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Tuneable powerful UV laser system with UV noise eater

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*THE REAL SCIENCE

INTRODUCTION

The present work reports for the first time on development and experimental study of a laser system based on a CW dye-jet laser with intracavity radiation frequency doubling, which provides output radiation power of up to 250 mW at the fibre delivery exit over the 275–310-nm range, while featuring the output radiation line width of less than 5 GHz and UV radiation power instability within 1%.

Developed laser system can automatically set the output radiation wavelength within the range of 275–310 nm to the precision of 2 pm.

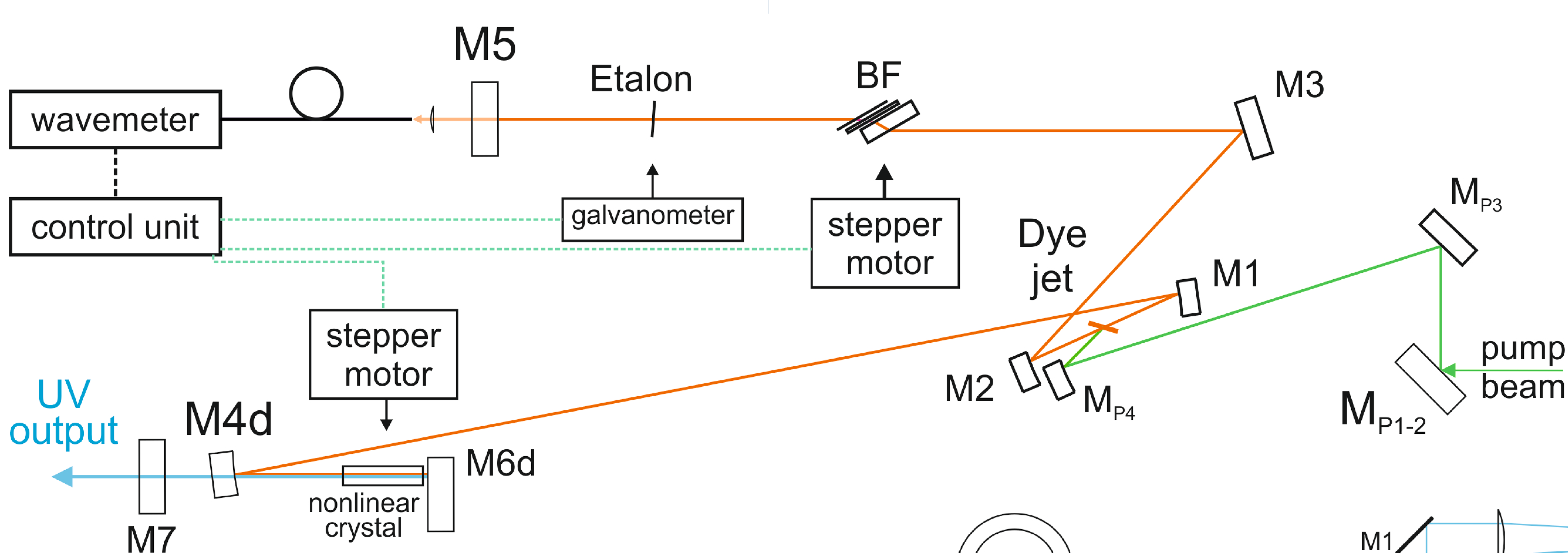


Fig. 1. Diagram of the studied tuneable UV laser system: BF – birefringent filter, Mp – mirrors guiding the pump radiation into the laser, M1–M6 – cavity mirrors, M7 – dichroic spectral filter.

The output radiation wavelength was controlled with a wavelength meter to a precision of 1 pm within the 400–1100-nm range. AutoWaveSet© technology was used for automatic wavelength setting down to the precision of the radiation line width in generation of both the fundamental and second harmonics, as well as for 'stitching' of continuous wavelength tuning ranges of the laser system (each of these ranges was 206-GHz wide). This technology is capable of precisely tuning the laser system to a dialled wavelength using only a wavelength meter and no other sensors or detectors.

