High-Speed, Low-Noise, Radiation-Tolerant CCD Image Sensors for Strategic High-Energy Astrophysics Missions

Completed Technology Project (2018 - 2019)

Project Introduction

NASA's 2016 Physics of the Cosmos Program Annual Technology Report (PATR) identifies 'fast, low-noise, megapixel X-ray imaging arrays' as a top-priority technology development need for future strategic astrophysics missions. The Lynx large mission concept now under study by NASA for presentation to the 2020 Decadal Survey in Astronomy and Astrophysics, in particular, includes a notional high-definition X-ray imaging instrument requiring a combination of readout rate, noise, spatial resolution and size that cannot be furnished by currently-mature technologies. We have been developing a new generation of charge-coupled device (CCD) detectors with the aim of meeting this need. X-ray imaging CCDs have been flown successfully for more than twenty years, and state of the art devices provide low noise and near-theoretical spectral resolution, as well as spatial resolution and size approaching that required for Lynx. However, Lynx requires detector readout rates more than two orders of magnitude faster than current technology, with no compromise in noise or spectral resolution. This performance must be achieved within the instrument power and mass constraints and maintained over the expected lifetime of a strategic mission. We propose to advance the readiness of CCD technology to meet these requirements by capitalizing on developments at MIT Lincoln Laboratory for other applications which also require fast, large format, low-noise, low-power imagers. Building on high-speed prototype CCD X-ray detectors currently operating in our laboratory, we aim to fabricate and demonstrate devices with lower noise, better low-energy quantum efficiency, and improved radiation tolerance.

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
Massachusetts Institute of Technology(MIT)	Lead Organization	Academia	Cambridge, Massachusetts
MIT Kavli Institute	Supporting Organization	Industry	

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

Massachusetts Institute of Technology (MIT)

Responsible Program:

Strategic Astrophysics Technology

Project Management

Program Director:

Mario Perez

Program Manager:

Mario Perez

Principal Investigator:

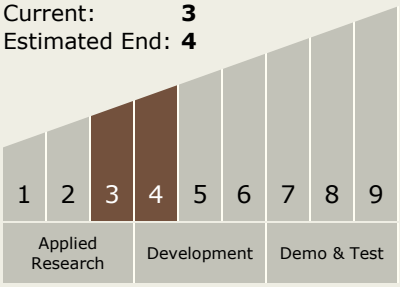
Marshall Bautz

Co-Investigators:

Beverly J Lamarr
Christopher W Leitz
Barry E Burke
Eric D Miller
Jeffrey A Mendenhall
Daniel R Schuette
Richard Foster
Gregory Prigozhin
Michael P Corcoran

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System