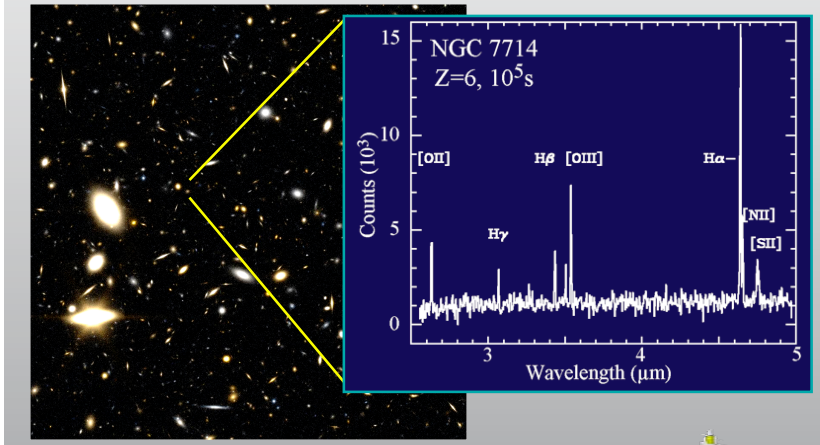
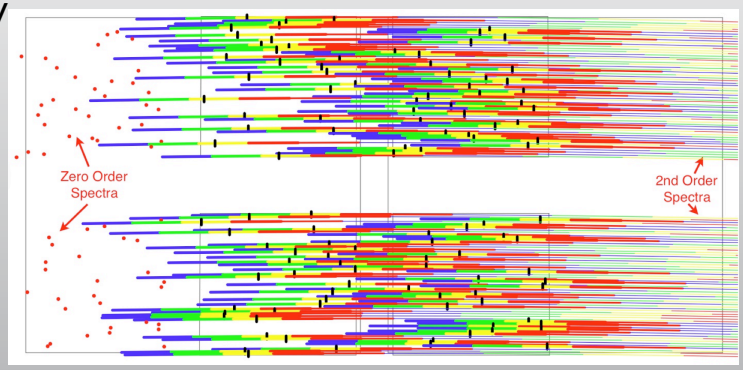
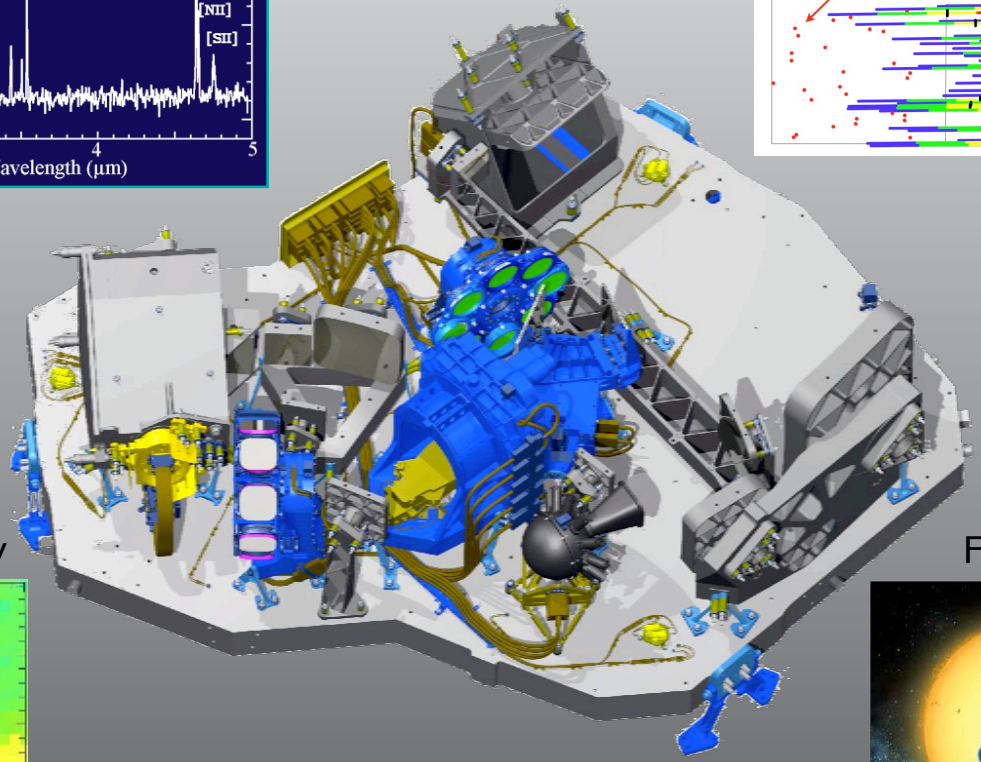
NIRSpec –
The JWST Near-InfraRed Spectrograph

