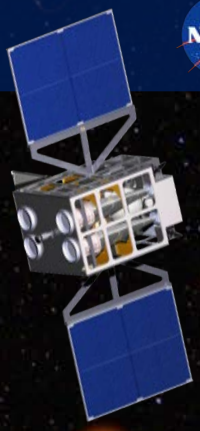
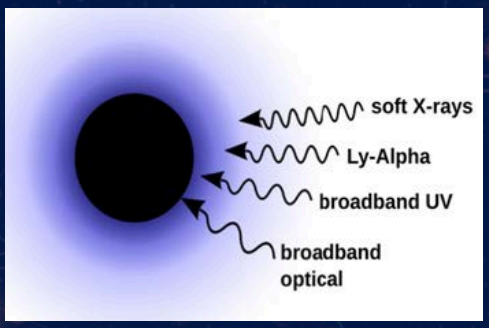
SEEJ: Smallsat Exosphere Explorer of hot Jupiters



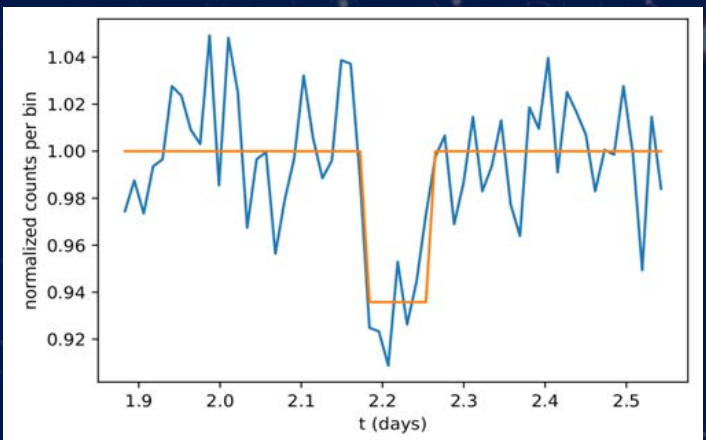
SEEJ (pronounced "siege") will be a 24x28x38 inch ESPA size satellite. Four telescopes, each with its own CMOS detector, will be co-aligned with each other and the primary star tracker. All avionics, communications and fuel fit inside the envelope. Low-cost solar panels will provide sufficient power for all required communications, avionics and thermal control.

The primary objective of SEEJ is to measure the depth of planetary transits of 7 Hot Jupiters from 0.5-2.0 keV to 2% accuracy.

- X-ray transits are deeper and wider than optical transits.
- This is a sign of expanded atmospheres with possible mass loss.
- Observations will test how host star properties affect planetary atmospheres and how planets affect host stars.



Transit X-ray Light Curve



Simulated co-added SEEJ X-ray light curve of 40 transits of a HD 189733b-like planet in front of its host star (blue), together with the simplest fitting model choice, an inverse top hat fit to the data (orange). The input model has a 5.5% X-ray transit depth.

