



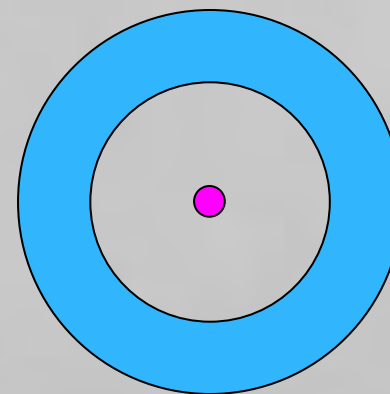
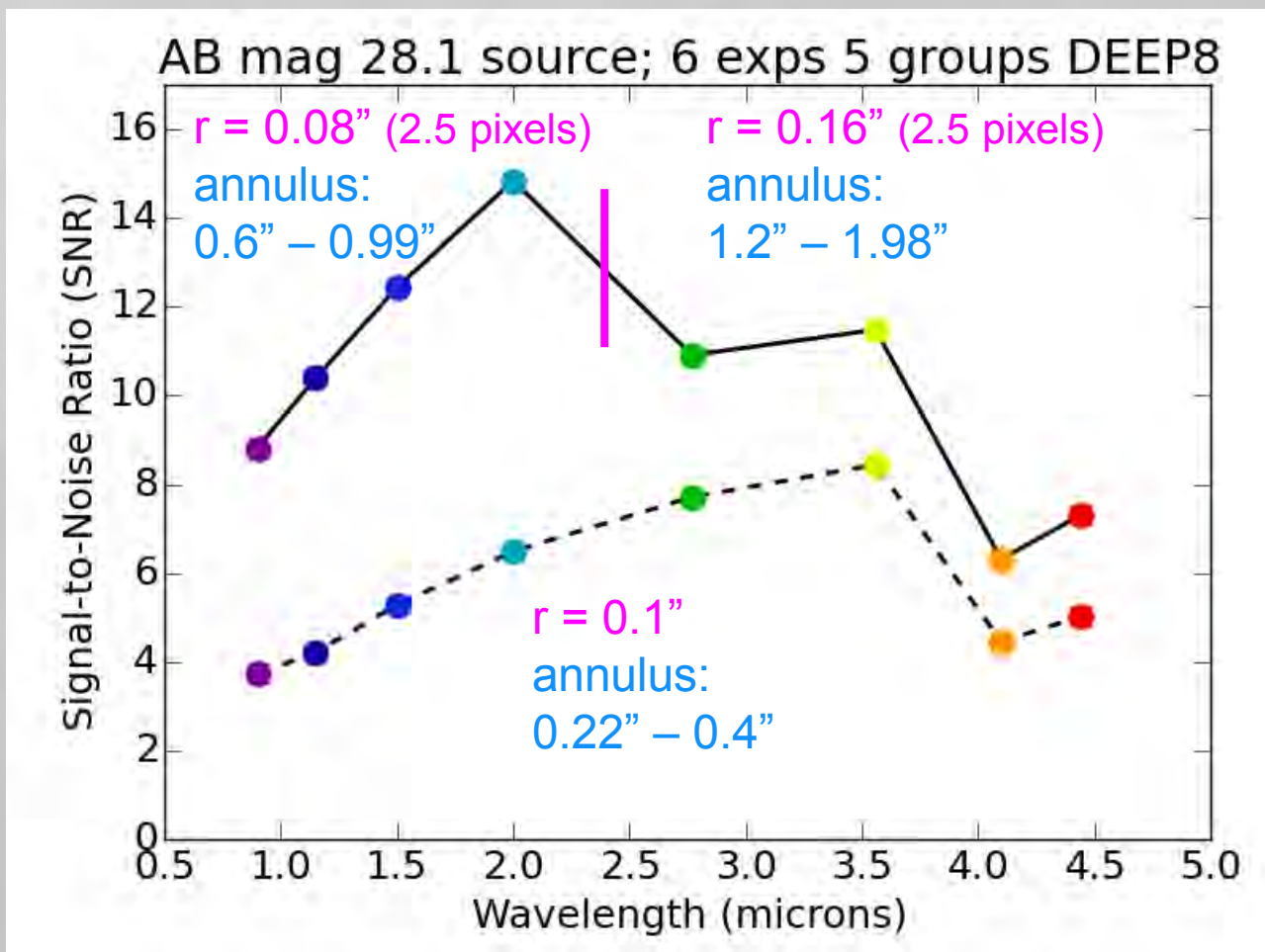
JWST ETC Pandeia GTO CANUCS NIRCcam Imaging and the Python engine

