

Editorial

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The European Optical Society Annual Meeting, EOSAM 2024, covered the full breadth of optics and photonics through a rich combination of topical meetings, focused sessions, tutorials, and industrial presentations. The 12th edition of the event was organized onsite in Napoli, Italy, from 9 to 13 September 2024, and was hosted by the University of Napoli Federico II, one of the oldest public universities in the world. The city with its unique blend of history, culture, and Mediterranean energy, provided an ideal setting for dialogue and collaboration within the international optics community. The conference brought together nearly 500 participants from 36 countries, including researchers, students, industry professionals, and leading experts. With 470 accepted contributions across 13 topical meetings and 4 focused sessions, EOSAM 2024 offered a comprehensive view of current developments in fields such as nonlinear optics, frequency combs, ultrafast science, optical coatings, beam shaping, metrology, and resonator physics. The scientific program was complemented by high-level plenary talks, a poster session, a vibrant exhibition, and special industry events. The meeting confirmed the growing impact of optics and photonics as key enabling technologies for scientific progress, sustainable development, and innovation in Europe and beyond.

Following the 12th EOSAM, this issue of the *Journal of the European Optical Society – Rapid Publications* (JEOS-RP) gathers fifteen papers that reflect the scientific diversity and vitality of the conference. Topics range from nonlinear optics and ultrafast dynamics to advanced optical coatings, from microfabrication strategies to resonator theory and metrology. This collection includes thirteen original research articles, one short communication, and one review article.

A central thread in this issue is the exploration of nonlinear and ultrafast phenomena. The review by Laurell et al. provides an authoritative and historically informed overview of backward-wave optical parametric oscillators (BWPOs), discussing their fundamental principles, design strategies, and applications in tunable coherent sources [1]. Building on the theme of frequency generation, Talenti et al. report a dual-nonlinearity approach in AlGaAs microresonators that combines $\chi^{(2)}$ and $\chi^{(3)}$ processes for efficient microcomb production, enabling flexible on-chip frequency synthesis [2]. In a more application-driven context, Staels et al. address a well-known limitation of multipass pulse compressors – residual phase distortion – by implementing a pulse-cleaning scheme that restores near-ideal temporal contrast [3]. The short communication by Glasset et al. contributes a focused study on chaotic dynamics and type-I intermittency in passively Q-switched Tm:YLF lasers, revealing critical thresholds for stable operation in the mid-infrared [4].

Several papers investigate materials and fabrication techniques that enhance or control light-matter interaction. Bärtschi et al. introduce a multilayer design based on quantized nanolaminates of Ta₂O₅ and SiO₂, fabricated with precise thickness steps to achieve high reflectivity in the ultraviolet, relevant for advanced mirror coatings [5]. Divay et al. explore hybrid material integration by coating optical microfibers and nanowires with TiO₂ and PMMA, thereby modifying their nonlinear optical response and opening up routes for integrated fiber-based nonlinear devices [6]. Belkner et al. propose an integrated system combining laser direct writing and chromatic confocal metrology, which allows for complex, three-dimensional structuring on curved surfaces with in-line feedback, a valuable tool for micro-optical prototyping [7]. Koch et al. investigate the relationship between surface roughness and infrared laser absorption in fused silica components, demonstrating how increased micro-roughness enhances localized heating through multiple internal reflections. Their findings support the development of laser-assisted grinding processes for optical and ceramic materials, highlighting both thermal efficiency and material compatibility [8].

The theme of optical metrology and resolution enhancement is addressed from both theoretical and practical standpoints. Hüser et al. present a thorough experimental investigation of microsphere-assisted microscopy, assessing resolution gains across different imaging configurations and highlighting practical limits in confocal and interferometric modes [9]. Nouri et al. offer a broad perspective on dimensional metrology, reviewing a variety of strategies – from digital twins to through-focus scanning – capable of improving measurement fidelity in label-free and structured-light systems [10]. Dierke et al. quantify the thermal sensitivity of the focal plane in modulation transfer function (MTF) setups, an important contribution for long-term stability in precision imaging [11]. Scholz et al. revisit the Cat’s Eye alignment used in asphere

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interferometry, showing how geometric and positioning errors propagate into measurement uncertainty and proposing improved calibration procedures [12]. Higuchi et al. present a sinusoidal phase modulation interferometer capable of measuring 2-dimensional in-plane displacements with sub-nanometer resolution at a sampling rate of 5 kHz. The system, based on high-speed cameras and electro-optic modulators, enables real-time analysis of dynamic deformations and air-induced wavefront aberrations, with potential applications in precision interferometry and astronomical instrumentation [13].

