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Author: Mr. Vladimir Schkolnik
Humboldt-Universität zu Berlin, Germany, vschkolnik@googlemail.com

Dr. Markus Krutzik
Humboldt-Universität zu Berlin, Germany, markus.krutzik@physik.hu-berlin.de
Dr. QUANTUS Team
Germany, hauke.muentinga@zarm.uni-bremen.de
Mr. FOKUS Team
Germany, m.lezius@menlosystems.com
Prof. Achim Peters
Humboldt University of Berlin, Germany, achim.peters@physik.hu-berlin.de

LASER SYSTEMS FOR PRECISION MEASUREMENTS OF FUNDAMENTAL PHYSICS IN SPACE

Abstract

Laser systems with precise and accurate frequencies are the key element in high precision experiments such as atom interferometers and atomic clocks. Future space missions probing the structure of our universe with quantum based tests of the equivalence principle or the detection of gravitational waves require robust and compact lasers with exceptionally high mechanical and frequency stability. We present a new generation of such compact diode laser systems optimized for precision measurements with ultracold atoms aboard sounding rockets.

The design, assembly and qualification of a laser system for experiments with degenerate Rubidium 87 in space during the MAIUS (Matter-wave Interferometry under Microgravity) mission will be presented. Payloads for two other sounding rocket experiments will also be reported. Firstly, FOKUS a laser system which will operate together with a rocket-borne frequency comb on the TEXUS 51 mission and secondly, KALEXUS containing two narrow line-width extended cavity diode lasers (ECDLs) for potassium spectroscopy. The laser system includes a redundancy architecture for reliable operation. The system will be integrated together with control and driver electronics within a pressurized payload module and will operate autonomously on the TEXUS 53 mission. All presented laser systems are to be launched within the next 12 months.

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