Institut für Festkörperphysik

Abteilung Atomare und Molekulare Strukturen

Leibniz Universität Hannover

Vortragsankündigung

Montag, den 03.07.2023
um 14:00 Uhr
Seminarraum 001
Schneiderberg 39 (LNQE)

spricht

Prof. Jungwon Kim

(Korea Advanced Institute of Science and Technology - KAIST)

zum Thema

“It is the perfect timing for optical frequency combs: from clocking CMOS chips to imaging blackholes “

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Abstract

Optical frequency combs, with their unique features in both the time and frequency domains, have transformed precision science and engineering over the last two decades. In this talk, I will present on our latest progress in the ultralow-noise frequency combs and their applications in precision timing and microwave photonics. My research group has been at the forefront of the development of ultralow-noise optical frequency comb sources, including mode-locked fiber lasers and chip-scale microresonator-based combs (micro-combs) with quantum-limited timing jitter [1,2]. We further showed how to stabilize the timing of such comb sources with compact and robust fiber photonic methods [3,4]. Based on such ultralow-noise, compact and robust comb sources, we have pioneered innovative timing applications such as attosecond electronic pulse timing [5], on-chip clock distribution networks [6], ultrafast and sub-nm-precision time-of-flight sensors [7] and 3D dynamic imaging [8]. I will also present our currently on-going progress in microwave/mm-wave signal generation and distribution for radio astronomy [9] and time-domain metrology of ultrahigh-dynamic-range micro/nano mechanics [10]. I will also review the frequency comb-based timing distribution and synchronization methods via fiber links [11].

[1] J. Kim et al, “Ultralow-noise mode-locked fiber lasers and frequency combs: principles, status and applications,” Adv. Opt. Photon. 8, 465-540 (2016).

[2] D. Jeong et al, “Ultralow-jitter silica microcomb,” Optica 7, 1108-1111 (2020).

[3] D. Kwon et al, “Generation of multiple ultrastable optical frequency combs from an all-fiber photonic platform,” Sci. Adv. 6, eaax4457 (2020).

[4] D. Kwon et al, “Ultrastable microwave and soliton-pulse generation from fibre-photonic-stabilized microcombs,” Nature Commun. 13, 381 (2022).

[5] M. Hyun et al, “Attosecond electronic timing with rising edges of photocurrent pulses,” Nature Commun. 11, 3667 (2020).

[6] M. Hyun et al, “Femtosecond-precision electronic clock distribution in CMOS chips injected by frequency comb-extracted photocurrent pulses,” Nature Commun. 14, 2345 (2023).

[7] Y. Na et al, “Ultrafast, sub-nanometre-precision and multifunctional time-of-flight detection,” Nature Photon. 14, 355-360 (2020).

[8] Y. Na et al, “Massively parallel electro-optic sampling of space-encoded optical pulses for ultrafast multi-dimensional imaging,” Light Sci. Appl. 12, 44 (2023).

[9] M. Hyun et al, “Optical frequency comb-based generation and distribution of ultralow-noise radio-frequency single-tone and comb signals at a very long baseline interferometry (VLBI) radio telescope," in preparation.

[10] Y. Na et al, "Time-domain metrology of ultrahigh-dynamic-range micro/nano mechanics," in preparation.

[11] J. Kim et al, “Drift-free femtosecond timing synchronization of remote optical and microwave sources,” Nature Photon. 2, 733 (2008).