

Volume 20 Issue 6, June 2026

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Ultrafast nonlinear optics

A high-energy (MeV) electron excitation of a semiconductor induces an ultrafast nonlinear optical response near the bandgap. As a result, transient carrier dynamics modulate band-edge transmission on picosecond timescales, enabling a new route to probe radiation–matter interactions.

See [Jeong et al.](#)

Image: Ella Maru Studio. Cover design: Bethany Vukomanovic

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05 Jun 2026

The thin line for optical neural networks towards broad practical relevance

Optical neural networks promise unmatched efficiency, bandwidth, and latency — critical benefits as demand for neural network hardware surges. However, their practical value for general-purpose acceleration or specialized applications must be proven under application-realistic conditions. We discuss recent insights and outline key research priorities.

Anas Skalli & Daniel Brunner

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News & Views

- News & Views**

05 Jun 2026

Time-varying photonics enables polarization control

All-optical pumping of an isotropic aluminum zinc oxide film near its epsilon-near-zero regime enables dynamic polarization control on sub-picosecond timescales by generating birefringence, dichroism and optical activity.

Sangwan Sim
- News & Views**

05 Jun 2026

Implosion carving shrinks 3D-printed nanostructures

Laser-patterning a swollen hydrogel followed by controlled shrinkage enables the fabrication of high-refractive-index-contrast, nanometre-scale 3D photonic structures for visible-light applications.

Pavel Ruchka & Harald Giessen
- News & Views**

05 Jun 2026

Watching ionization in a new light

Ultrafast MeV electron pulses are found to induce a surprisingly strong modulation in the optical transmission of common semiconductors, enabling room-temperature detection of ionizing radiation with sub-10-ps timing precision. The findings could lead to next-generation medical imaging and radiation diagnostics.

Zhiyuan Wang & Renkai Li
- News & Views**

05 Jun 2026

Is ball lightning a relativistic soliton?

Ball lightning is not fully understood. It has been proposed that a stable lump of electromagnetic energy, known as a soliton, could be responsible, but such structures are usually microscopic. Now, high-power laser experiments have produced millimetre-scale relativistic solitons, indicating that they could indeed explain the phenomenon.

Sergei Bulanov
- News & Views**

05 Jun 2026

Metasurfaces bridge the terahertz gap

A carefully engineered nonlinear metasurface enables widely tunable, continuous-wave terahertz emission at room temperature, offering a compact and efficient route into a long-elusive spectral region.

Sarah Elghazaly & Euclides Almeida
- News & Views**

05 Jun 2026

Opto-magnetic hands

Jacopo Fregoni

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Review Articles

Review Article

11 May 2026

Temporal solitons and frequency combs in quadratic resonators

Dissipative quadratic solitons and corresponding frequency combs are reviewed, along with their new applications.

Nicolas Englebert, Robert M. Gray ... Dmitry V. Skryabin

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Articles

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03 Apr 2026

All-optical polarization control in time-varying low-index films via plasma symmetry breaking

Femtosecond pumping of an isotropic low-index subwavelength film enables ultrafast polarization control, with induced birefringence up to $0.1\pi \mu\text{m}^{-1}$, a dichroic ratio of $\sim 23\%$ and a non-reciprocal optical activity of $\pm 1.1^\circ \mu\text{m}^{-1}$.

Wallace Jaffray, Sven Stengel ... Marcello Ferrera
- Article**

19 Mar 2026

Surface acoustic wave Brillouin photonics on a silicon nitride chip

Strong stimulated Brillouin scattering is incorporated in a standard silicon nitride platform via a tellurium oxide layer. The authors demonstrate applications including a silicon-nitride-based Brillouin amplifier (net optical gain, 5 dB), a compact intermodal stimulated Brillouin laser capable of high-purity radio-frequency signal generation (intrinsic linewidth, 7 Hz) and a widely tunable microwave photonic notch filter (ultranarrow linewidth, 2.2 MHz).

Yuan Klaver, Randy te Morsche ... David Marpaung
- Article**

13 Apr 2026

Internal homojunction Sb₂Se₃ solar cell

A thermally evaporated Sb₂Se₃ solar cell featuring an internal n-type/p-type homojunction achieves a power conversion efficiency of 10.15% with a voltage deficit of 0.459 V.

Junjie Yang, Jianyu Li ... Tao Chen
- Article**

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12 May 2026

Isotropic shrinkage of patterned vacancies enables three-dimensional nanoprecise metastructures for visible light applications

A method that combines photopatterning with 10-fold shrinkage can fabricate three-dimensional metastructures with nanoscale features for applications with visible light.