UV Noise Eater

Commercial noise eaters are available for the visible and IR ranges, but the corresponding solutions for the UV light are still at the stage of development. In our method the attenuation element adjusting transmission of the input UV radiation consists of a fibre and a tilted quartz plate for guiding the radiation into the fibre. Adjustment of the tilt angle of the quartz plate leads to the corresponding displacement of the input beam relative to the fibre core. Thus, the fibre and the quartz plate form an element for adjustment of the fraction of the input radiation fed into the fibre.

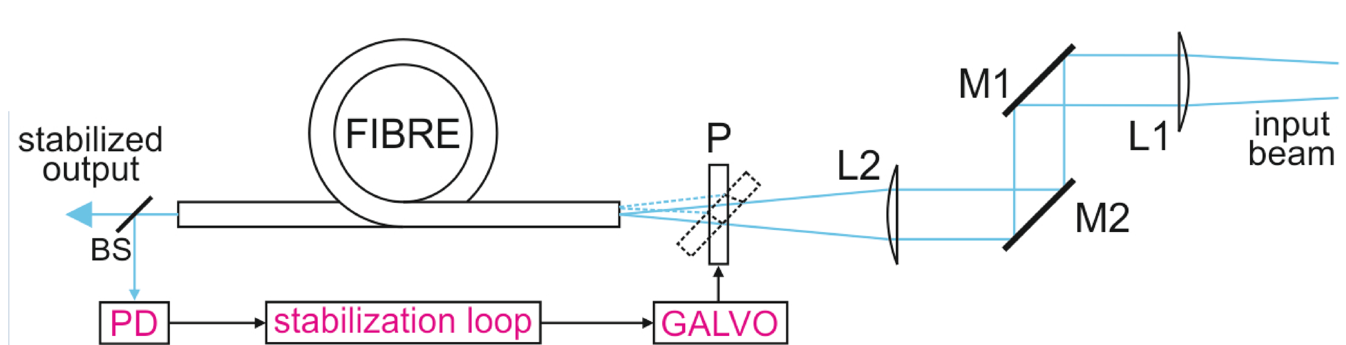


Fig. 2. Diagram of the proposed fibre-based UV noise eater: BS – beam splitter, PD – photodetector, P – quartz plate with AR coatings, L1, L2 – lenses, M1, M2 – totally reflective mirrors.

When using fast galvo drive (e.g. 62xxH Series Galvo made by Cambridge Technology) and a small quartz plate, the system has a response time of < 0.1 s and may be used for long-term stabilisation of radiation power exiting fibre.

We report, for the first time, the development of a UV noise eater based on a different principle as compared to the available noise eaters.

RESULTS

Long-term instability of the second-harmonic radiation does not exceed 1% at 150 mW exiting the fibre. The highest recorded second-harmonic power at 290 nm was over 200 mW when pumped with 12 W at 532 nm.

The intra-cavity SHG inside the laser cavity offers a significantly simpler solution for UV tunable source.

