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In-Orbit Performance of the Coupled Dark State Magnetometer

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The Coupled Dark State Magnetometer (CDSM) is a magnetometer developed by the Space Research Institute of the Austrian Academy of Sciences in cooperation with the Graz University of Technology. It is an optically pumped scalar magnetometer based on two-photon spectroscopy of free alkali atoms (Rubidium 87). The CDSM is currently operating on three space missions and will have launched on a fourth on 11 June 2025. The three missions “China Seismo-Electromagnetic Satellite 1” (CSES1; launched in February 2018), “Macau Science Satellite” (MSS1; launched in May 2023) and “China Seismo-Electromagnetic Satellite 2” (CSES2; launched in June 2025) were launched into Low-Earth-Orbit. The “Jupiter Icy Moons Explorer” (JUICE; launched in April 2023) is bound to explore the Ionian moons (arrival 2031) and had an Earth fly-by in August 2025. After a short introduction to the CDSM, selected mission data is presented with a special emphasis on the MSS1 mission. The performance of the CDSM is evaluated in three ways: First the data is compared to the CHAOS Earth’s field model. Secondly, for CSES1 and MSS1 the data is cross-validated with data from ESA’s SWARM mission. Last is an internal comparison with fluxgate magnetometer(s) on the same spacecraft. Based on this analysis, the CDSM demonstrates an accuracy better than 1.5 nT across the entire measurement range of 20,000 nT to 50,000 nT.

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