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Pilar García Parejo, Angel Jimenez-Girela, Daniel Merino-Pérez, Antonio Campos-Jara, Manuel Silva-López, et al.. Liquid crystal polarization rotators for the Miniaturized Absolute Magnetometer (MAM) of the NanoMagSat space mission. SPIE Defense + Commercial sensing 2024, Apr 2024, National Harbor, United States. pp.130500G, 10.1117/12.3013767 . cea-04605632

HAL Id: cea-04605632

<https://cea.hal.science/cea-04605632v1>

Submitted on 7 Jun 2024

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Liquid crystal polarization rotators for the Miniaturized Absolute Magnetometer (MAM) of the NanoMagSat space mission

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Liquid Crystal Polarization Rotators (LCPRs) have been developed for the Miniaturized Absolute Magnetometer (MAM) instrument in NanoMagSat project, an ESA's SCOUT program mission. This project consists of a constellation of three nanosatellites aimed to study the Earth's magnetic and ionospheric field. Each satellite is based on a 16U CubeSat-type structure and will carry two types of Helium-4 magnetometers: a MAM and an HFM (High Frequency Magnetometer). The instrument MAM consists of an optically pumped scalar and vector magnetometer derived from a previous mission, the Swarm ASM-V. In this type of instruments, a device to rotate the direction of the incident linear polarization of the pumping beam injected into the helium-4 gas cell sensor is required. In NanoMagSat, the LCPRs will replace the sensor head rotor driven by a piezoelectric motor used in the Swarm ASM-V mission, allowing a very significant miniaturization of the sensor head. The LCPRs developed are miniaturized devices derived from the polarization modulators based on liquid crystals of PHI and METIS instruments on board the Solar Orbiter mission. The LCPRs optimized for the NanoMagSat operative wavelength (1083 nm) have a very compact design with 9 mm clear aperture. The key performance parameters of the devices have been evaluated in a qualification test campaign, under the different environmental conditions expected in NanoMagSat, including the polarization rotation and the Polarization Extinction Ratio (PER) as a function of voltage, and the response times at the MAM polarization rotation scheme. The polarization rotation range and PER reach values higher than 200 degrees and 20 dB, respectively. In this work, the main LCPR performances and the main environmental campaign results will be presented. Based on the results found, the LCPRs design and qualification test campaign has been considered successful and they have been approved to be implemented for the NanoMagSat mission.