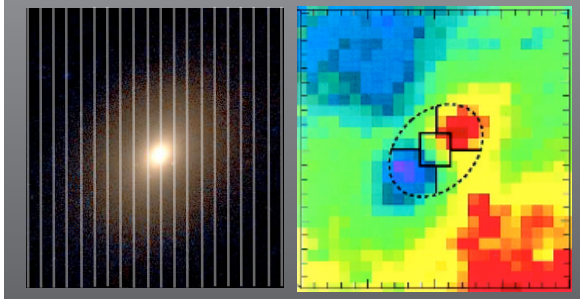


Multi-Object Spectroscopy

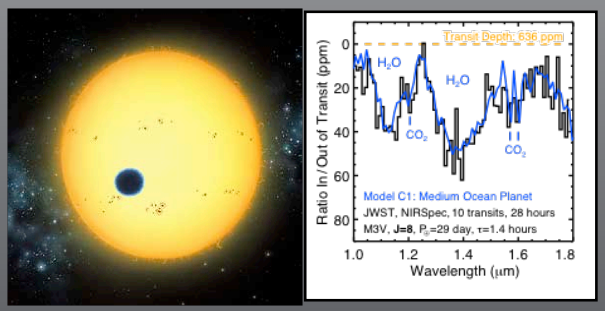




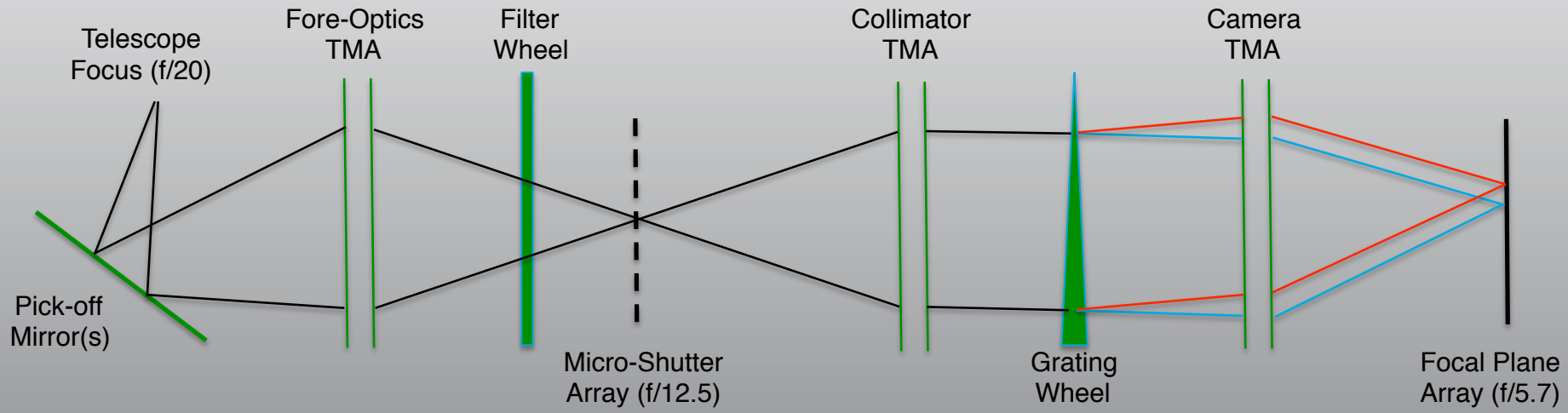
Integral-Field Spectroscopy

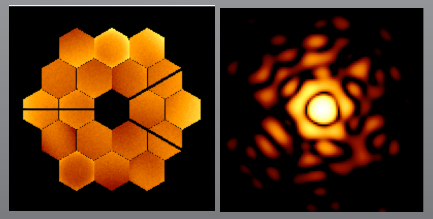


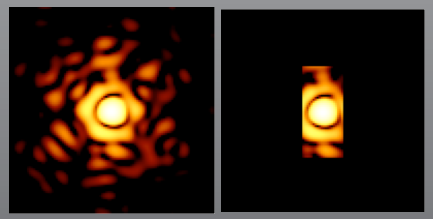
Fixed-Slit Spectroscopy

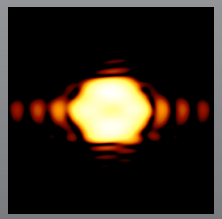


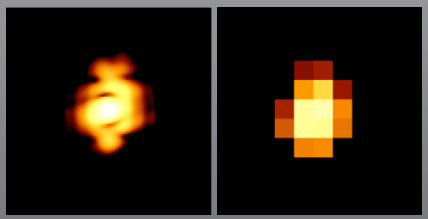
NIRSpec Optical Design



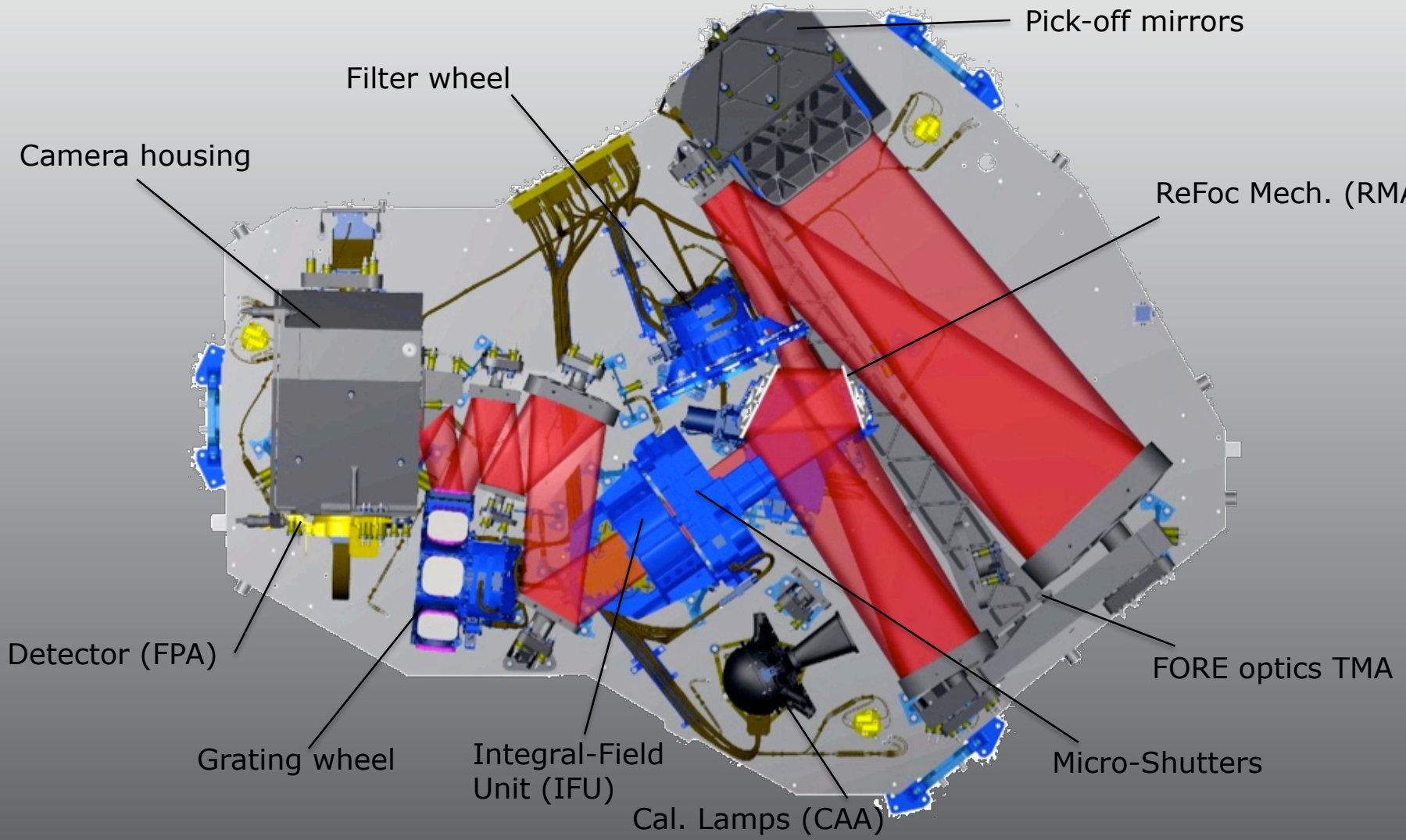

Telescope Focus


Slit Mask


Pupil at Disperser


Detector Array

NIRSpec Mechanical Design

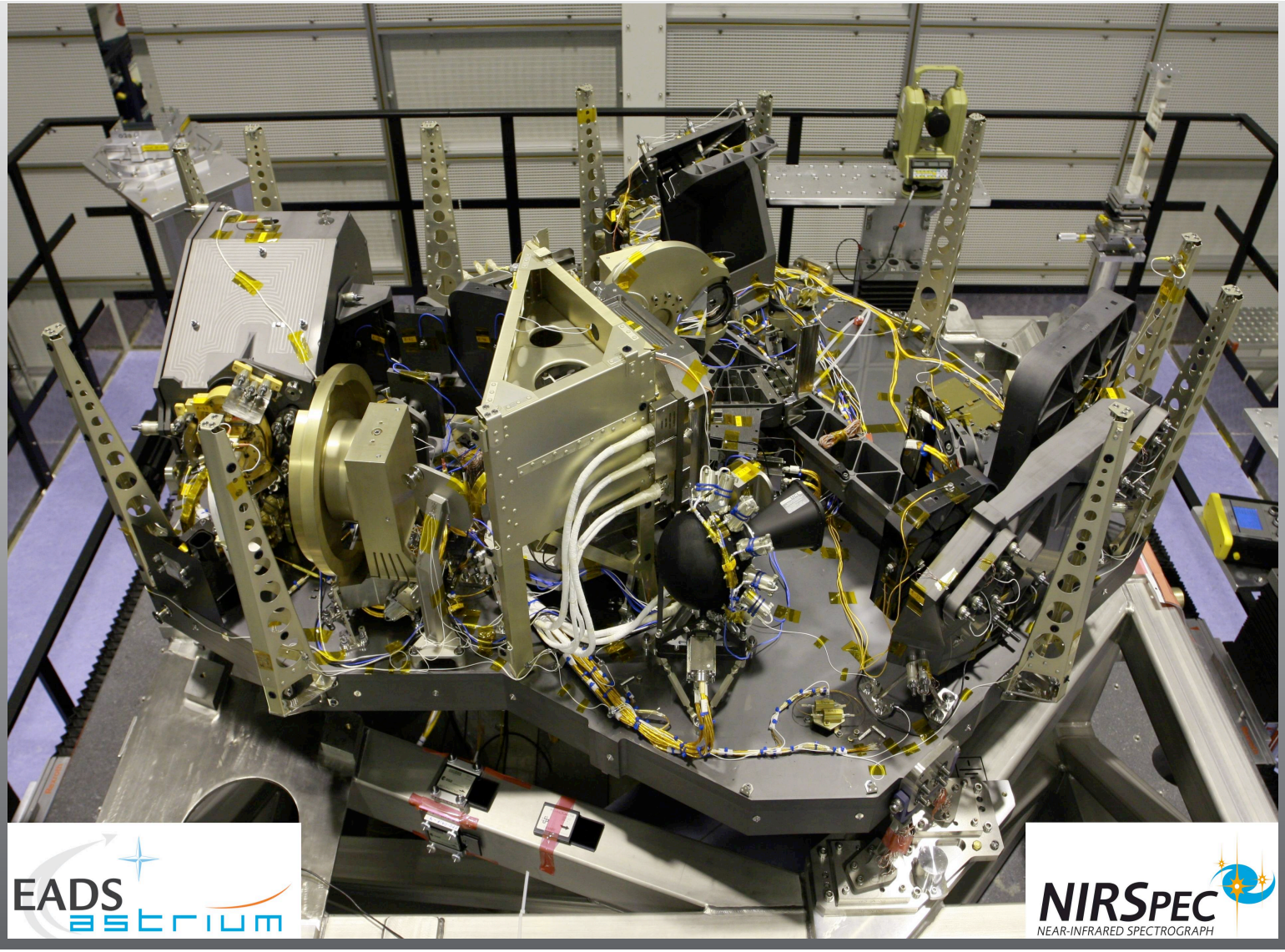


NIRSpec Demonstration Model

- delivered to NASA in Jan. 2010

- flight-like optics up to MSA plane

- mass dummies in COLL and CAM parts



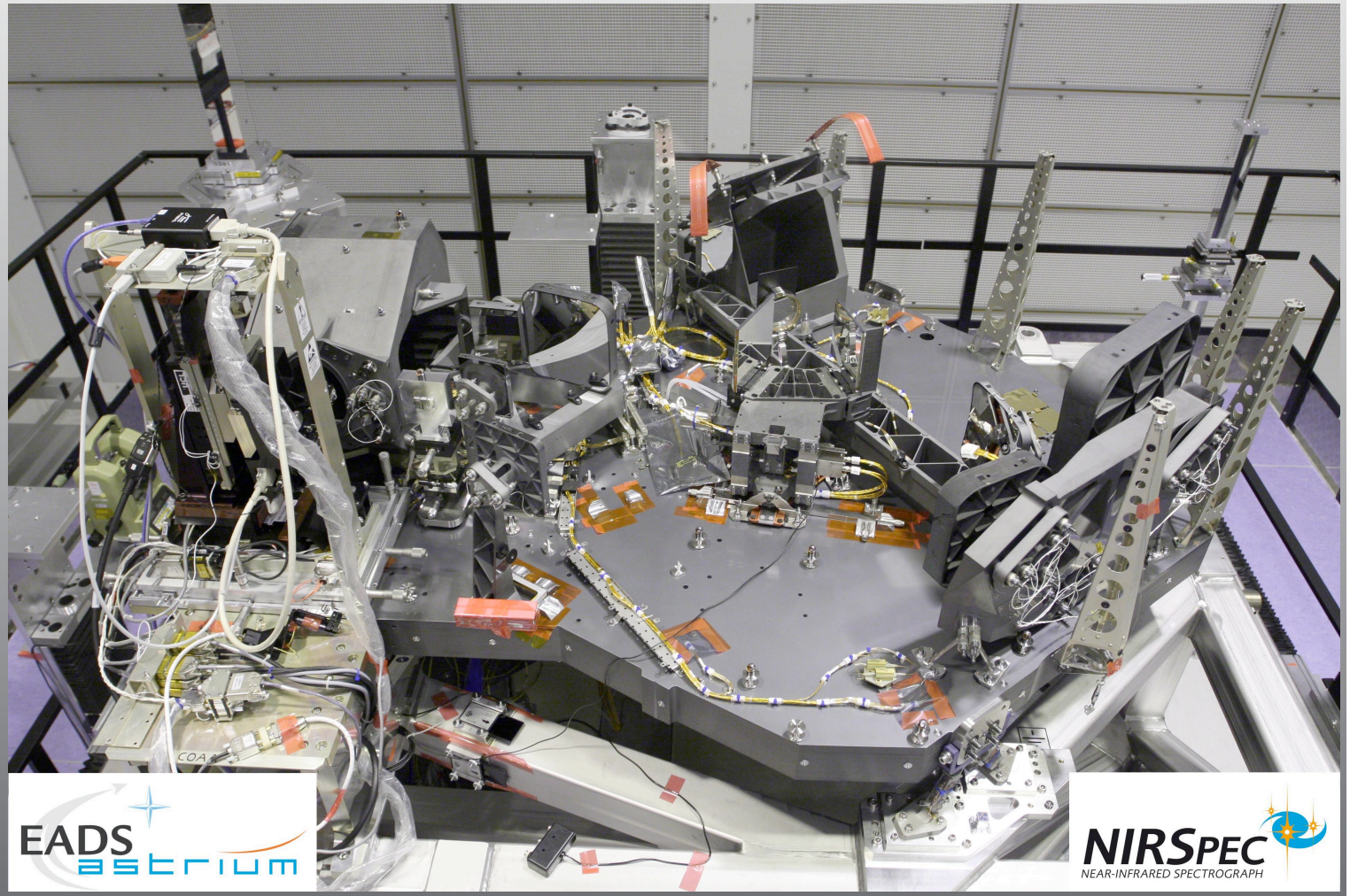
NIRSpec Flight Model

- currently being assembled at EADS

- 3 sub-systems missing:
  - FPA
  - MSA
  - GWA

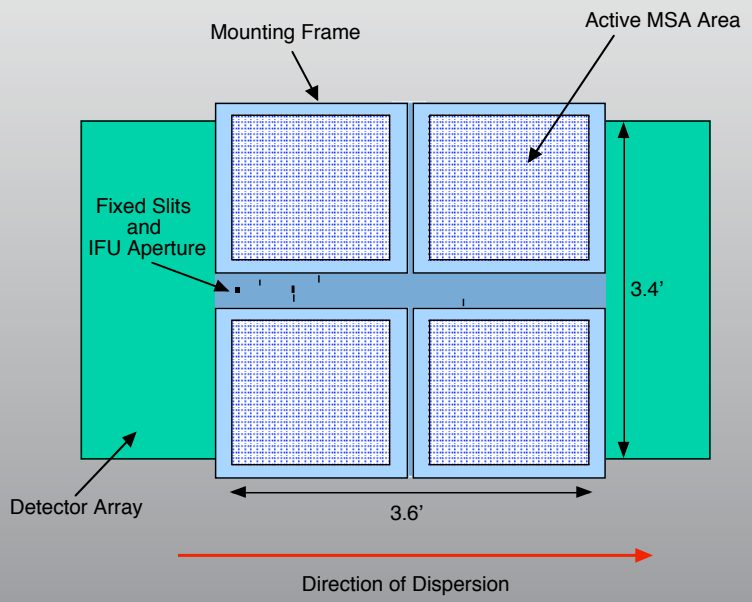
- on track for cryo campaign in Fall 2010

