

Attitude determination and control of space Hard X-ray Modulation Telescope (HXMT)

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Space hard x-ray is one of the most important energy bands for the study of high energy astrophysical process. However, the observations of space hard x-rays are comparatively less than that of other bands such as soft x-rays and high energy gamma-rays, mainly because of the difficulties with hard x-ray imaging. Based on the direct demodulation imaging method proposed by Li and Wu in 1993, Hard X-ray Modulation Telescope (HXMT) mission has been proposed and demonstrated. The main objectives of HXMT mission include high resolution all-sky survey of hard x-rays, deep pointing observation of interested sky regions, continuous observation of extraordinary sources and periodic survey of galactic plane. To accomplish these objectives, the telescope should be able to operate in two observation modes. One is the all-sky scan survey mode, in which the attitude of the HXMT satellite will be 3-axis stabilized and earth oriented. The all-sky survey can be achieved through the motion of the satellite in its orbit along with the precession of the orbital plane. The other observation mode is pointing and deep scanning of the selected sky regions, in which the attitude of the satellite will be in one inertial fixed orientation for a period, and then be maneuvered to another. Due to the physical principles of the direct modulation method, accurate attitude knowledge of the satellite is crucial to the interpretation of the telescope observation with high resolution. According to the target resolution of the hard x-ray image the attitude determination accuracy for all the three axes of the satellite body frame requires to be better than 0.01° . The attitude determination and control system (ADCS) of the HXMT satellite has been designed. The major functions of the ADCS include: (1) rate damping after separation from launch vehicle, (2) sun acquisition and orientation which is the initial and safe attitude of the satellite, (3) earth-oriented 3-axis stabilization and inertial pointing 3-axis stabilization which are the normal attitudes of the satellite, and (4) attitude maneuver control. A configuration of sensors and actuators has been made and a series of estimation filters and control rules have been designed to perform the functions and guarantee the reliability of the ADCS. This paper will give a general introduction to the ADCS of the HXMT satellite.