

# Low Noise Camera for Suborbital Science Applications

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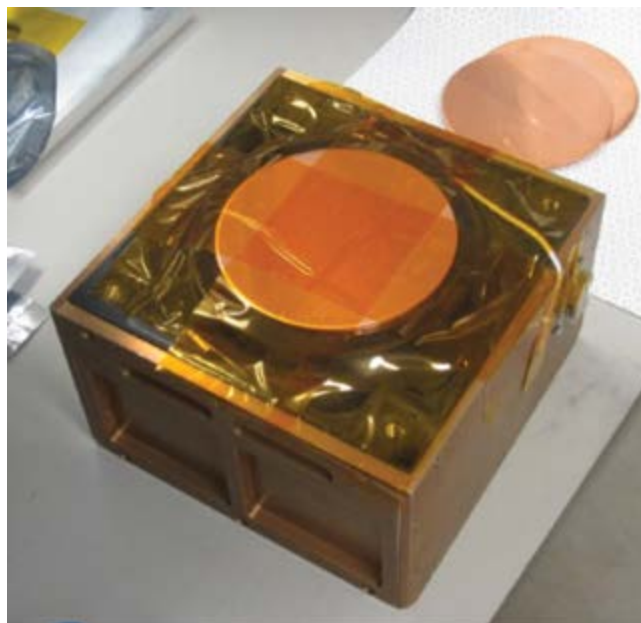
## Sponsoring Program(s)

Marshall Space Flight Center/Center Management and Operations  
Center Strategic Development Steering Group,  
Center Investment Fund

## Project Description

Low-cost, commercial-off-the-shelf- (COTS-) based science cameras are intended for lab use only and are not suitable for flight deployment as they are difficult to ruggedize and repackage into instruments. Also, COTS implementation may not be suitable since mission science objectives are tied to specific measurement requirements, and often require performance beyond that required by the commercial market. Custom camera development for each application is cost prohibitive for the International Space Station (ISS) or midrange science payloads due to nonrecurring expenses (~\$2,000 K) for ground-up camera electronics design. While each new science mission has a different suite of requirements for camera performance (detector noise, speed of image acquisition, charge-coupled device (CCD) size, operation temperature, packaging, etc.), the analog-to-digital conversion, power supply, and communications can be standardized to accommodate many different applications. The low noise camera for suborbital applications is a rugged standard camera platform that can accommodate a range of detector types and science requirements for use in inexpensive to mid range payloads supporting Earth science, solar physics, robotic vision, or astronomy experiments. Cameras

developed on this platform have demonstrated the performance found in custom flight cameras at a price per camera more than an order of magnitude lower.



**Low noise camera for the CLASP mission.**

**Comparison of observed noise performance with cameras at comparable price (COTS-based) and performance (custom flight) points.**

Camera	Observed Noise Performance
COTS-Based	60–100 e-
Custom Flight	10 e-
Low Noise Camera	7 e-

### *Anticipated Benefits*

The demonstrated performance advantage of the low noise camera over COTS solutions will enable researchers to develop higher performance experiments at a cost compatible with low-cost flight opportunities. The relatively low cost associated with the performance of these cameras enables a greater proportion of project

funds to be invested in other components or subsystems to enhance science objectives or reduce overall mission risk.

### ***Potential Applications***

The Extreme Ultraviolet (EUV) Snapshot Imaging Spectrograph (ESIS) is a next-generation imaging spectrograph being developed by Montana State University to investigate reconnection in explosive events, and transport of mass and energy through the transition region of the Sun's atmosphere. The instrument consists of a pseudo-Gregorian design telescope with light projected by concave diffraction gratings to four of the NASA Marshall Space Flight Center- (MSFC-) developed low noise cameras. The ESIS experiment is scheduled to be flown from White Sands Missile Range in the summer of 2017.

The Marshall Grazing Incidence X-ray Spectrograph (MaGIXS) is a stigmatic grazing-incidence spectrograph experiment designed to observe spatially resolved soft x-ray spectra of the solar corona for the first time. The instrument consists of a Wolter type-1 sector telescope and a slit spectrograph. A single MSFC-developed low noise camera will be used to capture the spectral image.

This camera will also be used to provide solar images in a reflight of the successful 2012 High Resolution Coronal Imager (Hi-C) sounding rocket mission. The main objective of the Hi-C investigation is to determine the geometric configuration and topology of the structures making up the inner corona. The secondary objective is to examine the dynamics of those structures within the constraints of the 300-s observing time available from a sounding rocket. Use of this lower noise camera will significantly enhance the image quality and effective resolution from this instrument.

### **Notable Accomplishments**

The version of this camera using an e2v CCD57 detector is currently integrated into the Chromospheric Lyman-Alpha SpectroPolarimeter (CLASP) instrument, scheduled for launch in the summer of 2015. Modifications to the standard platform to accommodate the CCD230 detector for the ESIS, MaGIXS, and Hi-C reflight missions are nearing completion.