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DEPLOYMENT SIMULATION FOR LISA GRAVITATIONAL WAVE MISSION

Abstract

Gravitational wave (GW) detection is a focused research subject at present. Second-generation ground-based interferometers are being completed for the first GW detection in the high-frequency band (10–100 kHz). The first direct GW detections have been announced in 2016 and we have entered the era of GW astronomy. LISA (Laser Interferometric Space Antenna) Pathfinder was launched on 3 December 2015 for preparing the technology of space detection of GWs in the middle and low frequency band (0.1 Hz–10 Hz; 100 nHz–0.1 Hz), and has not only achieved its drag-free performance goal, but also has basically achieved the drag-free goals of LISA proposal and most first generation space GW mission proposals. This achievement paved the road for space GW detections. LISA has a formation of three spacecraft, arranged in an equilateral triangle with 2.5 Mkm arms, inclined by 60 with respect to the ecliptic and flying along an Earth-like heliocentric orbit trailing Earth by 20 deg. LISA is proposed to be launched on 2030.12.18. After specifying the initial states of three spacecraft according to JPL DE431 solar ephemerides, we use the multi-segment compact finite-difference method for the orbit equation to calculate the delta-V for deployment of LISA from LEO. The deployment of 3 spacecraft to 3 mission orbits has slight different delta-V for each. Our calculations show that the mean value is 1.856 km/s for transfer time of 200 day. Furthermore, the deployment simulation will be optimized for delta-V with the launch date and the transfer time for LISA mission and other LISA-like missions, e.g. ASTROD-GW and ALIA-Descope (Taiji).