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Development of femtoAmpere photo-current measurement facility in preparation of LISA Charge Management System end-to-end discharge test

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We are developing and tuning a facility to support the end-to-end discharge test campaign, part of the LISA Gravitational Reference System(GRS) test campaign, which probes directly the photo-current produced by UV illumination of the Test Mass and Electrode Housing via an electrometer. LISA Test Masses will be subject to collisions from charged space particles with energies >100 MeV, which penetrate into the spacecraft. These produce a net positive charging rate on each Test Mass λ = 1-100 e/s(1-100 aA), depending on solar activity. LISA acceleration noise budget requires |QTM| < 2.4 pC, assuming as a baseline the measured net charging rate of LPF λ = 25 e/s(4 aA). A Test Mass will reach this limit in 14 days, so discharging the Test Masses is fundamental to assure the success of the mission. The Charge Management System(CMS) consist of UV leds at ~4.9 eV, that shining the AU-coated surface frees low energy electrons, produce a negative charge flux which counters the effect of the Test Mass positive charging rate. The facility consists of a LPF Electrode Housing replica and an hollow Test Mass, kept in vacuum and connected to an electrical interface that controls the Electrode Housing end electrodes voltage biases and to the electrometer. Here I show how this facility can probe directly the discharge current with resolution at ~1 fA and how this kind of setup can replicate the in-flight electrical conditions. The technique developed with this facility will become the guideline for the end to end tests that will be part of the LISA GRS testing campaign from the engineering model to the integrated flight model of the GRS Head.

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