

激光技术与器件

Ramsey-CPT原子频标的高性能小型脉冲微波源研究

管超 竺小松 周群 耿钦

解放军电子工程学院, 安徽 合肥 230037

摘要:

根据Ramsey-CPT原子频标对脉冲微波源高性能小型化的要求, 采用直接数字频率合成器(DDS)激励锁相环频率合成器, 再结合可编程数字功率衰减器和阻抗匹配电路, 从而实现具有高稳定度、高分辨率、快跳频速度、低相位噪声、小体积、小步长扫描的脉冲微波源。比较应用于Ramsey-CPT原子频标的脉冲微波源方案, 介绍脉冲微波源的基本原理, 简述其具体实现方法, 并通过仿真优化得到最佳的输出性能。实现的脉冲微波源具有优良的技术性能, 进一步提高了Ramsey-CPT原子频标输出频率的性能。同时, 达到了设计小型化的要求, 有利于Ramsey-CPT原子频标的便携式应用。

关键词: 激光物理 原子频标 拉姆齐干涉-相干布居囚禁 脉冲微波源 锁相环 可编程数字功率衰减器

High-performance and miniature pulse microwave source for Ramsey-CPT frequency standard

GUAN Chao, ZHU Xiaosong, ZHOU Qun, GENG Qin

Electronic Engineering Institute, PLA, Hefei 230037, China

Abstract:

In accordance with the high-performance and miniature requirement to pulse microwave source by the Ramsey-CPT atomic frequency standard, a pulse microwave source, with the characteristics of high stability, high resolution, fast frequency hopping speed, low phase noise, miniature, and small scanning step, is realized through direct digital frequency synthesizer (DDS) exciting phase-locked loop (PLL) frequency synthesizer and then connecting the digital step attenuator and the impedance matching circuit. Several schemes of the pulse microwave source for Ramsey-CPT atomic frequency standard are compared. The basic principle and the practical method of the pulse microwave source are introduced. At last, the best performance of the output signal is obtained by optimizing the simulation result. The pulse microwave source has excellent technical performance, and further improves the output signal of the CPT atomic frequency standard. Moreover, the overall design comes up to the miniaturized requirement, and is favorable to portable application of the Ramsey-CPT atomic frequency standard.

Keywords: laser physics atomic frequency standard Ramsey-CPT pulse microwave source phase-locked loop digital step attenuator

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通讯作者: 竺小松 (1963 -) 教授, 硕士, 目前主要从事CPT原子频标方面的研究。

作者简介:

作者Email: hottin@126.com

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