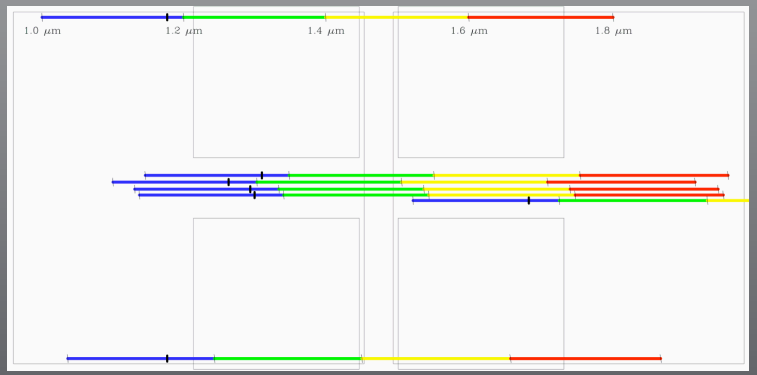
- delivery in Spring 2011



Key Features

- All-Reflective Optics
- 3.4’ x 3.6’ FoV (9 arcmin^2 for MOS)
- 0.2” mas nominal slit width
- 3 slit selection devices:
  - Micro-Shutter Array
  - 5 high-contrast fixed slits
  - 3” x 3” Integral Field Unit
- 3 spectral resolutions:
  - R=100 (prism, 0.6 - 5.0 μm)
  - R=1000 (3 gratings, 0.6 - 5.0 μm)
  - R=2700 (3 gratings, 0.6 - 5.0 μm)





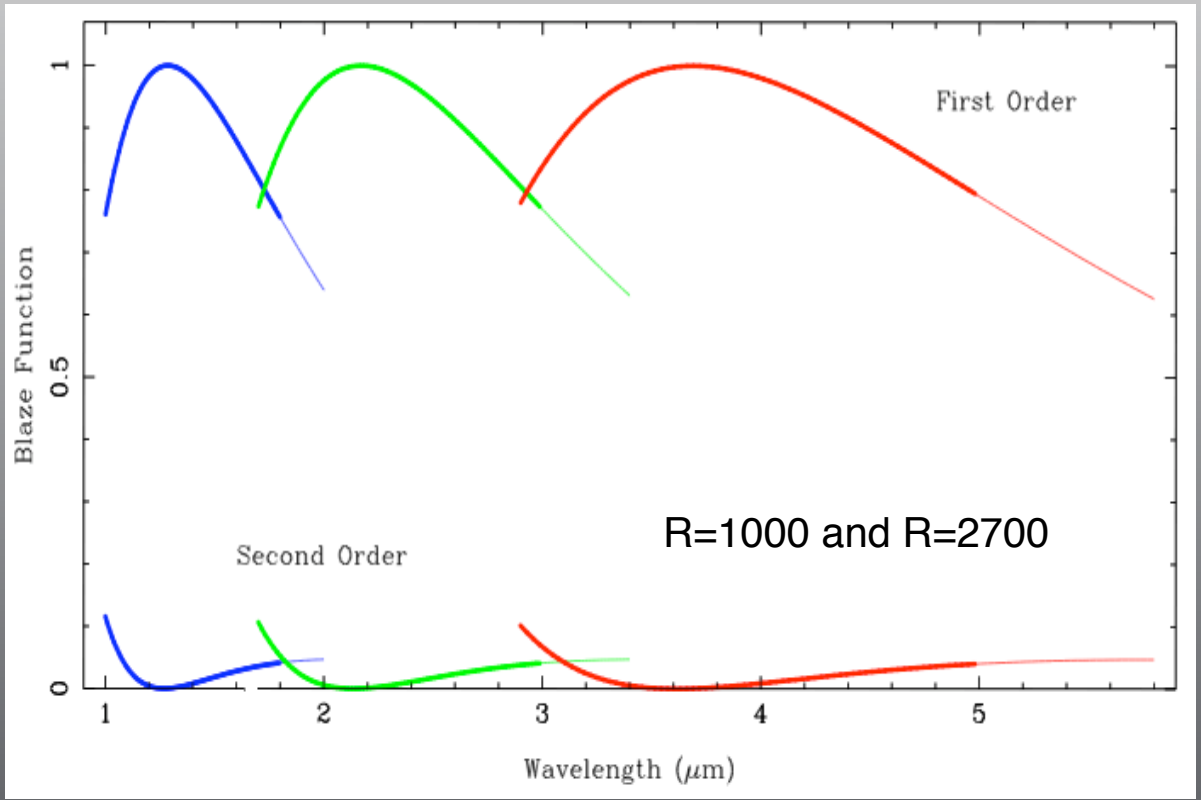
The NIRSpec spectral bands

wavelength range 0.6 - 5 μm spans 4 octaves!

→ gratings need order separation!

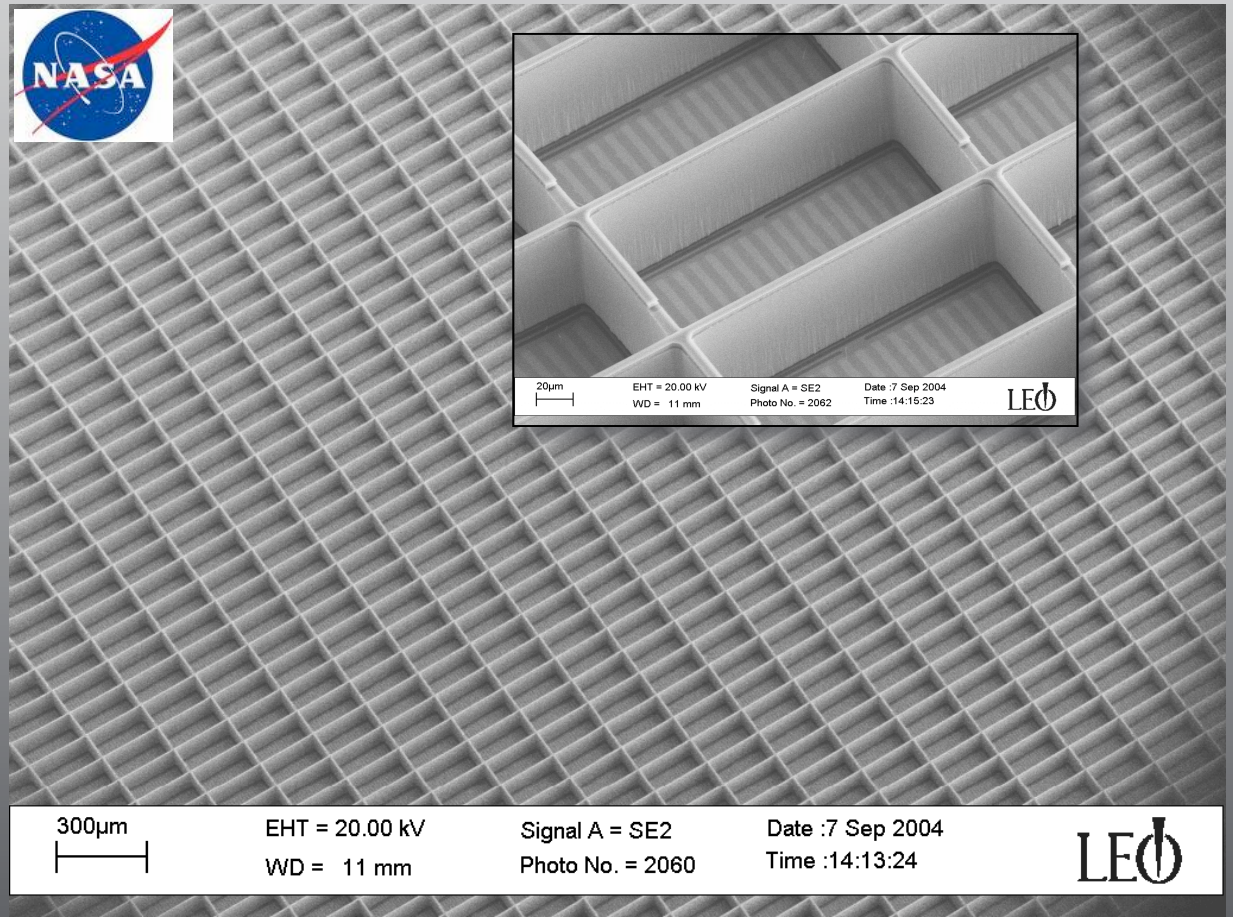
use long pass filters:

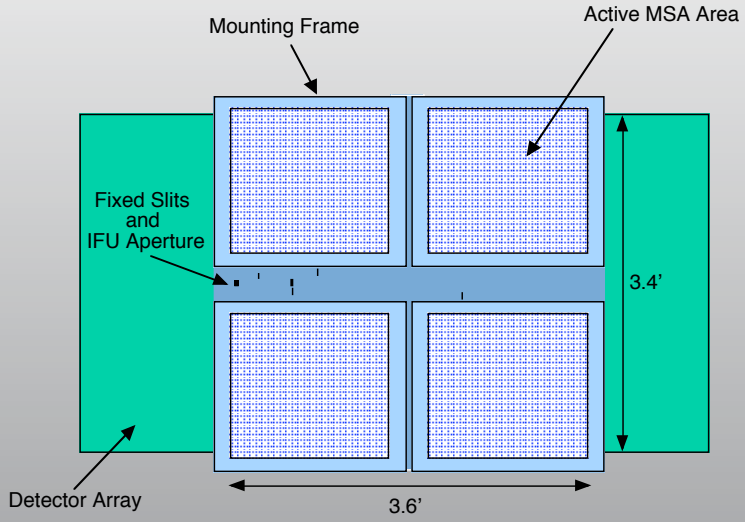
Name	Bandpass	Average Trans.
F140X	0.8 μm < λ < 2.0 μm	> 85%
F110W	1.0 μm < λ < 1.2 μm	> 90%
F070LP	λ > 0.7 μm	> 80%
F100LP	λ > 1.0 μm	> 80%
F170LP	λ > 1.7 μm	> 80%
F290LP	λ > 2.9 μm	> 80%
CLEAR	λ > 0.6 μm	> 80%
OPAQUE	n/a	n/a

