High- precision Frequency Transmission based on IQ Modulation and Silicon Photonics

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At present, the development of silicon photonic chips is very rapid, and it has achieved a very wide range of applications. In terms of devices, silicon photonic chips can be used to make modulators, lasers, passive devices, and in terms of application systems, it also plays a very important role in laser communication, sensing and many other fields. Time-frequency transmission based on optical fiber is a key laser communication technology in the field of space-time reference, optical clock comparison and optical-definition of seconds in the future. Therefore, silicon photonic chips are introduced into time-frequency transmission based on optical fiber, hoping to fully exerting its advantages, the system will develop in the direction of miniaturization, low power consumption and low cost.

Recently, we built a silicon photonics chip (SiPh) that integrates an IQ modulator, couplers, variable optical attenuators, beat coupler and other devices. NKT 1550nm laser coupled to the light of SiPh. A 500MHz frequency signal locked on the rubidium clock is used to divide two channels, one of which is modulated by the IQ modulator on SiPh, and demodulated by an OE. The other channel microwave frequency signal is used as a reference signal for phase discrimination. According to the calculated Allan deviation of discriminated phase, the stability of the 500MHz microwave frequency signal after EO-OE based on SiPh is 6.0×10^{-14} at 1 s and 9.8×10^{-17} at 10000 s. After 82km fiber link transmission, the transmission stability of 500MHz microwave frequency signal is 7.5×10^{-14} at 1 s and 7.0×10^{-15} at 10000 s respectively.

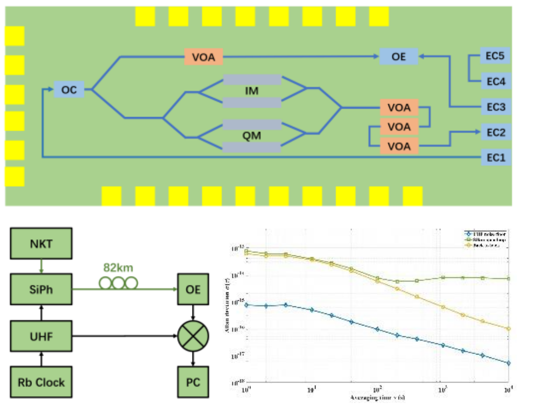

Fig. 1: Internal structure of the silicon photonic chip, experimental diagram and Allan Deviation results. OC: optical coupler, EC：edge coupler, VOA: variable optical attenuator, OE: optic-electro conversion, IM/QM: I/Q modulation, UHF: signal generators, NKT: laser.

We are doing noise compensation of the fiber transmission, due to the Chinese New Year holiday, the results would be shown in the full-text after further confirmation and review. It has been confirmed that silicon photonic chips can indeed carry out high-precision optical fiber time-frequency transmission, and it will greatly simplify the system structure. In the next step, we will continue to improve the chip to make the whole system into a perfect state.