

Latest News



Industry Cooperation Publish Date : 2026-03-25

NYCU Partners with HHRI and RPI to Develop High-Speed Micro-LED Quantum Random Number Generator



Edited by Chance Lai

As display technologies continue to advance, Micro-LED is emerging as a transformative force

Global
Driving
Innovation

Collaboration
Photonic

across the semiconductor and communications industries. A research team led by the Semiconductor Research Institute of the Hon Hai Research Institute (HHRI), in collaboration with National Yang Ming Chiao Tung University (NYCU) and Rensselaer Polytechnic Institute (RPI), has developed a high-speed, scalable quantum random number generator (QRNG) based on indium gallium nitride (InGaN) Micro-LED arrays.

The breakthrough leverages the intrinsic quantum randomness of spontaneous emission in Micro-LEDs, offering a compact and energy-efficient solution for next-generation secure communications and photonic systems. The findings have been published in the *IEEE Photonics Journal*.

**Breaking Through
Conventional Limits with
Record Data Rates**

The research was led by Professor Hao-Chung Kuo, Director of the Semiconductor Research Institute at HHRI and Chair Professor at NYCU, alongside Dr. Yu-Heng Hong and researcher Yun-Han Chang. The NYCU team included Professor Chun-Liang Lin and Distinguished Professor Chi-Wai Chow, working in collaboration with Chair Professor Boon S. Ooi from RPI.

The project also received strong support from Taiwan's National Science and Technology Council (NSTC).

**Advancing Taiwan's
Leadership in Quantum
and Photonic
Technologies**

This achievement highlights Taiwan's growing leadership in quantum information science and optical communications. By combining low cost, low power consumption, and

Traditional QRNG systems have long been constrained by low data rates and limited integration capabilities. By harnessing the quantum entropy generated from Micro-LED spontaneous emission, the research team successfully overcame these bottlenecks.

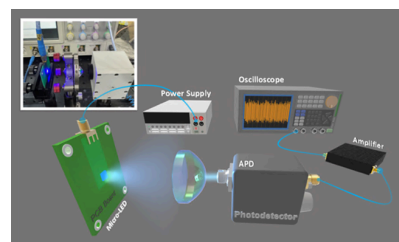
The newly developed system achieves data transmission speeds of up to 12.5 Gb/s, marking a significant advancement over existing technologies and setting a new benchmark for high-speed quantum random number generation.

From Quantum Encryption to Next-Generation Optical Interconnects

Micro-LED technology offers key advantages including high bandwidth, low power consumption, and compact size. Unlike conventional laser-based

miniaturized design, Micro-LED-based QRNG technology lays the groundwork for future single-chip, multi-channel quantum random number generation systems.

Beyond secure communications, the technology is expected to accelerate advancements in quantum encryption, probabilistic AI models, and high-performance secure networks—pushing forward the global adoption of next-generation digital infrastructure.



Schematic diagram of the QRNG experimental setup, featuring a Micro-LED as the quantum entropy source, a focusing lens, and an avalanche photodiode.

systems that rely on bulky external optical components, Micro-LEDs are highly compatible with chip-scale integration.

These properties unlock a wide range of cross-disciplinary applications:

- **Secure communications for 6G and low-Earth orbit (LEO) satellites**

Micro-LED devices can simultaneously transmit data and generate true random numbers, enabling “encrypt-as-you-transmit” architectures. This integrated approach is expected to play a critical role in future 6G networks, satellite communications, and fintech security systems.

- **Next-generation active optical cables (AOC) for AI data centers**

As AI-driven workloads continue to surge, data centers face increasing demands for high-speed, energy-efficient interconnects. Micro-LED

arrays enable parallel data transmission through hundreds of microchannels, significantly reducing power consumption compared to traditional laser-based optical modules. At the same time, they offer high reliability comparable to copper cables while supporting longer transmission distances—meeting the needs of future gigawatt-scale AI infrastructure.

Related Image(s) :



cover image

[Back](#)

[Open/Close](#)

Contact Us



Yangming Campus

Address :

No. 155, Sec. 2, Linong St. Beitou Dist., Taipei City 112304, Taiwan

Phone : +886-2-2826-7000

Chiaotung Campus

Address :

No. 1001, Daxue Rd. East Dist., Hsinchu City 300093, Taiwan

Phone : +886-3-5712121

Copyright © 2023 Office of International Affairs, NYCU. All rights reserved.



Privacy and Security Policy Update Date : 2026-04-09