Operations Concept

GEO+11K orbit provides nearly uninterrupted visibility

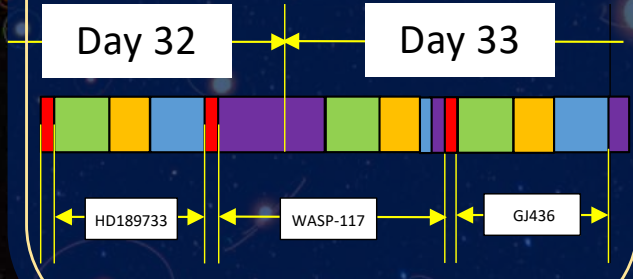
Pre-Transit Baseline Viewing ~ 4 hr

Transit Viewing – 3 hr

Post-Transit Baseline Viewing ~ 4 hr

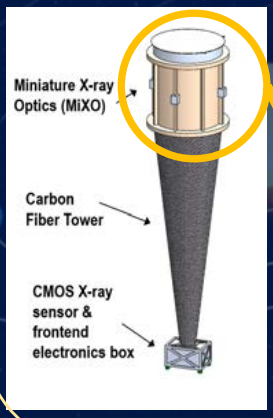
Extended phase Viewing Time

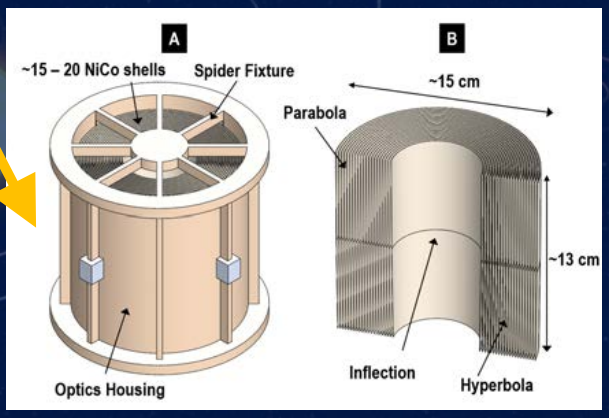
Slew Time – 1 hr

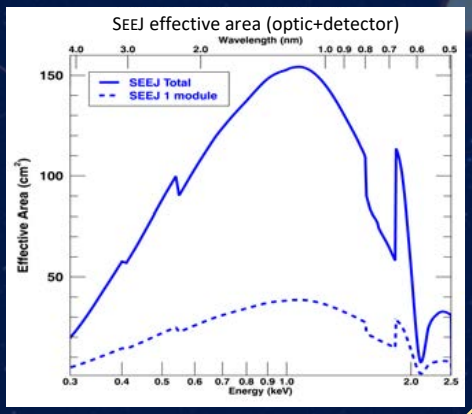


SEEJ Instruments and Spacecraft

SEEJ, like XMM-Newton, will use multiple modules to accumulate significant collecting area. A MiXO optics module is composed of compact lightweight Wolter-I X-ray optics suitable for CubeSat/SmallSat missions. MiXO leverages the on-going development of electroformed Ni-alloy replication techniques to make Wolter-I X-ray optics with large area-to-mass ratios.

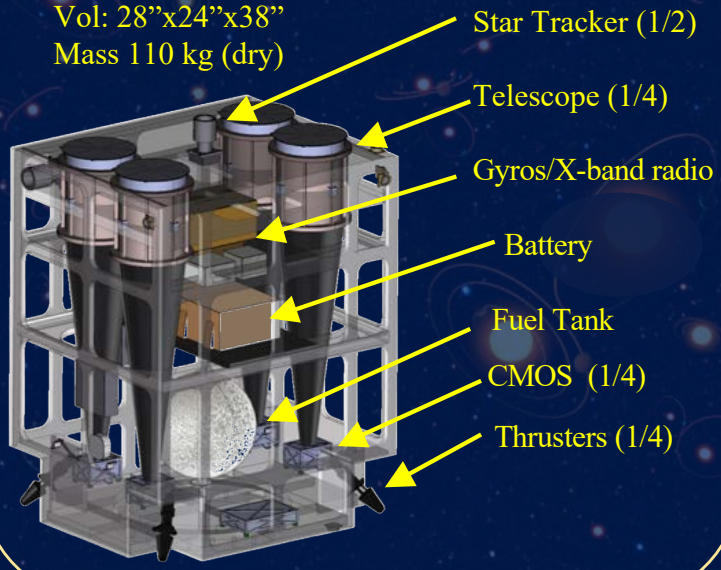




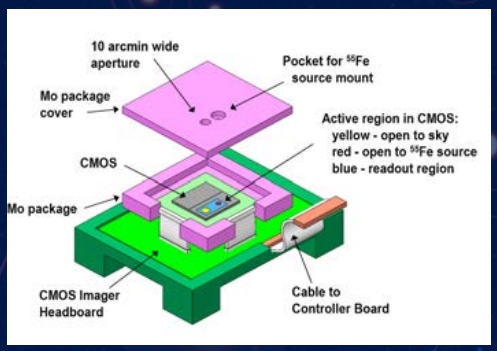


Spacecraft Design

Vol: 28”x24”x38”
Mass 110 kg (dry)



CMOS Detectors



We will use back-illuminated, high-gain CMOS detectors which have good QE even at low energies. CMOS can be read out very quickly and so can look at bright optical sources while maintaining sensitivity to soft X-rays. CMOS can also operate at high temperature relative to CCDs without significant noise.

Science and Implementation Team

Scott Wolk PI	Almus Kenter — CMOS Lead
JaeSub Hong D-PI	Christopher Moore — Camera Lead
Martin Elvis SOC	Katja Poppenhäger — Science Lead
Suzanne Romaine MiXO-Lead	Vinay Kashyap — Analysis Lead
NASA MSFC S/C design MOC	Bruce Wiegmann — Design Engineer

Schedule

Substantial margin in the prescribed development cycle