled nonlinear materials, and are readily available.

This thesis presents the development of High-power, stable, high-repetition-rate, picosecond ultraviolet (UV) sources are of crucial importance for a variety of applications, such as atmospheric sensing, spectroscopy or optical data storage. Further, precise material processing or laser patterning requires high energy sources with ultrashort pulses for increased accuracy.

This thesis presents the generation of the second- and third-harmonic of a high-power, picosecond Yb-fiber laser at 1064 nm, delivering excellent stability and high quality beam profile.

Moreover, efforts to refine the THG efficiency led to a successful improvement of the aforementioned fiber-based source at 355 nm. This was achieved by deploying a single-pass second-harmonic generation (SHG) under noncritical phase-matching in LiB_3O_5 (LBO) crystal, which considerably enhanced the output power and improved the overall performance with regard to stability and beam quality in the green, that are technologically important for a diverse range of technological applications. The obtained results at 355 nm confirm the viability of BIBO as a highly attractive material for efficient generation of low-intensity, high-average-power picosecond pulses in the UV.

Further, we demonstrated a fiber-based high-repetition-rate UV source at 266 nm based on single-pass FHG in BBO crystal in a simple and practical design. Using direct single-pass SHG

of 1064 nm in LBO as a pump source for the BBO crystal, 1.7 W of output power at 266 nm was generated in a high beam quality with excellent stability and spectral features. This compact and robust design represents the highest single-pass efficiency and average power of a MHz-repetition-rate picoseconds UV source at 266 nm ever demonstrated.

Thursday November 26, 16:00 h. ICFO Auditorium

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