Design of Locally Enhanced Electric Field in Dielectric Loaded Rectangular Resonator for Quantum Microwave Measurements

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Abstract

Rydberg-atom electrometers have the remarkable advantages of self-calibration and high sensitivity. Based on the classical electromagnetic theory, a localized electric field enhancement structure of a hybrid rectangular resonator is proposed to improve the sensitivity of quantum microwave measurement. It should be noted that the prototype of the hybrid rectangular resonator is fabricated and measured at 9.925 GHz. The results of full-wave simulations show that the uniform and high electric field enhancement in the TE101 fundamental mode is realized. The transient process of resonance is simultaneously simulated, and the time to settle steady state is given as about 104 ns. As indicated through experimental results that the structure can reach 24 dB (enhancement factor of 15.8). As a result, the method proposed in this study, based on atomic measurement capabilities, enables us to improve the measurement sensitivity further and promotes the practical development of quantum microwave measurement technology.

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