A Novel Laser Power Measurement Scheme Using Rubidium Clock

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Lasers are widely used in basic science research and industry. The laser power is a key parameter. To measure the laser power, many methods are developed, including methods based on photodiode, cryogenic radiometer, photodynamic sensing, integrating sphere. Precise measurements of weak laser power are necessary, while few methods can meet this requirement.

To realize the measurement of weak laser power down to microwatt and nanowatt, we adopt an atomic clock to measure the laser power, which is traceable to the output frequency of the atomic clock. This scheme is mostly based on the light shift effect. A 795 nm semiconductor laser and a Rb atomic clock are utilized. The laser is incident into the cell of the rubidium clock and the frequency of atomic clock varies with the laser power. The affect of 795 nm laser power, wavelength on frequency of Rb atomic clock is analyzed. The experimental results show that the output frequency of Rb clock changes with the laser wavelength and power. At a wavelength of 794.99 nm, 2 μW laser power leads to a frequency shift of 0.13 mHz@10MHz, and the frequency shift of the atomic clock increases with the laser power increasing.

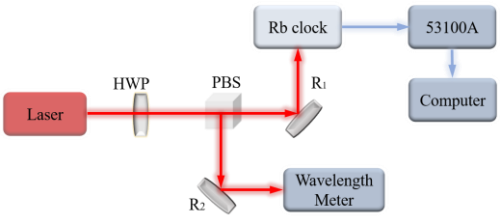

Fig.1.Schematic diagram of the experimental setup. HWP: half wave plate, PBS: polarization splitter, R_1,R_2: reflectors.

In summary, a novel method to measure the weak laser power is proposed. The experiment is carried out to realize the quantum measurement of weak laser power. It provides a new way to trace laser power to atomic frequency. Moreover, the experimental setup can be further improved to stabilize laser power.

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