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SNR Depends on Aperture Size



photometric aperture
sky annulus

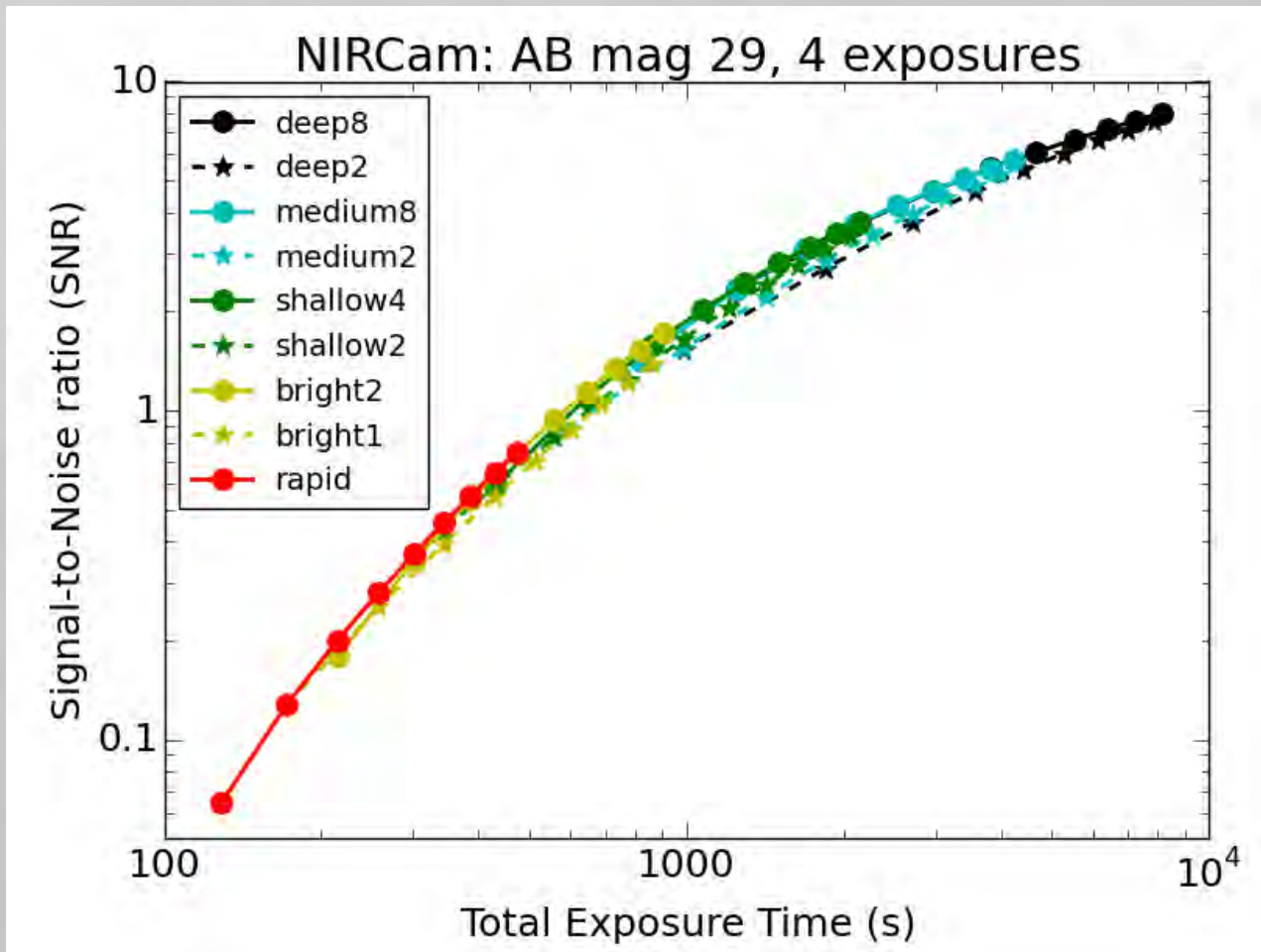
NIRCam

0.0317" short wavelength pixels

