Light Source at 759 nm for an Yb Optical Lattice Clock Using Second-Harmonic Generation

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Optical lattice clocks (OLCs) are strong candidates for the redefinition of the SI unit of time (the second), with uncertainties surpassing Cs fountain clocks by two orders of magnitude. In optical lattice clocks, atoms are confined in optical traps (optical lattice) at the magic wavelengths. In Yb OLCs and Sr OLCs, which are the most developed atomic species for OLCs, a ring Ti:sapphire laser is usually used for the light source of the optical lattice. As this laser is expensive and the maintenance is relatively difficult, tapered amplifiers (TAs) can be good replacements. However, TAs have relatively strong amplified spontaneous emission (ASE), which introduces additional ac Stark shifts, and makes the uncertainty evaluation difficult. In this report, we utilized second-harmonic generation to obtain the lattice light source at 759 nm (the magic wavelength for an Yb OLC). By using a waveguide periodically-poled lithium niobate, the light source at 1519 nm with 184 mW could be converted to 759 nm with 76 mW. The optical power noise level was much less than the ASE of a TA as shown in Fig. 1. This light source will be applied to one of the Yb OLC developed at KRISS.

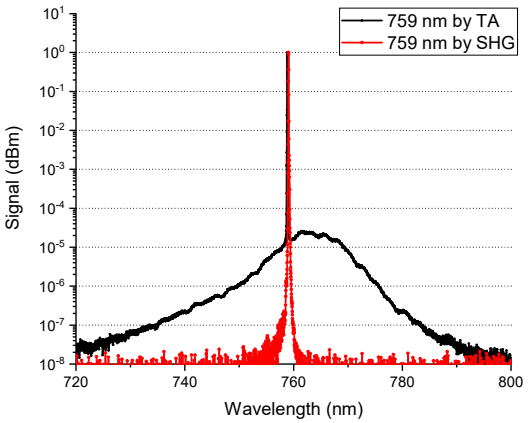

Fig. 1: Optical spectrum analyzer measurement of the light source at 759 nm obtained by TA (black line) and by SHG (red line).