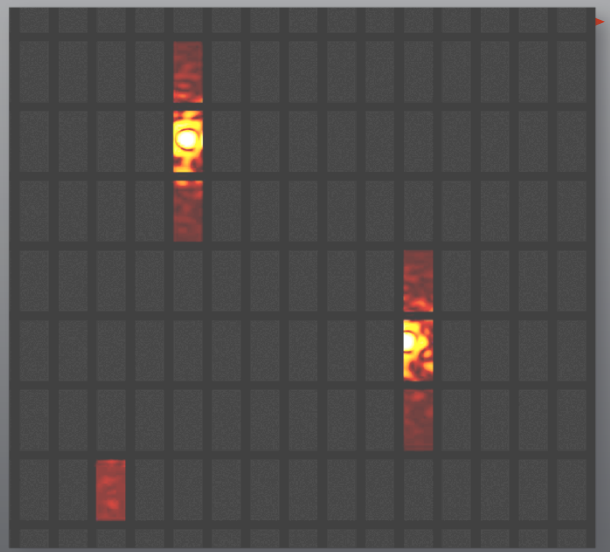


Micro-Shutter Array

4 x (365 x 171) individually controllable "doors"
up to ~100 objects observable simultaneously





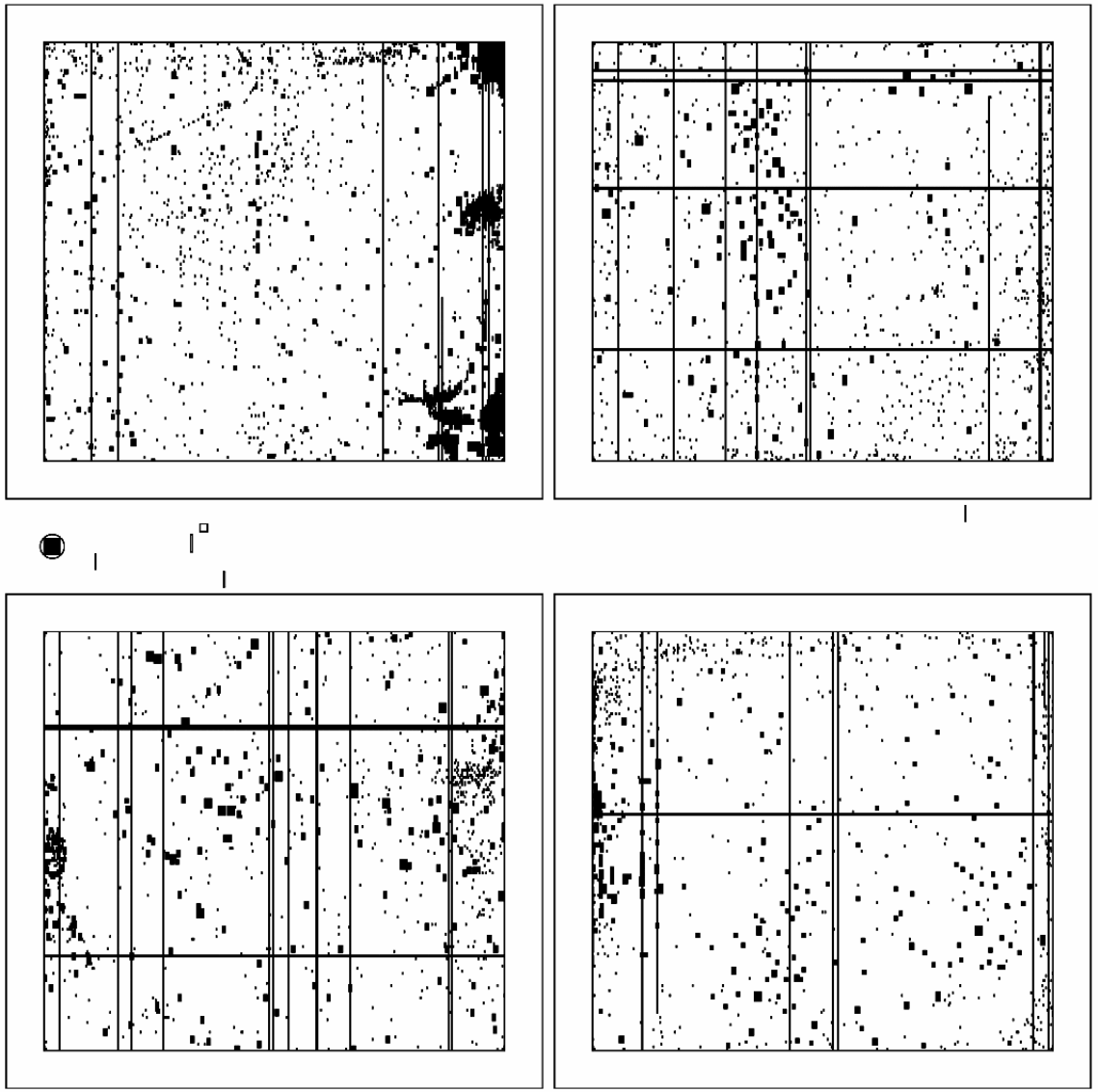


MSA performance: Closed Shutters

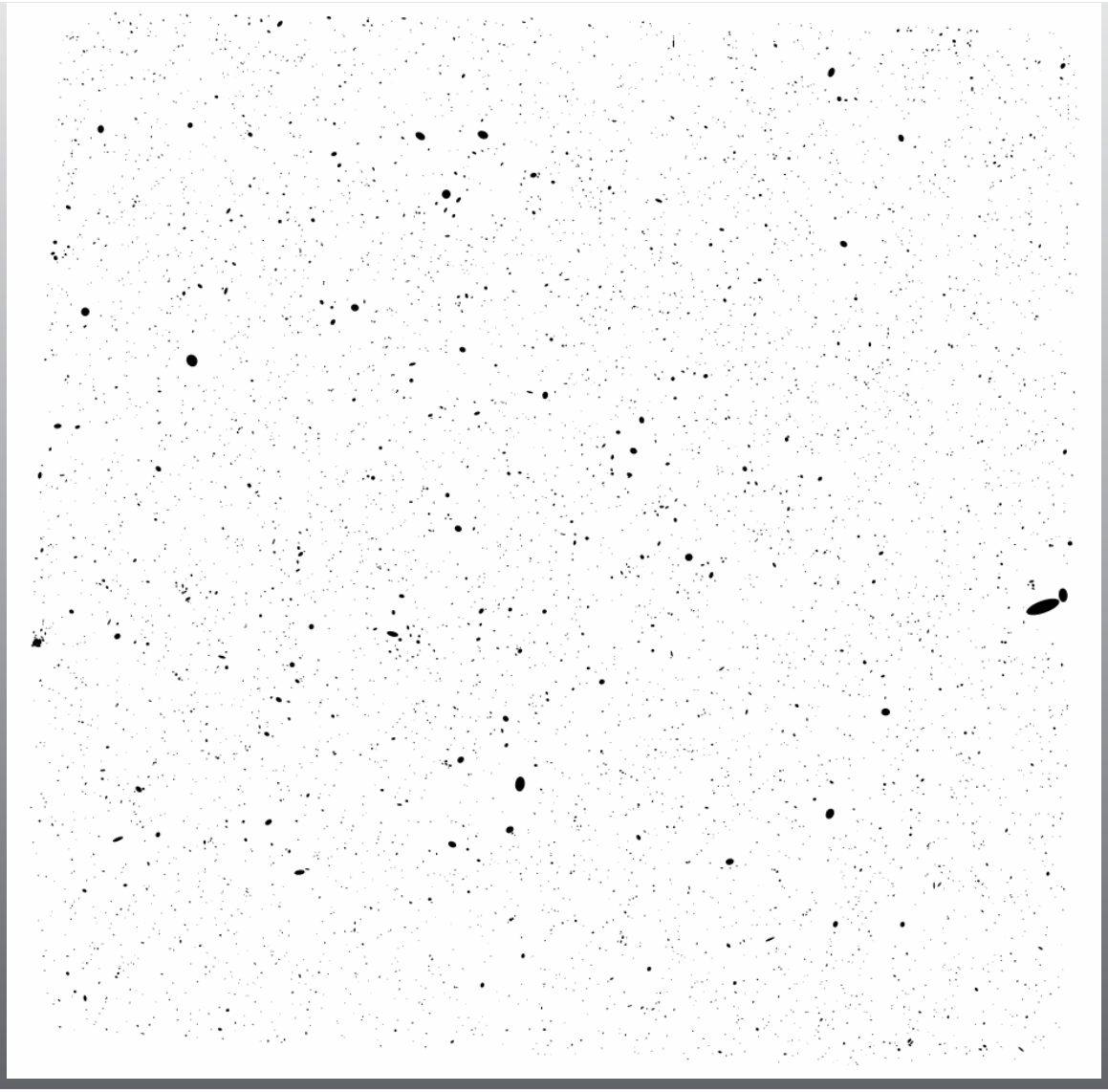
shutters that do not open ("failed closed"):

