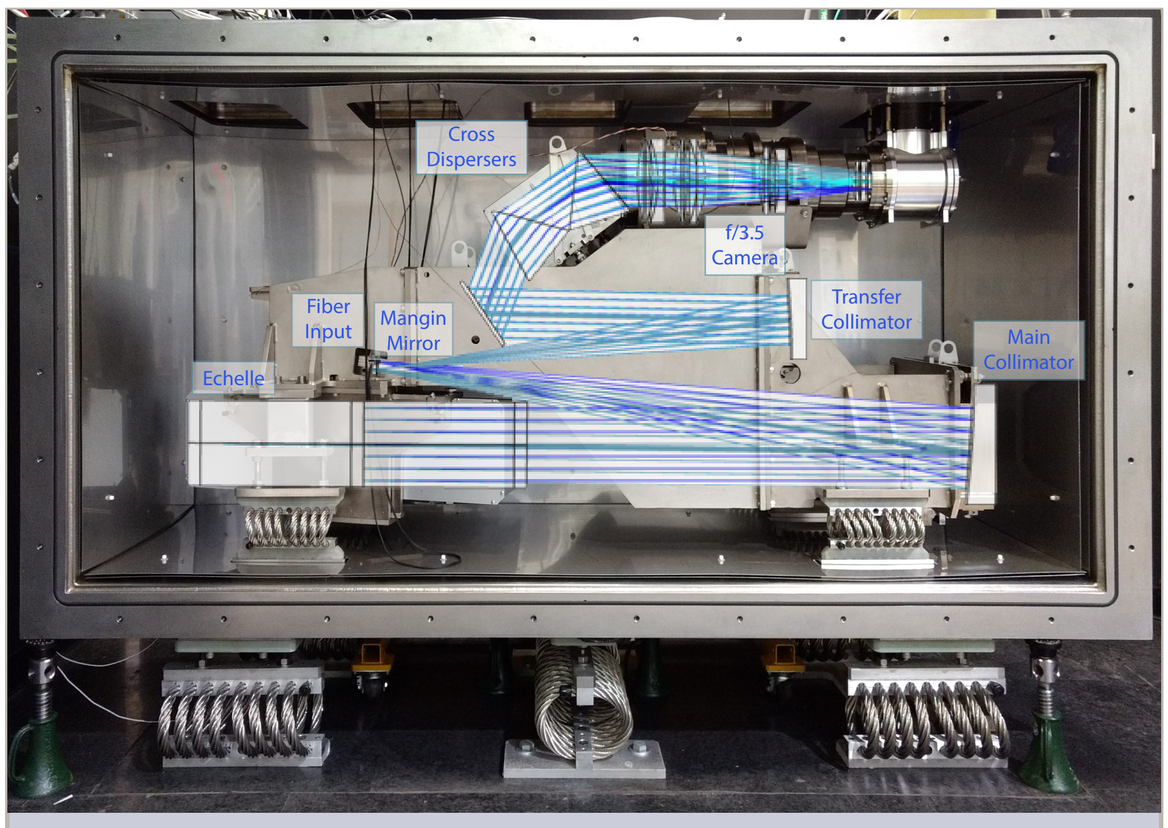
EXPRES: Precision, Radial-Velocity Measurements with an STA 1600 Detector

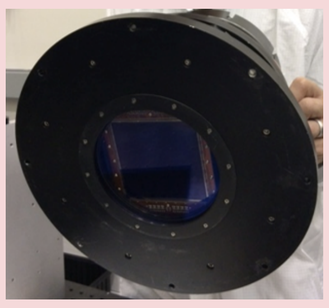
Lily L. Zhao, Debra A. Fischer, Colby Jurgenson, Dave Sawyer, Tyler McCracken, Andrew Szymkowiak, John Brewer, Ryan Blackman, Ryan Petersburg, Allen Davis, Joel Ong



EXPRES in its vacuum chamber at the DCT. The light path and optical elements diagram is overlayed. Thermal enclosure not pictured.

