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Impact-Induced Mission Effects and Risk Assessments (3)

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KEYNOTE: PROGRESS IN CHINA'S SPACE DEBRIS PROTECTION RESEARCH-RETROSPECT AND PROSPECT

Abstract

Over the past two decades, China has made remarkable progress in the field of space debris protection, which not only provided strong support for the design of space debris protection for China's manned spacecraft, but also manifested different characteristics in multiple research directions and keeps improving its capabilities. This paper introduces the resent progress in China's space debris protection research in detail, including (1) space debris impact risk assessment, protection design, and protection structure development, etc., for China space station. (2) development of advanced shielding materials, including wave impedance-gradient materials with high kinetic energy dissipation, active materials PTFE/Al based on thermochemical reaction, and silicon carbide fiber/Basalt/Kevlar/Al-mesh stuffed Whipple shields. (3) developing of vulnerability research, including threshold impact conditions for spacecraft component failure (cable, pipeline, pressure vessel, Solar array), spacecraft survivability evaluation software. (4) developing of ultrahigh-velocity launching techniques, including achieved the stable launch capability over 10 km/s for the spherical projectile with mm diameter at three-stage light gas gun, launched sub-gram flyer to above 18 km/s by using Electric gun, and launched sub-gram flyer over 10 km/s by Laser-driven device. (5) developing of the satellite impact breakup model and the space debris environment engineering model (SDEEM). The basic function of SDEEM 2019 is basically equivalent to the latest version of MASTER. On-orbit detection of millimeter-scale space debris is being carried out. (6) The influence of temperature and projectile shape on impact effect and ballistic limit curve. Keyword: Space debris, China space station shield design, advanced shielding materials, vulnerability, ultrahigh-velocity launching techniques, satellite breakup model and the space debris environment engineering model, projectile shape effect. The research priorities for the next 10 years in China are prospected.