- cannot be used, but do not cause further harm

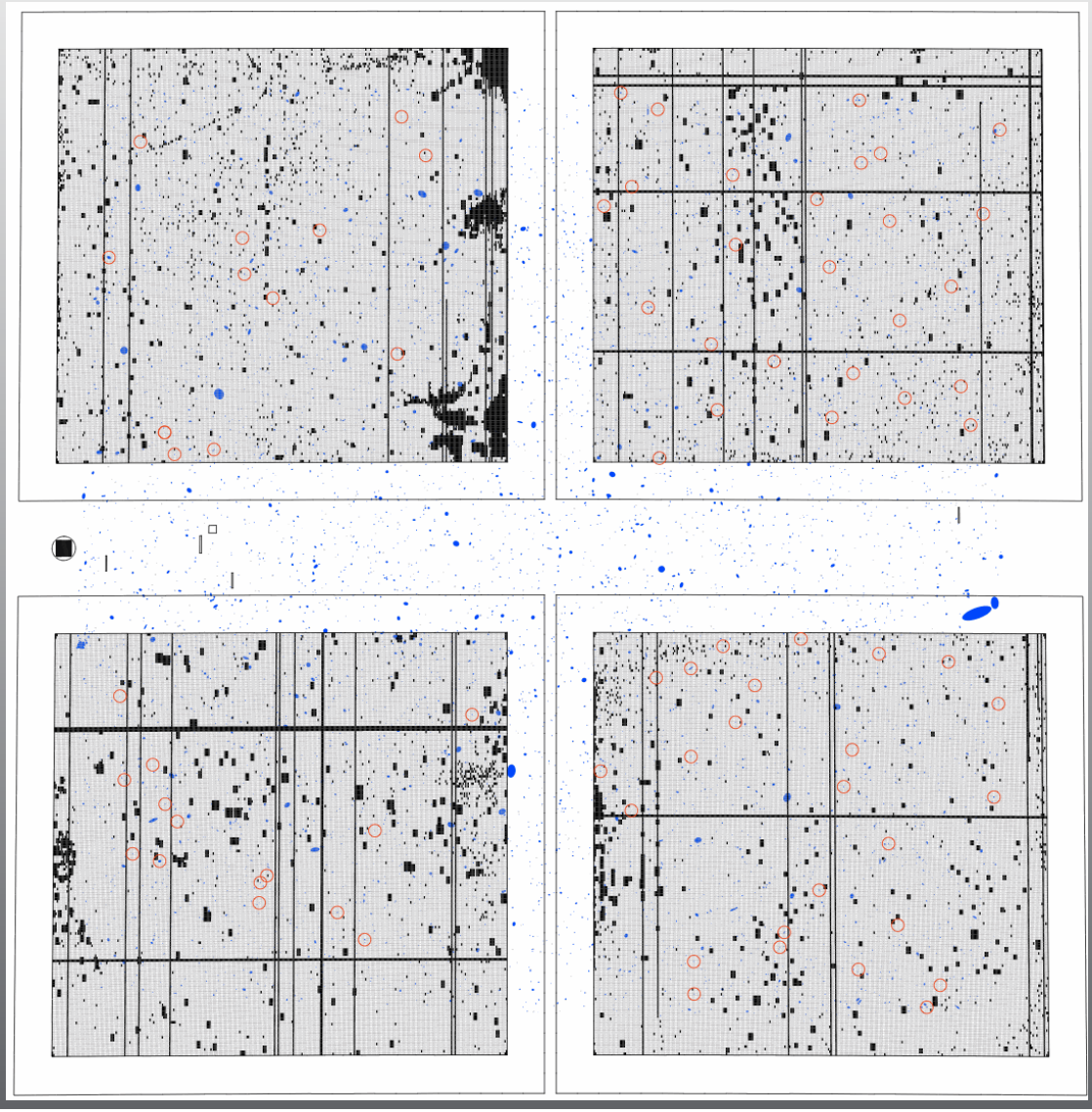
- electrical shorts cause entire columns/rows to fail in closed state



