a single cycle of wide-range smooth scanning amounts to 7–7.5 GHz for the fundamental wave and 14–15 GHz for the second harmonic radiation (the parameters for the fundamental wave were calculated from those measured for the second harmonic radiation). Therefore, the entire smooth scanning range achieved for the second harmonic radiation is 240-GHz wide and consists of 17 spectrally stitched individual continuous tuning ranges with the average width of ~14.5 GHz.

Table 1. Overview of the laser parameters expressed in frequency units

Parameter	Value, GHz
FSR of the laser cavity	0.6
Frequency offset produced by PZT of M3 mirror, 1064 / 532 nm	9 / 18
Overlapping ranges of smooth frequency tuning, 1064 / 532 nm	1.5–2 / 3–4
Effective width of smooth frequency tuning range, 1064 / 532 nm	7–7.5 / 14–15
Total smooth frequency scanning range, 1064 / 532 nm	120 / 240

It is pertinent to note that the term "generation frequency tuning" used in numerous publications on single-frequency Nd:YVO_4 lasers [9–16] does not always imply smooth adjustment of the laser's output frequency. This term may refer, for instance, to the possibility of setting any (or a specific) wavelength within the specified spectral range. Generally, this does not preclude mode hopping in the process of frequency tuning [12, 14–16] and furthermore does not guarantee automatic continuous or quasi-continuous scanning of the generation frequency over the entire specified spectral range.

3. Conclusion

The authors of the present work proposed and practically implemented a method of smooth automatic output frequency tuning in a single-frequency Nd:YVO_4 laser with intra-cavity second-harmonic generation, achieving quasi-continuous tuning of the laser's fundamental (1064 nm) output frequency within the range of 120 GHz and of the laser's second-harmonic (532 nm) output correspondingly over the range of 240 GHz. The proposed method relies on two electro-mechanically driven intra-cavity low-finesse Fabry-Perot etalons and an external high-finesse scanning Fabry-Perot interferometer for spectral stitching of individual ranges of continuous laser frequency tuning. The experimental results achieved during the conducted studies demonstrate a practical possibility of using this method to achieve quasi-continuous scanning of the generation frequency in a laser with intra-cavity SHG across spectral ranges of around 0.5-nm width and wider. The demonstrated algorithm of automatic laser frequency adjustment may be advantageously applied in many CW diode-pumped solid-state lasers with intra-cavity SHG (Nd:YAG/YLF/YAP, Yb:YAG/LuAG, and others) that use analogous configurations of a ring cavity to ensure single-frequency operation. Furthermore, this algorithm will also be useful in tuneable single-frequency lasers with intra-cavity SHG, in which the two-etalon smooth frequency tuning range is limited to around 0.5–1 nm by a coarser wavelength selector, such as a birefringent filter [17].

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