

Frequency doubled Nd:YLF laser: an all-solid-state local oscillator for a calcium optical atomic clock

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Atomic clocks are used today in a number of scientific and technological applications, ranging from tests of relativity, or variations of fundamental constants, to the use in navigation and telecommunication. The next generation of such high precision devices will be based on optical transitions of suitable laser cooled and trapped atoms. In this paper we describe a frequency-doubled, diode-pumped solid-state Nd:YLF ring laser emitting at 657 nm, proposed as a local oscillator in an optical atomic clock based on laser cooled and trapped calcium atoms. Compared to diode lasers, its main advantages include higher power, less intrinsic frequency noise, and the possibility of remote transfer in optical fibers using the fundamental light at 1314 nm. The Nd:YLF is optically pumped by a fiber-coupled diode laser at 806 nm, which can deliver output powers up to 30 Watts. Frequency doubling is performed inside the cavity using a 10-mm long AR-coated BIBO crystal, under type I, critical phase-matching at room temperature. The red output of the Nd:YLF laser is locked to a high-finesse Fabry-Perot cavity using the Pound-Drever-Hall technique. The laser frequency stability relative to this cavity is estimated by an spectral analysis of the error signal. Measurements of the optical frequency at 457 THz, and its coherent subdivision into microwave frequencies, will be performed using an optical frequency comb developed at UNICAMP, based on a ultrabroadband 2 GHz Ti:sapphire femtosecond laser.