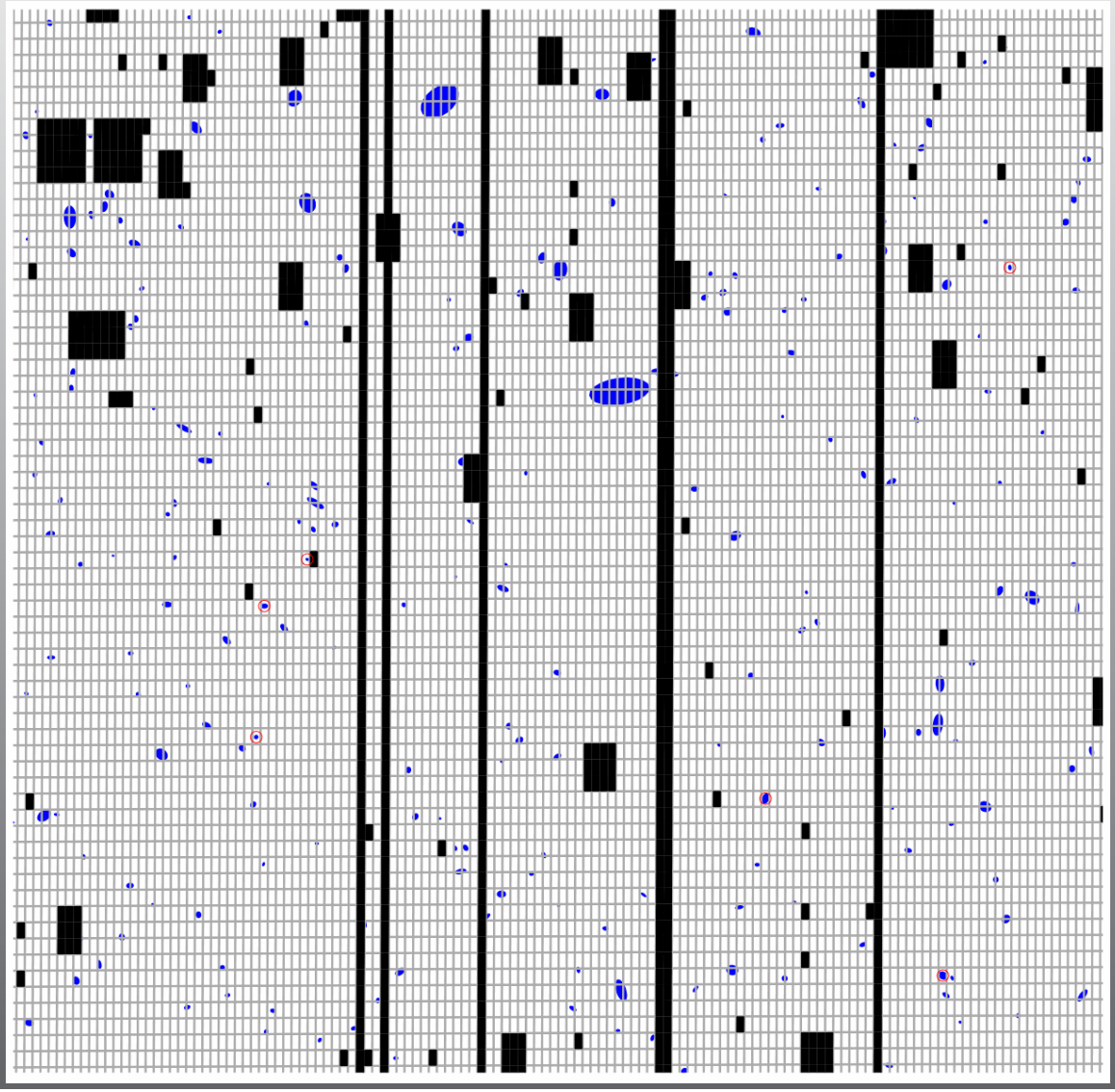
An Example: the HUDF



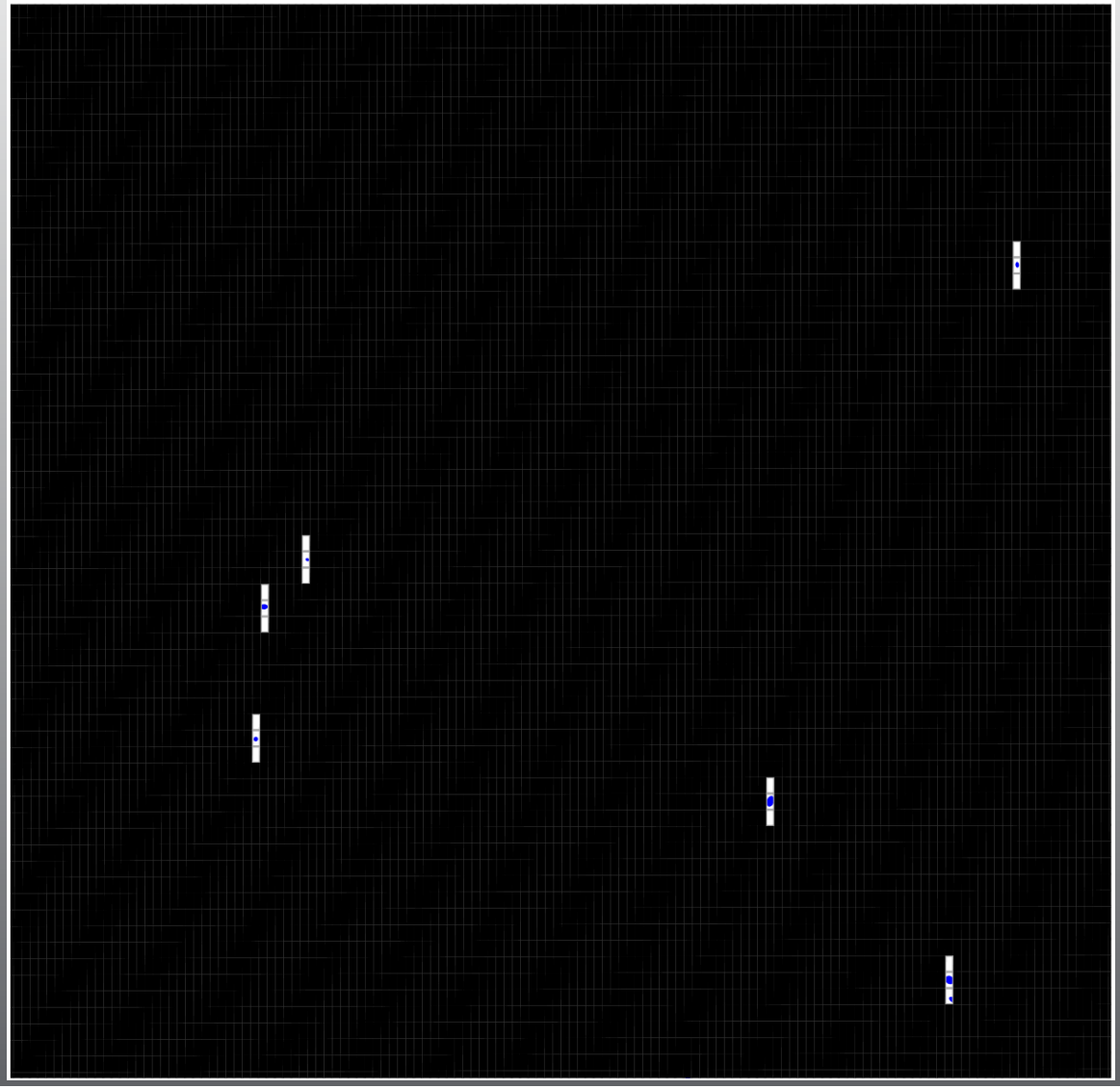
An Example: the HUDF



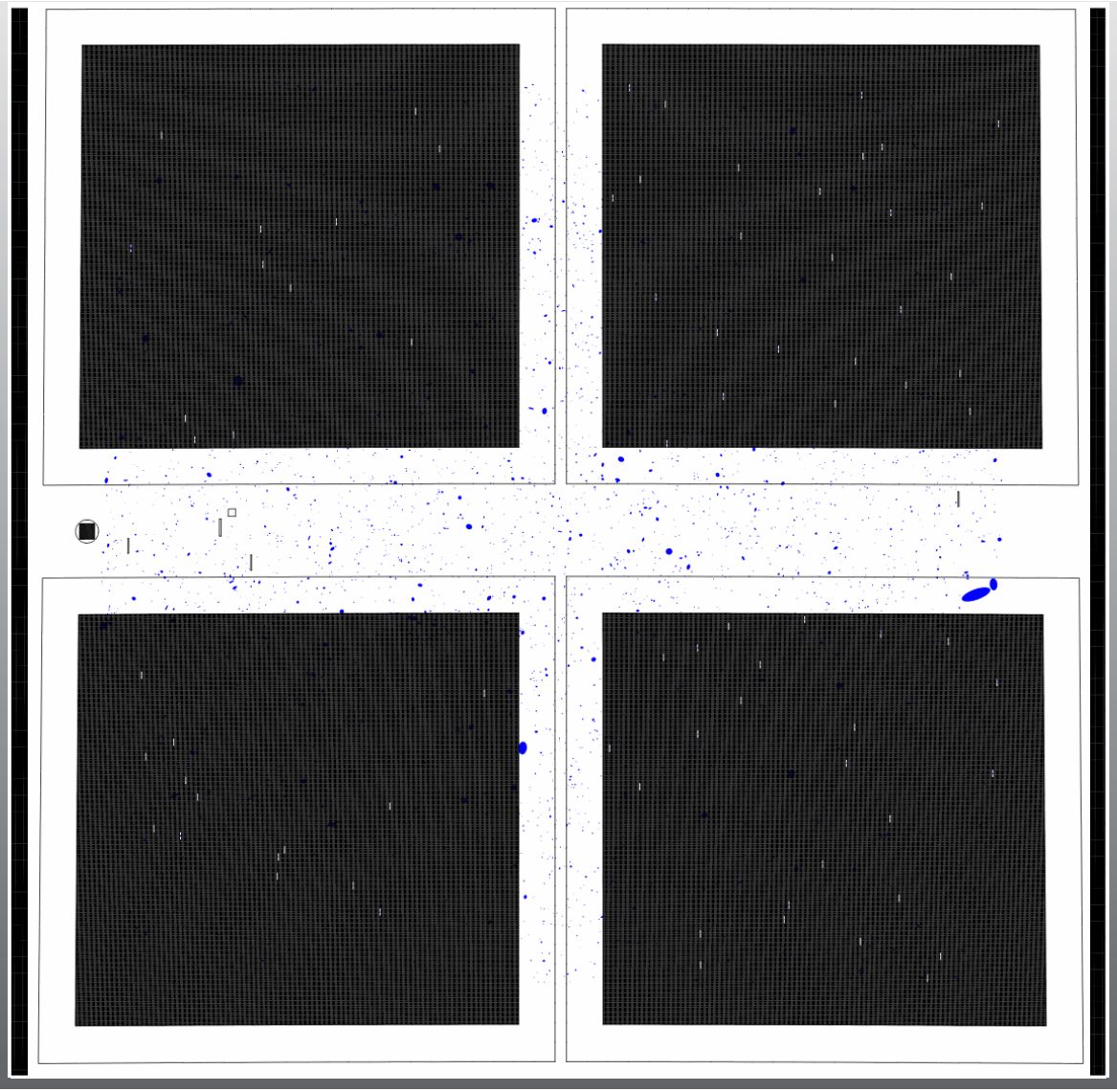
An Example: the HUDF



An Example: the HUDF

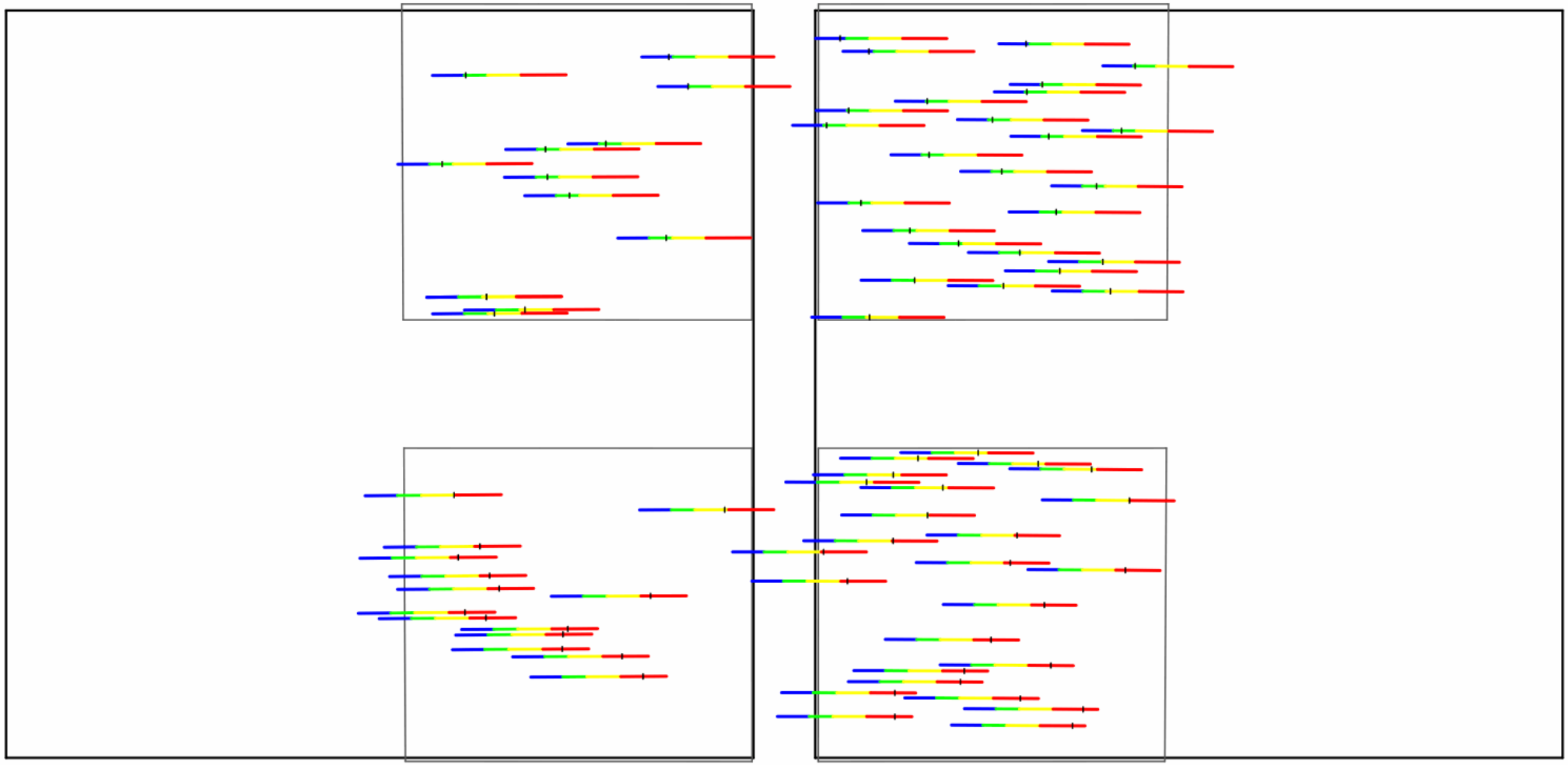


An Example: the HUDF



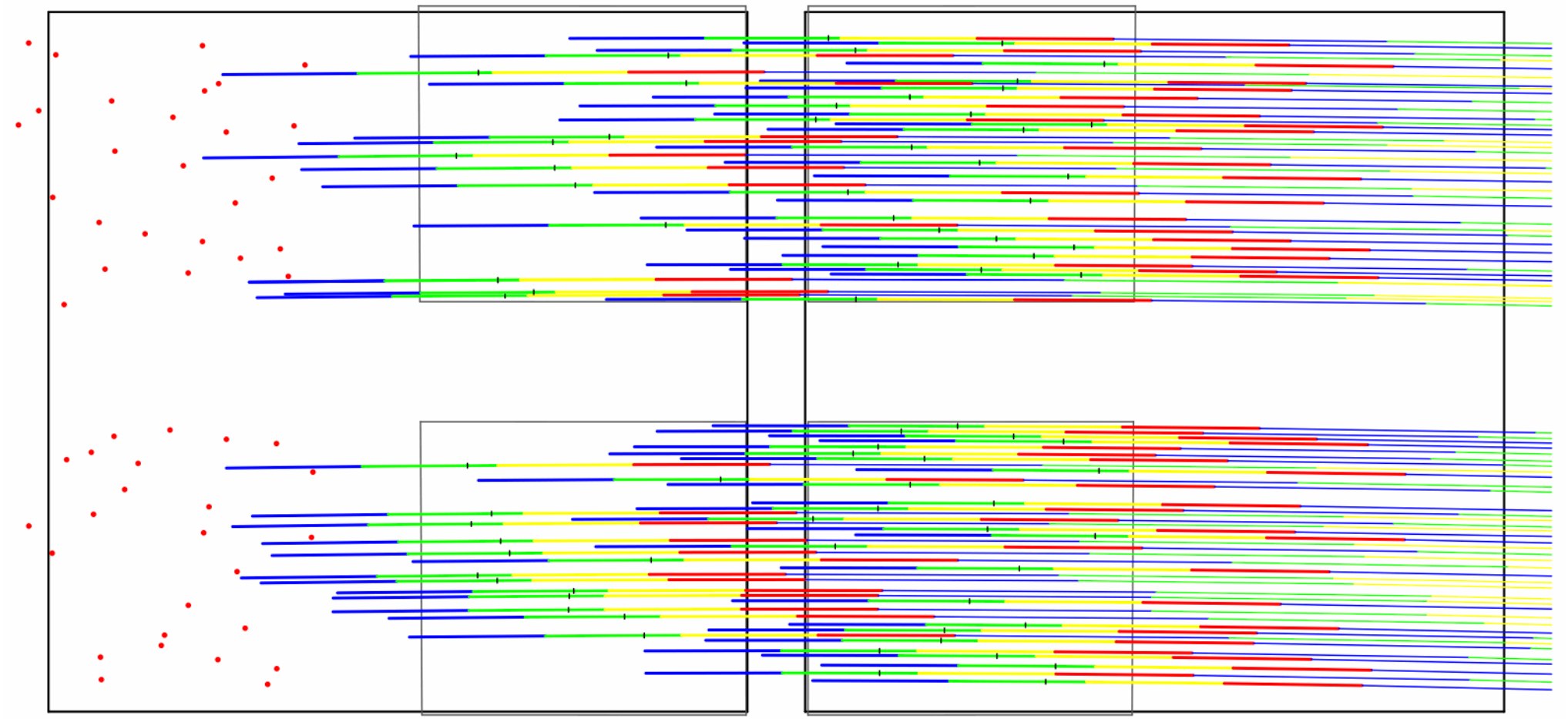
An Example: the HUDF

R 100:



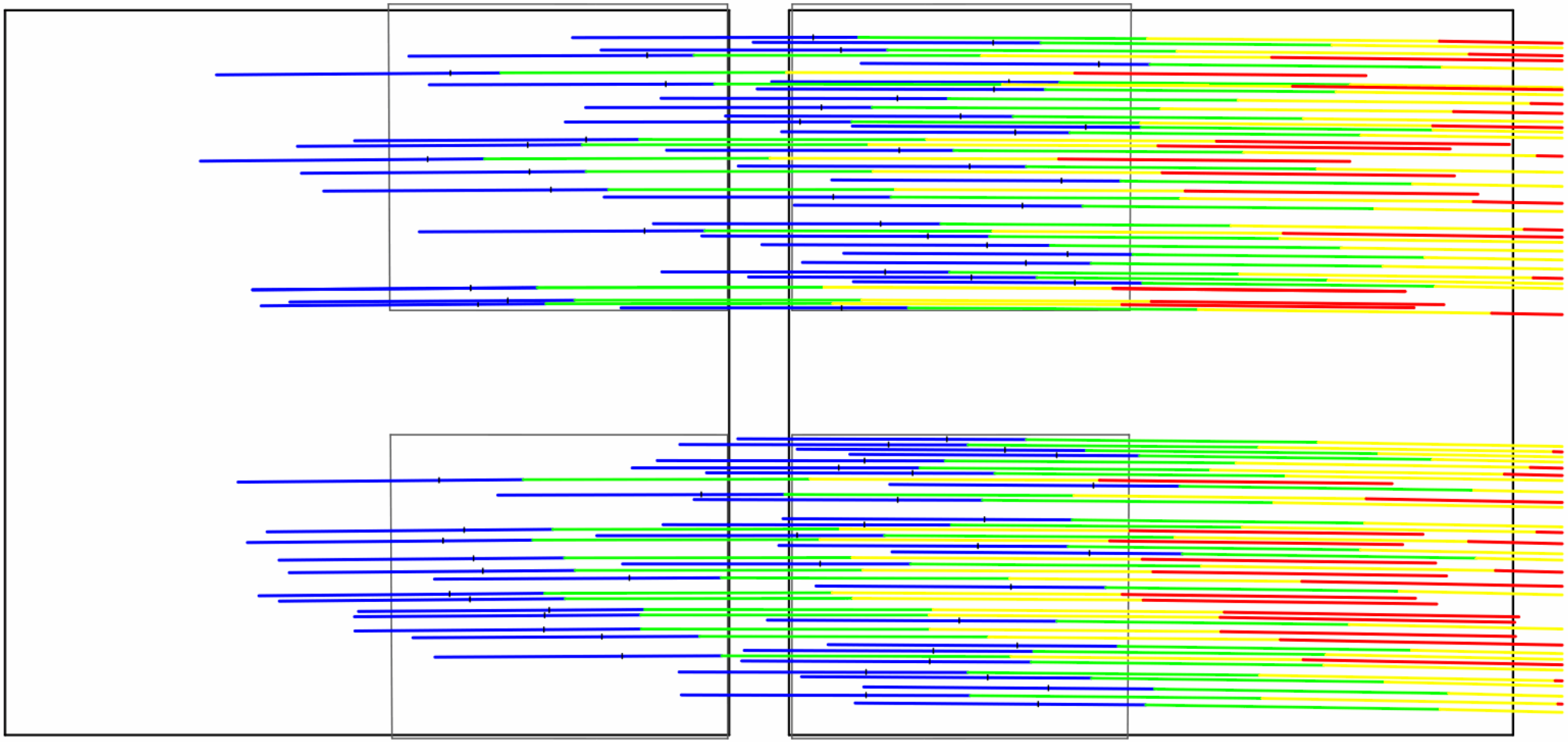
An Example: the HUDF

R 1000:



An Example: the HUDF

R 2700:

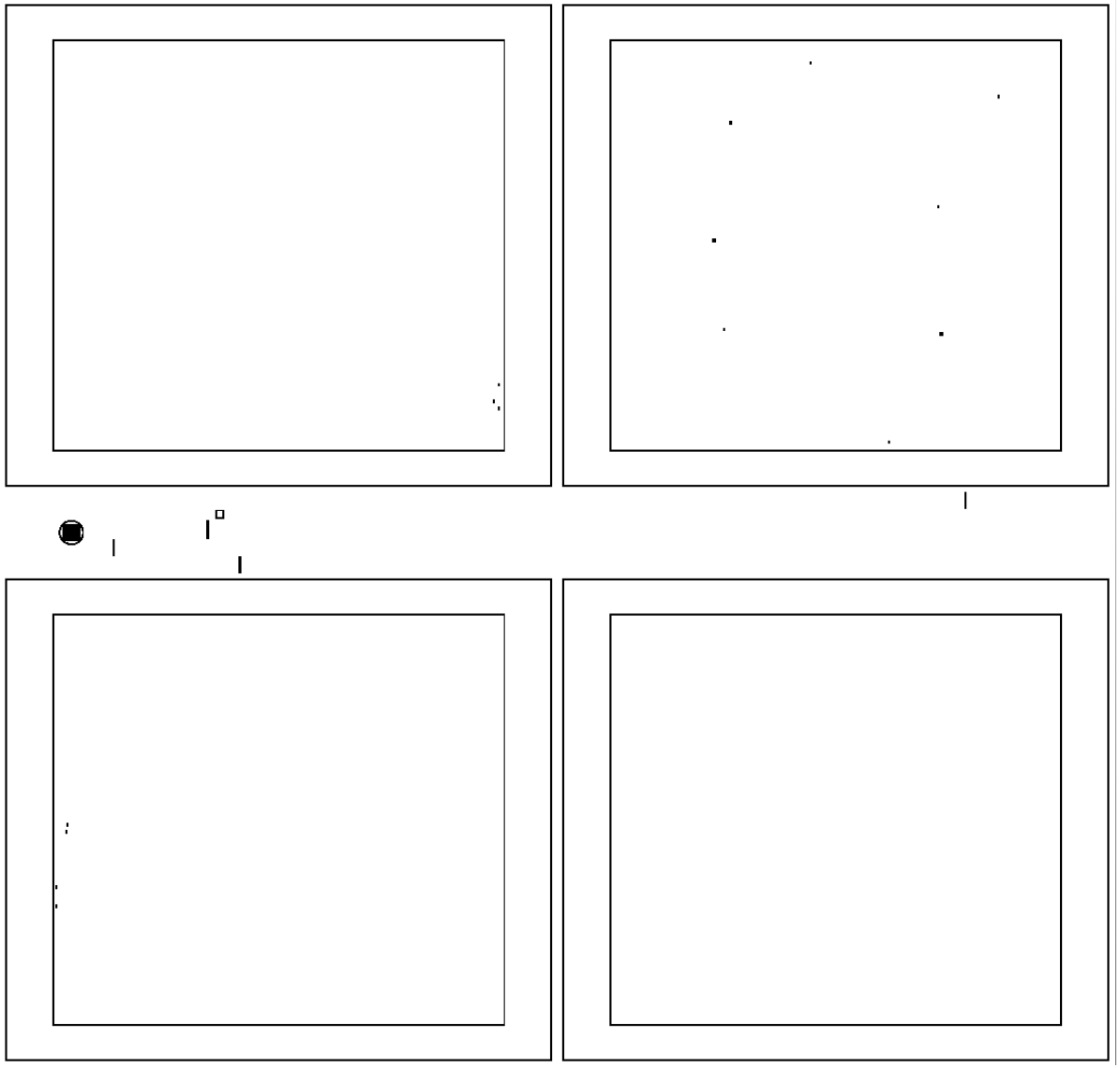


MSA Performance: Open Shutters

shutters that do not close ("failed open"):

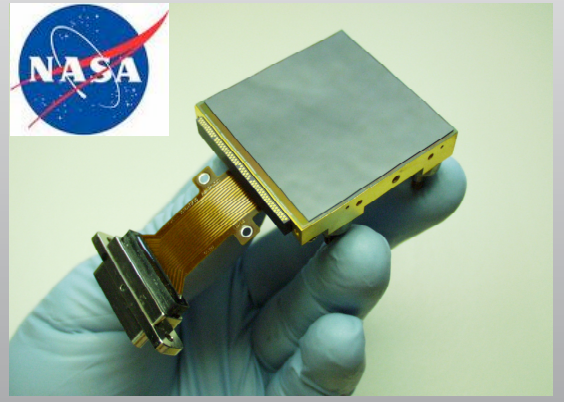
- are critical because they contaminate science spectra

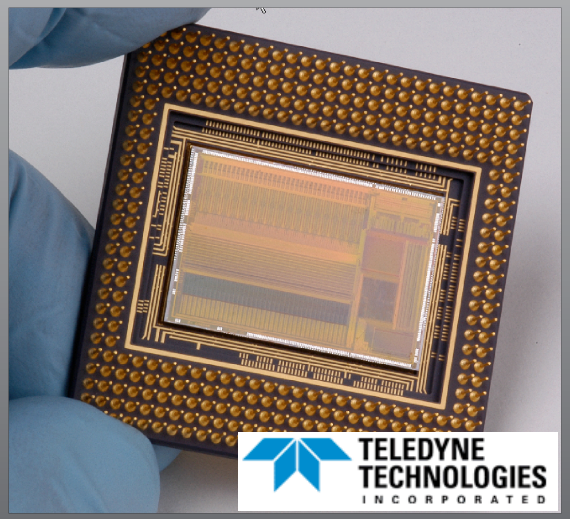
- can mostly be plugged, turning them into "failed closed"



NIRSpec Detectors

- Material: HgCdTe
- light sensitive from 0.6 to 5 μm
- 2 x (2048 x 2048) pixels
- pixel size 18 μm
- low readout noise
- low dark current