EXPRES: The EXtreme PREcision Spectrograph

- R=135,000
- Environmentally stabilized
- 390-750 nm
- 4.3-m Discovery Channel Telescope (DCT)
- Up to 280 partial nights/year

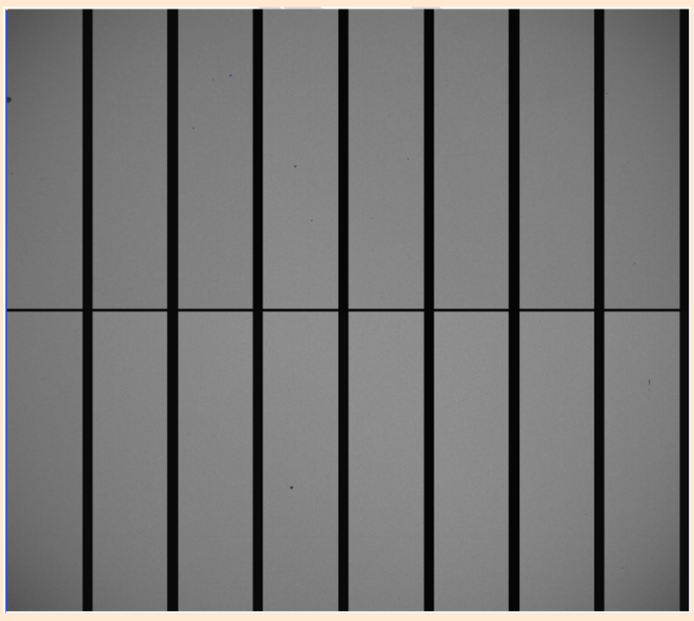


STA Detector

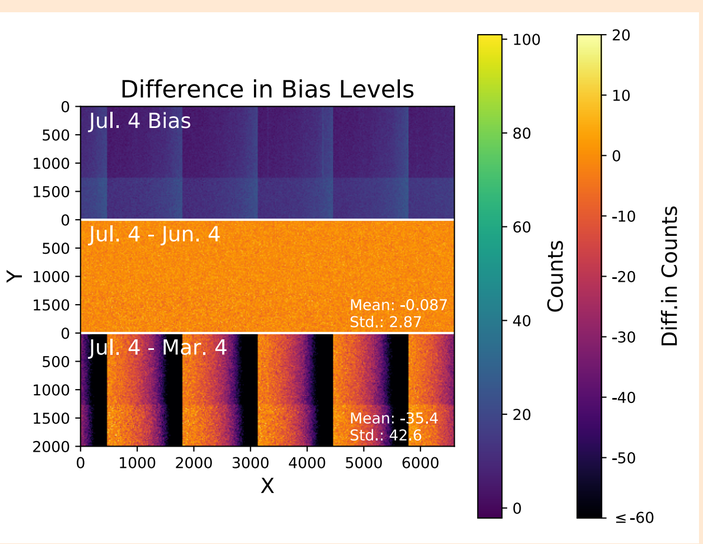
- 10k by 10k
- 9 micron pixels
- No pixel-stitching errors

Bias Level and CTE

This STA detector is designed to have a charge transfer efficiency (CTE) > 0.9999996. We observe consistent bias levels to ±5 counts.

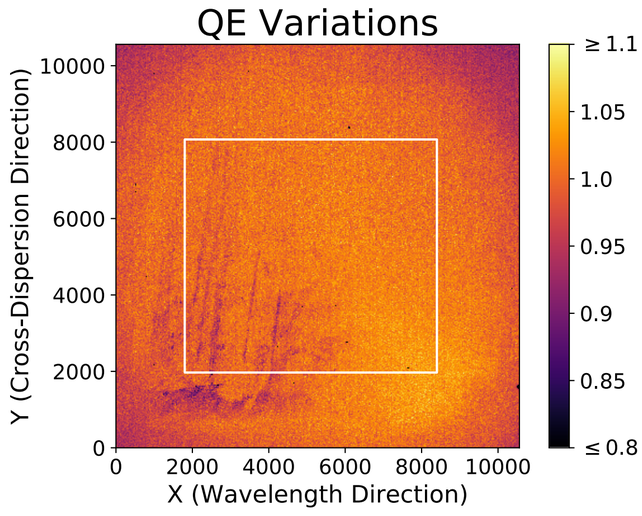


The illuminated CCD.



Cutouts of a median bias image (top) and the difference in counts against previous bias images. The greater difference in the Mar. 4 bias is due to an insufficient pre-settle time that was later corrected.

