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**Quantum random number generation for loophole-free Bell tests**

MORGAN MITCHELL, CARLOS ABELLAN, WALDIMAR AMAYA, ICFO - Institute of Photonic Sciences — We describe the generation of quantum random numbers at multi-Gbps rates, combined with real-time randomness extraction, to give very high purity random numbers based on quantum events at most tens of ns in the past. The system satisfies the stringent requirements of quantum non-locality tests that aim to close the timing loophole. We describe the generation mechanism using spontaneous-emission-driven phase diffusion in a semiconductor laser, digitization, and extraction by parity calculation using multi-GHz logic chips. We pay special attention to experimental proof of the quality of the random numbers and analysis of the randomness extraction. In contrast to widely-used models of randomness generators in the computer science literature, we argue that randomness generation by spontaneous emission can be extracted from a single source.

- [1] Strong experimental guarantees in ultrafast quantum random number generation, M. W. Mitchell, C. Abellan, W. Amaya Phys. Rev. A 91, 012314 (2015)
- [2] Ultra-fast quantum randomness generation by accelerated phase diffusion in a pulsed laser diode, C. Abellán, W. Amaya, M. Jofre, M. Curty, A. Acín, J. Capmany, V. Pruneri, M. W. Mitchell Opt. Express 22, 1645-1654 (2014)

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