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IMAGING X-RAY POLARIMETRY EXPLORER (IXPE) MISSION IMPLEMENTATION AND
DEVELOPMENT PROGRESS

Abstract

The Imaging X-Ray Polarimetry Explorer (IXPE) is designed to expand understanding of high-energy astrophysical processes and sources, in support of NASA's first science objective in Astrophysics: "Discover how the universe works." Polarization uniquely probes physical anisotropies—ordered magnetic fields, aspheric matter distributions, or general relativistic (GR) coupling to black-hole spin—that are not otherwise measurable. Imaging enables the specific properties of extended x-ray sources to be differentiated. The Imaging X-Ray Polarimeter Explorer (IXPE) Mission is a NASA Small Explorer (SMEX). It is designed as a 2-year mission which launches to a circular LEO orbit at an altitude of 540 km and an inclination of 0 degrees. The payload uses a single science operational mode capturing the x-ray data from the targets. The mission design follows a simple observing paradigm: pointed viewing of known x-ray sources (with known locations in the sky) over multiple orbits (not necessarily consecutive orbits) until the observation is complete. The Observatory communicates with ground stations via S-band link. The IXPE Observatory consists of spacecraft and payload modules built up in parallel to form the Observatory during system integration and test. IXPE's payload is a set of three identical, imaging, X-ray polarimeter systems mounted on a common optical bench and co-aligned with the pointing axis of the spacecraft. Each system, operating independently, comprises a 4-m-focal length Mirror Module Assembly that focuses X-rays onto a polarization-sensitive imaging detector separated by the deployable boom. Each Detector Unit (DU) contains its own electronics, which communicate with the payload computer that in turn interfaces with the spacecraft. Each DU has a multi-function filter wheel assembly for in-flight calibration checks and source flux attenuation. The payload is accommodated on the spacecraft top deck. The spacecraft provides the necessary resources to support and operate the payload elements and enable continuous science data collection. The IXPE Project completed its Phase A activities in July 2016 with the submission of the Concept Study Report to the NASA Explorers Program Office as a Small Explorer (SMEX) Mission. The IXPE Project was selected in January 2017. The IXPE Project held SRR

in September 2017 and had Mission PDR in June 2018. Mission CDR is planned for May 2019. This paper summarizes the IXPE mission system, provides details on the Observatory, spacecraft and payload, expected launch process and ground system along with design and development status.