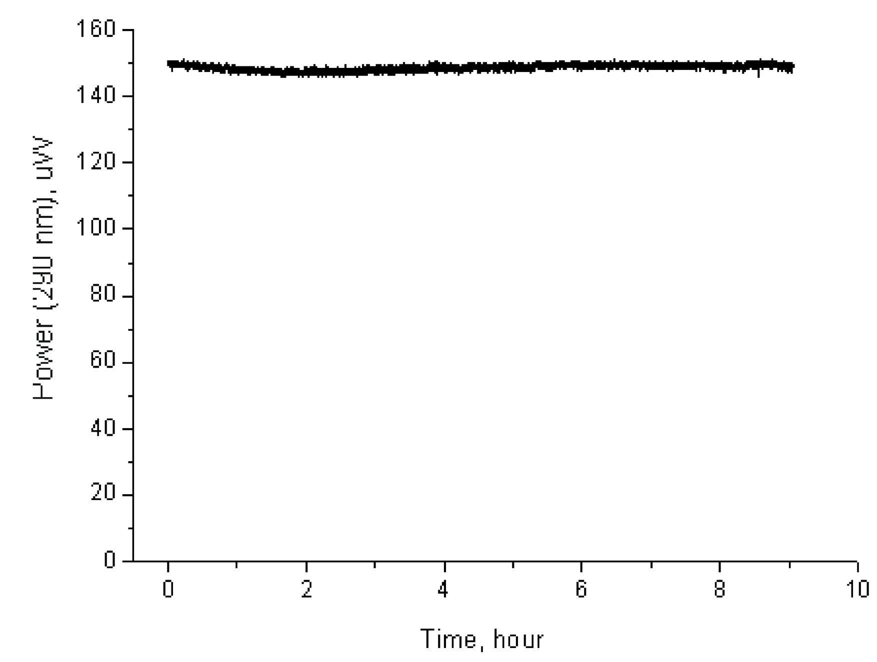
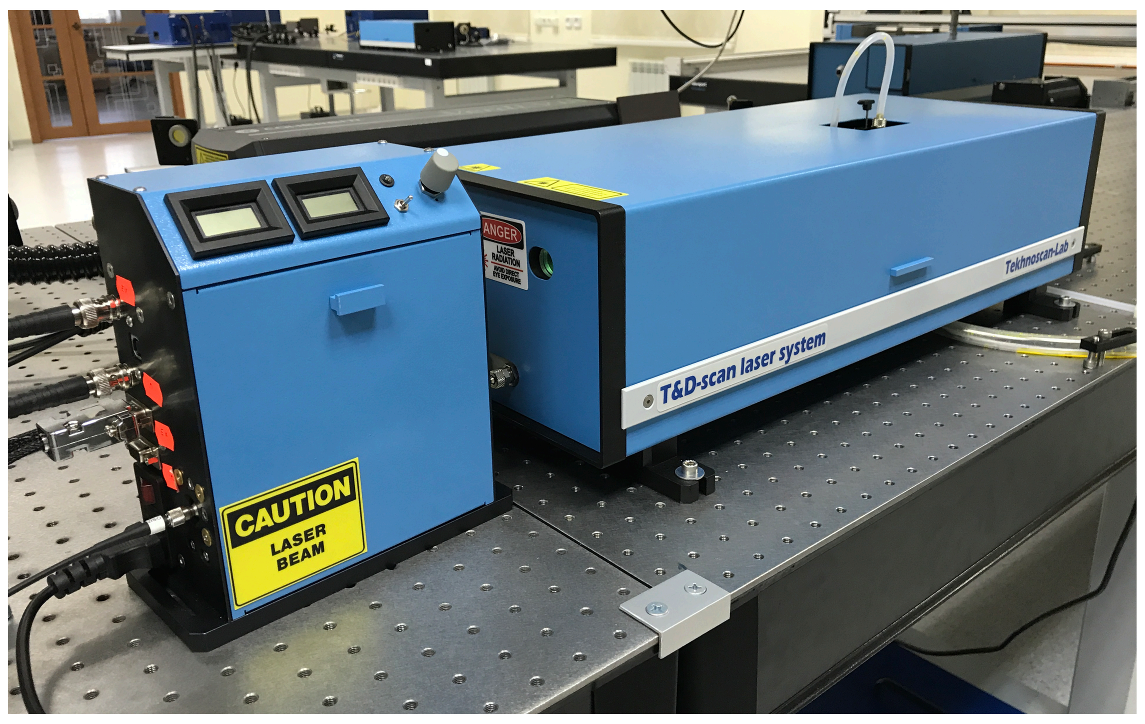


Fig. 3. Time trace of the second-harmonic radiation from a T&D-scan laser system at 290 nm.



CONCLUSIONS

The developed tuneable laser system with a noise eater based on an original design ensures continuous UV radiation output at the level of several hundred mW within the 275–310-nm range with the output line width narrower than 5 GHz. The proposed technology of fibre-based noise eater is universal and makes this noise eater applicable also in visible and IR spectral ranges, while ensuring better than 1% long-term stability of the second-harmonic radiation power.

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