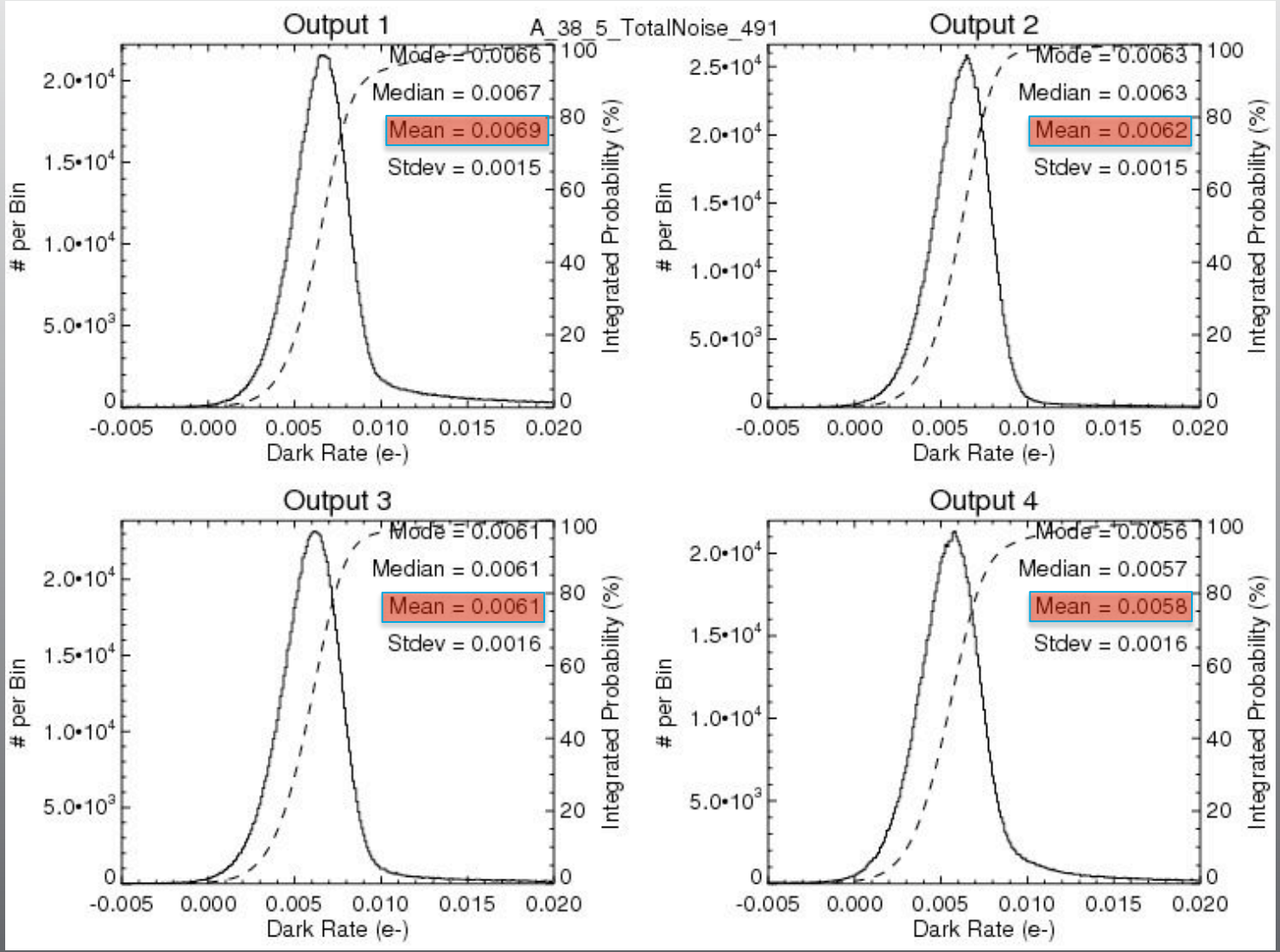




- operated with cryogenic ASIC
  ("application-specific integrated circuit")
- controls power supply & operation of arrays
- data digitization "at the source"

this just in:
Flight Detector Performance

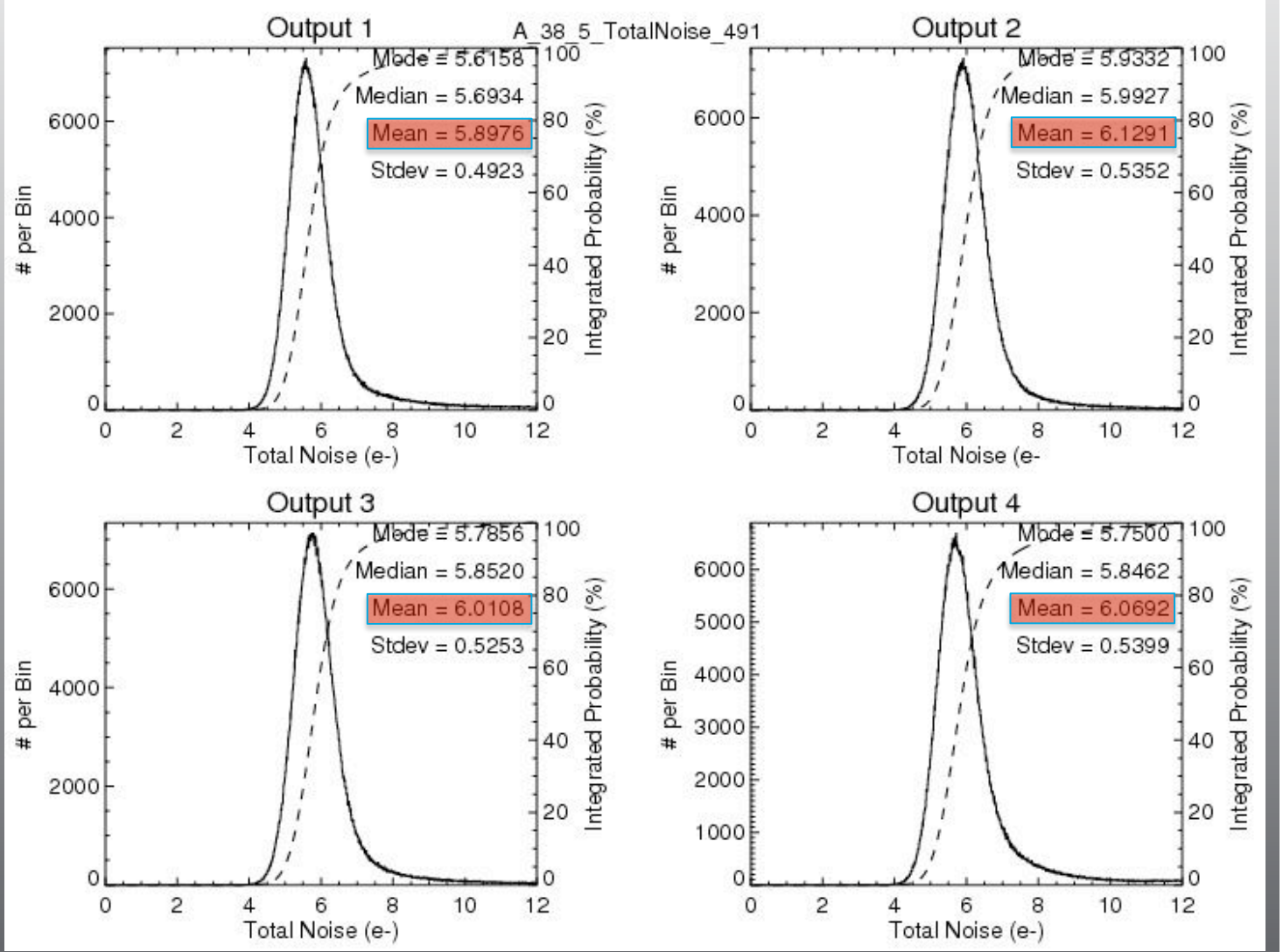
Dark current is less than specified 0.01 e^-/s !



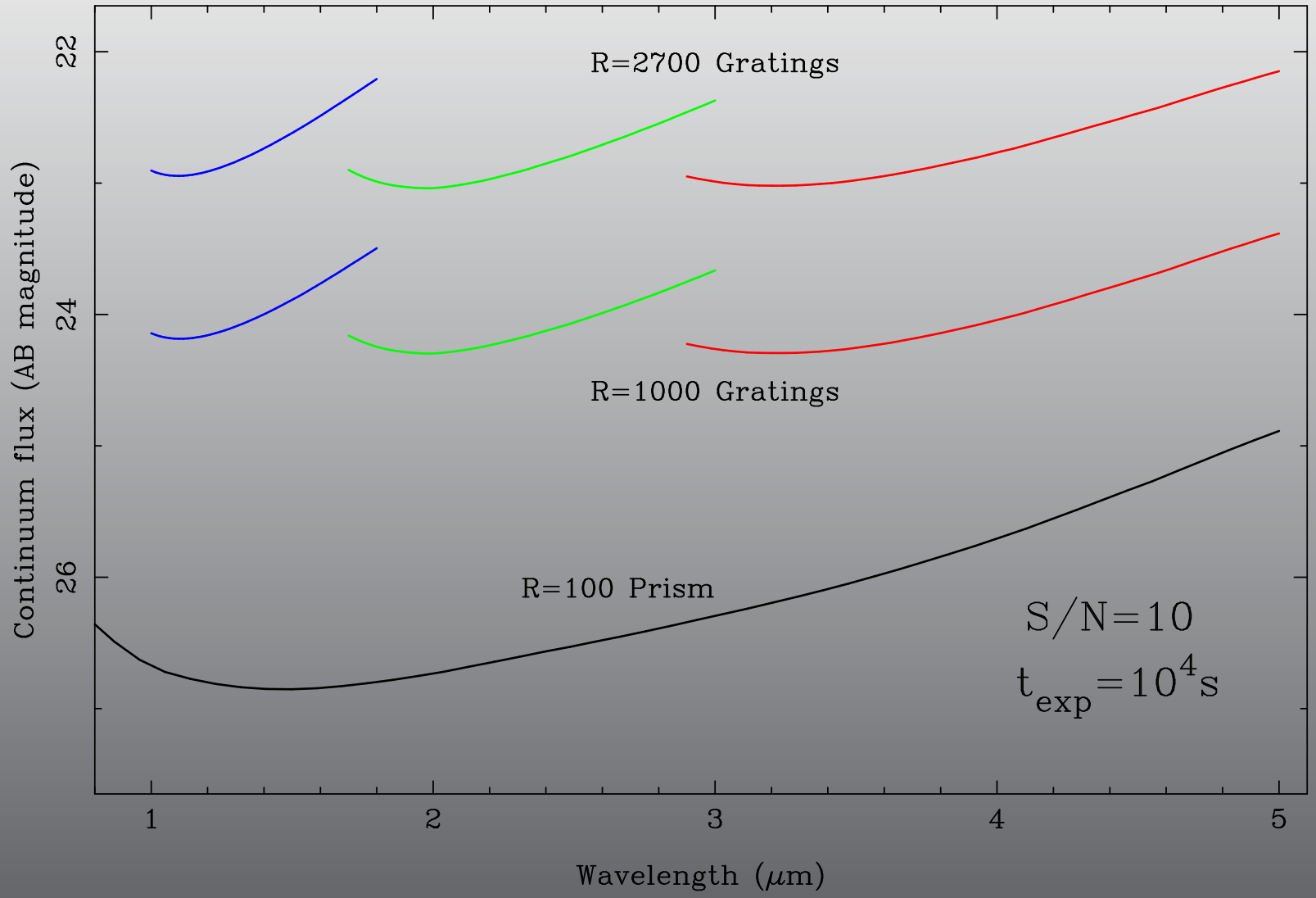
this just in:
Flight Detector Performance (2)

Total noise in 1000s exposure (88 samples) seems to meet the spec !

(assumed gain value of 1.2 e-/DN needs to be verified...)



Expected Continuum Sensitivities



Expected Unresolved Line Sensitivities