Quansan Yang, Gaojie Yang ... Edward S. Boyden
- Article**

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15 Apr 2026

Optical convolutional spectrometer

A centimetre-scale convolutional spectrometer offers high performance, low cost and ~ 500 -nm bandwidth. The system classifies diverse solid samples and quantifies concentrations of solutions with detection accuracy surpassing commercial benchtop spectrometers.

Chunhui Yao, Jie Ma ... Qixiang Cheng
- Article**

31 Mar 2026

Organic intercalation strategy for efficient all-evaporated perovskite light-emitting diodes

A sequential deposition method combined with a multifunctional organic additive enables sky-blue all-thermally evaporated perovskite light-emitting diodes with a peak external quantum efficiency of 20.15%, as well as their integration into an active-matrix display prototype.

Chencheng Peng, Zhiyuan He ... Lei Wang
- Article**

27 Apr 2026

Minimizing strain for ultra-stable tin perovskite LEDs

An optimized thermal evaporation process for tin-based perovskites enables precise strain engineering in the perovskite layer, resulting in perovskite light-emitting diodes with a half-lifetime of 1,250 h at a constant current density of 100 mA cm^{-2} and a peak external quantum efficiency of 6.6% for emission at 944 nm.

Weidong Tang, Gan Zhang ... Dawei Di
- Article**

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20 Apr 2026

Strong ultrafast nonlinear optical response from megallectronvolt electrons in semiconductors

Nonlinear optical responses of semiconductors induced by 150-fs and 4.2-MeV electron pulses are investigated. Sub-10-ps bandgap modulations with intensities up to 24.5% are observed near the bandgap and are explained by the band-filling effect and bandgap renormalization.

D. Jeong, T. R. Hopper ... C. S. Levin
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14 Apr 2026

Interferometric measurement of nuclear resonant phase shift with a nanoscale Young double waveguide

A nanoscale X-ray double-waveguide interferometer is developed to measure the phase shift due to the 14.4-keV nuclear resonance of the Mössbauer isotope ⁵⁷Fe. The phase shift is extracted from just a few single-photon interference measurements using Bayesian inference.

Leon M. Lohse, Ankita Negi ... Tim Salditt
- Article**

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16 Apr 2026

Generation of continuous-wave 1–11 THz radiation with intersubband polaritonic metasurfaces

Tunable continuous-wave terahertz radiation spanning 1–11 THz is generated at room temperature via difference-frequency generation process in nonlinear metasurfaces. Milliwatt-level terahertz output is achieved by pumping the metasurfaces with two milliwatt-level continuous-wave mid-infrared lasers.

J. H. Krakosky, M. Rieder ... M. A. Belkin
- Article**

29 Apr 2026

Atomically dense Sb₂O₃ interlayer for highly stable perovskite photovoltaic modules

An Sb₂O₃ interlayer at the perovskite/electron transport layer interface increases the reverse-bias resistance of the cells to $\sim 22.3 \text{ V}$. Modules with an area of 62.37 cm^2 achieved a certified power conversion efficiency of 23.1%, 96% of which was maintained after 1,000 h of operation at 65 °C.

Teng Cheng, Ying Zhang ... Qi Chen
- Article**

04 May 2026

Molecular quantum-dot orbital hybridization supports efficient endothermic singlet exciton fission

Hybridization of molecular and quantum-dot energy levels aids singlet exciton fission.

Jie Zhang, Hayato Sakai ... Masanori Sakamoto
- Article**

03 Jun 2026

Single-shot full-field X-ray imaging with 10-nm resolution using hard X-ray free-electron laser pulses

Using X-ray free-electron laser pulses with mirror optics to generate a sub-10-nm focal spot and an algorithm to compensate for fluctuations in illumination, this study demonstrates single-shot in-line holography for femtosecond imaging with a field of view exceeding 1 μm and a spatial resolution of 10 nm.

Gota Yamaguchi, Jumpei Yamada ... Makina Yabashi
- Article**

16 Apr 2026

Ball-lightning-like relativistic terahertz solitons

When a femtosecond laser is focused onto a tungsten tip, excited surface plasmon polaritons form a relativistic terahertz soliton at the tip apex in a supersonic argon jet. It exhibits sustained stability over 100-ns durations and 400- μm spatial dimensions and resembles ball lightning.

Chuliang Zhou, Dongdong Zhang ... Ruixin Li

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Amendments & Corrections

- Author Correction**

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06 May 2026

Author Correction: Quantum state processing through controllable synthetic temporal photonic lattices

Monika Dhinwa, Farzam Nosrati ... Roberto Morandotti
- Author Correction**

05 May 2026

Author Correction: Universal routing of light via optical thermodynamics

Heddyeh M. Dinani, Georgios G. Pyrialakos ... Mercedeh Khajavikhan

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