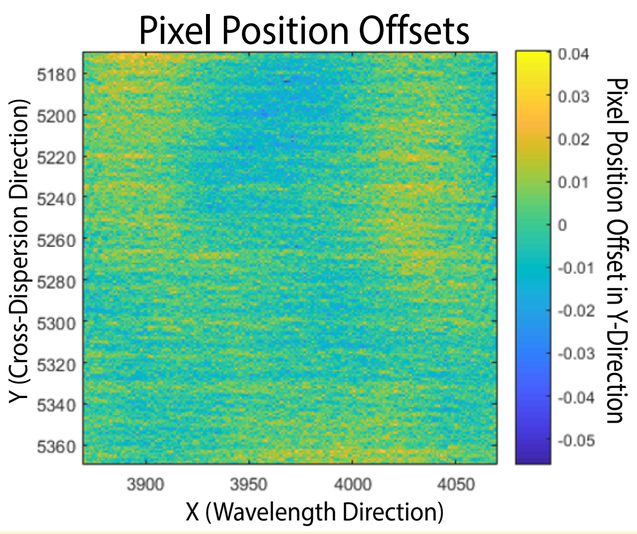
Quantum Efficiency



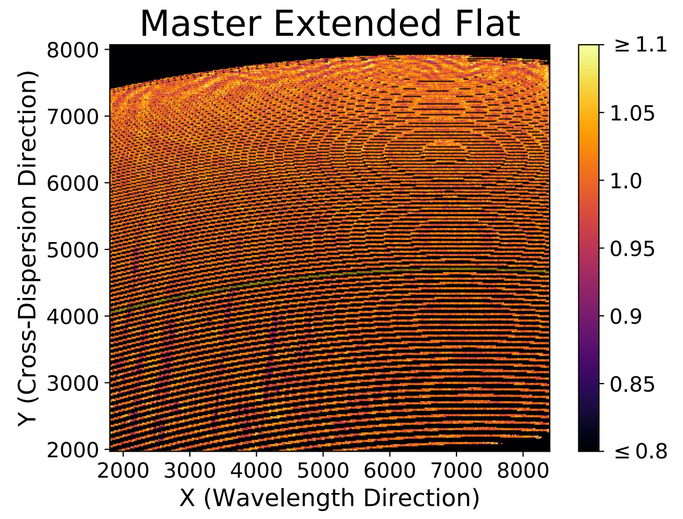
The level of quantum efficiency (QE) variation is ~3.3%. More troublesome spatially correlated variations can be seen in the lower-left of the above QE map (provided by STA).

Pixel Positions

Pixel nonuniformity remians an unsolved problem. Laser data were plagued with dust fringing and laster instability.

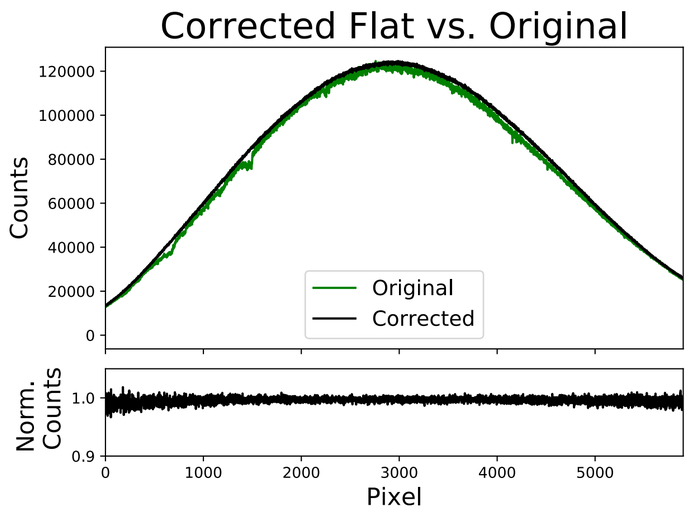


Master Flat



QE variations are corrected for using a master extended flat. This is constructed from combining ~600 exposures of an LED source through a taller version of the science fiber.

The order highlighted in green is shown corrected below.



An LED through the science fiber before and after flat fielding (top). Dividing out a concave-hull blaze model gives a flat result (bottom).