0.0648" long wavelength pixels



Selecting a NIRCam Readout Pattern



MACSJ0416.1-2403

2019-11-30

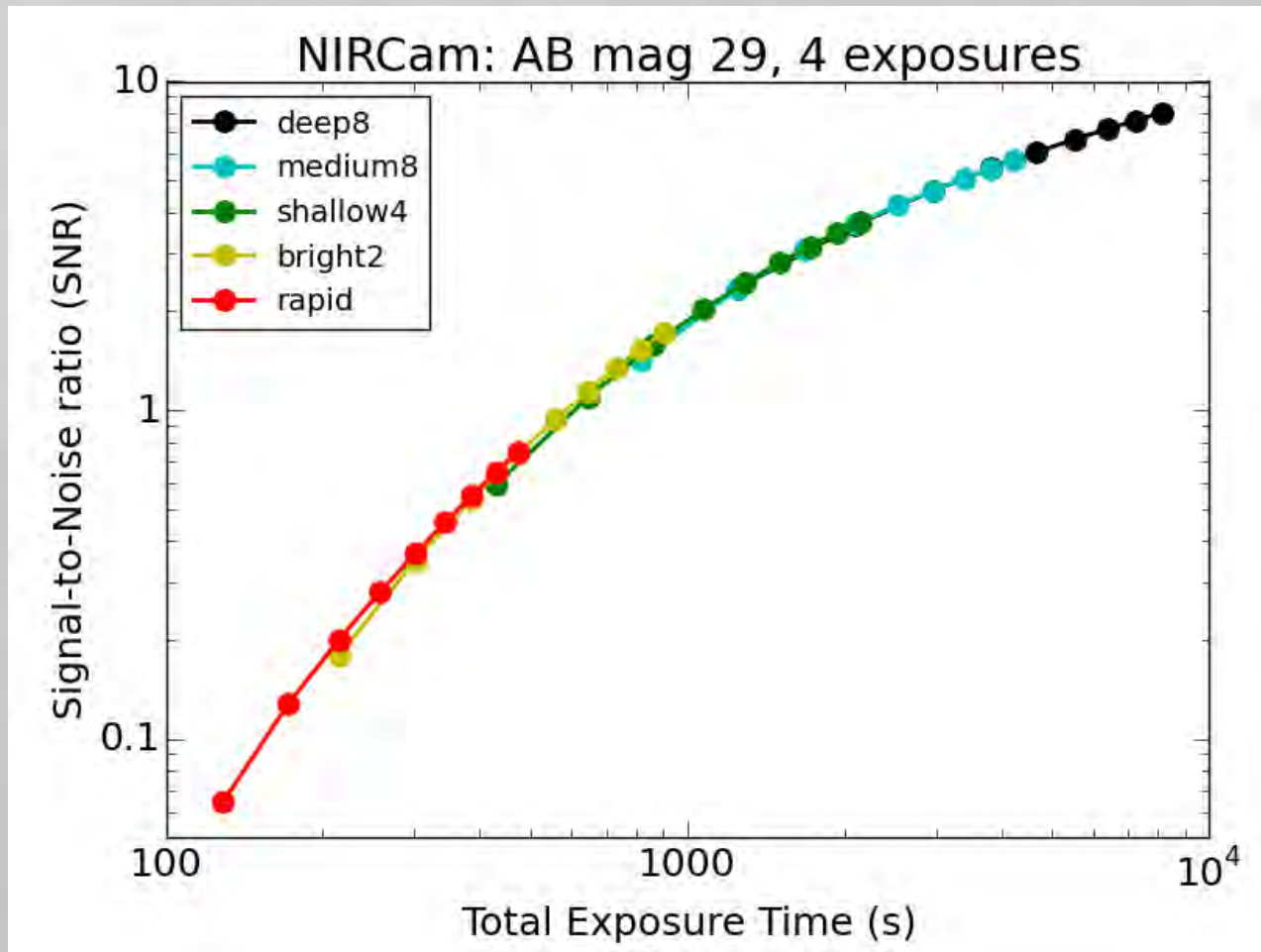
F200W

Default photometric apertures

($r = 0.1''$; sky annulus $0.22'' - 0.4''$)

