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DWDM-based White Rabbit Multi-User Time and Frequency Distribution in a Quantum Communication Testbed

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In this abstract we report a multi-user time and frequency distribution architecture based on White Rabbit (WR) technology and dense wavelength-division multiplexing. A novel in-situ calibration method of the chromatic dispersion-induced delay asymmetry in a deployed link has been implemented. The calibration procedure provides effective and accurate calibration for the White rabbit time synchronization technology in deployed fiber links from the local master end, without need to perform any measurements at the remote slave end. The scheme has been installed in the Niedersachsen Quantum Link and has been fully characterized in both laboratory and field. The proposed calibration technique has been verified in the field by an independently deployed electronically stabilized time and frequency distribution (ELSTAB) system.

Niedersachsen Quantum Link (NQL) is a quantum key distribution (QKD) testbed, and it consists of a 78 km long pair of dark fibers between the cities of Hannover and Braunschweig. The link connects Leibniz University of Hannover (LUH) and Physikalisch-Technische Bundesanstalt (PTB) Braunschweig. One of the dark fibers is dedicated to quantum applications, while the second fiber is used for the dissemination of time and frequency reference signals as well as classical communication between the two sites. Within LUH campus, the link connects the Institute of Quantum Optics (IQO), Hannover Institute of Technology (HITec), and the Institute for Solid State Physics (FKP) [1]. Currently, an entanglement-based QKD system is installed in NQL, where Alice is located at FKP and Bob at PTB. The aim of the proposed WR scheme is to distribute time and frequency signals from PTB to three distant locations: IQO, HITec, and FKP. The preliminary field measurements show that the instability of the clock output of the WR slave node at FKP is 8.7×10-17 at 105 s of integration time. The achieved pulse-per-second (PPS) time offset error between the Grandmaster at PTB and the slave remote Node at FKP is 139±12 ps, verified by the independently calibrated ELSTAB system.

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