Finally, two articles delve into the modeling and computational design of structured light and resonant systems. Hofmann et al. propose an advanced iterative algorithm to derive phase masks that shape both beam intensity and thermal distribution in 3D, with relevance for amplifier engineering and laser processing [14]. Wu et al. contribute a theoretical analysis that starts from first principles to derive a full dynamical model of optical resonators from Maxwell's equations, bridging a gap between field theory and practical coupled-mode approximations [15].

We thank all the authors for their valuable contributions and the reviewers for their thoughtful assessments. We are confident that this collection will serve as a useful reference for researchers working at the forefront of optics and photonics, and a testimony to the scientific quality presented at EOSAM 2024.

References

- 1 Laurell F, Pasiskevicius V, Backward-wave optical parametric oscillators: principles, applications, and recent advancements, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 25 (2025). <https://doi.org/10.1051/jeos/2025023>.
- 2 Talenti FR, et al., Interplay of $\chi^{(2)}$ and $\chi^{(3)}$ effects for microcomb generation, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 23 (2025). <https://doi.org/10.1051/jeos/2025018>.
- 3 Segundo Staels VW, Conejero Jarque E, San Roman J, Phase compensation scheme to achieve clean pulses from a multipass cell post-compression setup, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 18 (2025). <https://doi.org/10.1051/jeos/2025015>.
- 4 Glasset M, Dupont H, Georges P, Druon F, Type-I intermittency route to the chaos in passively Q-switched Tm:YLF laser emitting at 2.3 μm , *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 14 (2025). <https://doi.org/10.1051/jeos/2025010>.
- 5 Bärtschi M, et al., UV coatings using Ta₂O₅-SiO₂ quantized nanolaminates, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 24 (2025). <https://doi.org/10.1051/jeos/2025021>.
- 6 Divay L, et al., Thin layer deposition of TiO₂ and PMMA on optical micro or nano fibers for nonlinear optics, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 15 (2025). <https://doi.org/10.1051/jeos/2025009>.
- 7 Belkner J, et al., An integrated exposure and measurement tool for 5-DOF direct laser writing based on chromatic differential confocal sensing, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 27 (2025). <https://doi.org/10.1051/jeos/2025017>.
- 8 Koch S, et al., Investigations into temperature measurement in a laser-based heating process of optical, machined components, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 22 (2025). <https://doi.org/10.1051/jeos/2025020>.
- 9 Hüser L, et al., Microsphere-assistance in conventional, interference and confocal microscopy – modeling and experimental results, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 16 (2025). <https://doi.org/10.1051/jeos/2025011>.
- 10 Nouri M, et al., Resolution enhancement methods in optical microscopy for dimensional optical metrology, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 7 (2025). <https://doi.org/10.1051/jeos/2025002>.
- 11 Dierke H, Schake M, Influence of ambient temperature changes on the focus point for measurements of the modulation transfer function MTF, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 20 (2025). <https://doi.org/10.1051/jeos/2025012>.
- 12 Scholz G, Evers D, Fortmeier I, Investigation of the positioning accuracy of the Cat's Eye as a reference position in asphere-measuring interferometry, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 19 (2025). <https://doi.org/10.1051/jeos/2025016>.
- 13 Higuchi M, Sato T, Aketagawa M, 2-dimensional in-plane displacement measurement system at fast sampling rate of 5 kHz using sinusoidal phase modulation interferometer, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 32 (2025). <https://doi.org/10.1051/jeos/2025028>.
- 14 Hofmann O, Buske P, Kurth R, Bonhoff A, Holly C, Beyond the IFTA – Phase mask generation for 3D laser beam shaping, tailored temperature distributions and optical amplifiers, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 17 (2025). <https://doi.org/10.1051/jeos/2025013>.
- 15 Wu T, Zarouf R, Lalanne P, On the exact Maxwell evolution equation of resonator dynamics, *J. Eur. Opt. Soc.-Rapid Publ.* **21**(1), 5 (2025). <https://doi.org/10.1051/jeos/2024048>.