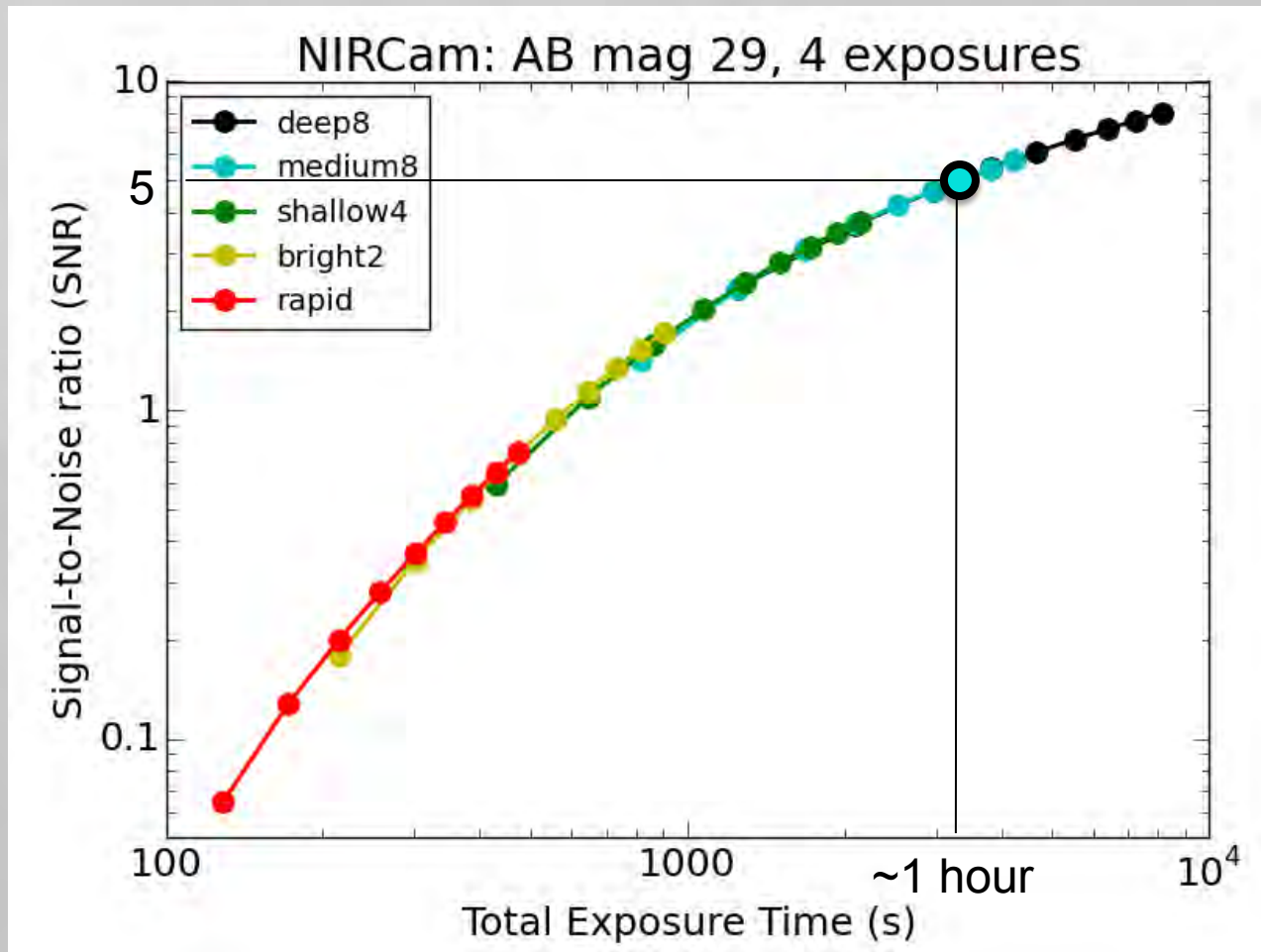


Recommended Readout Patterns



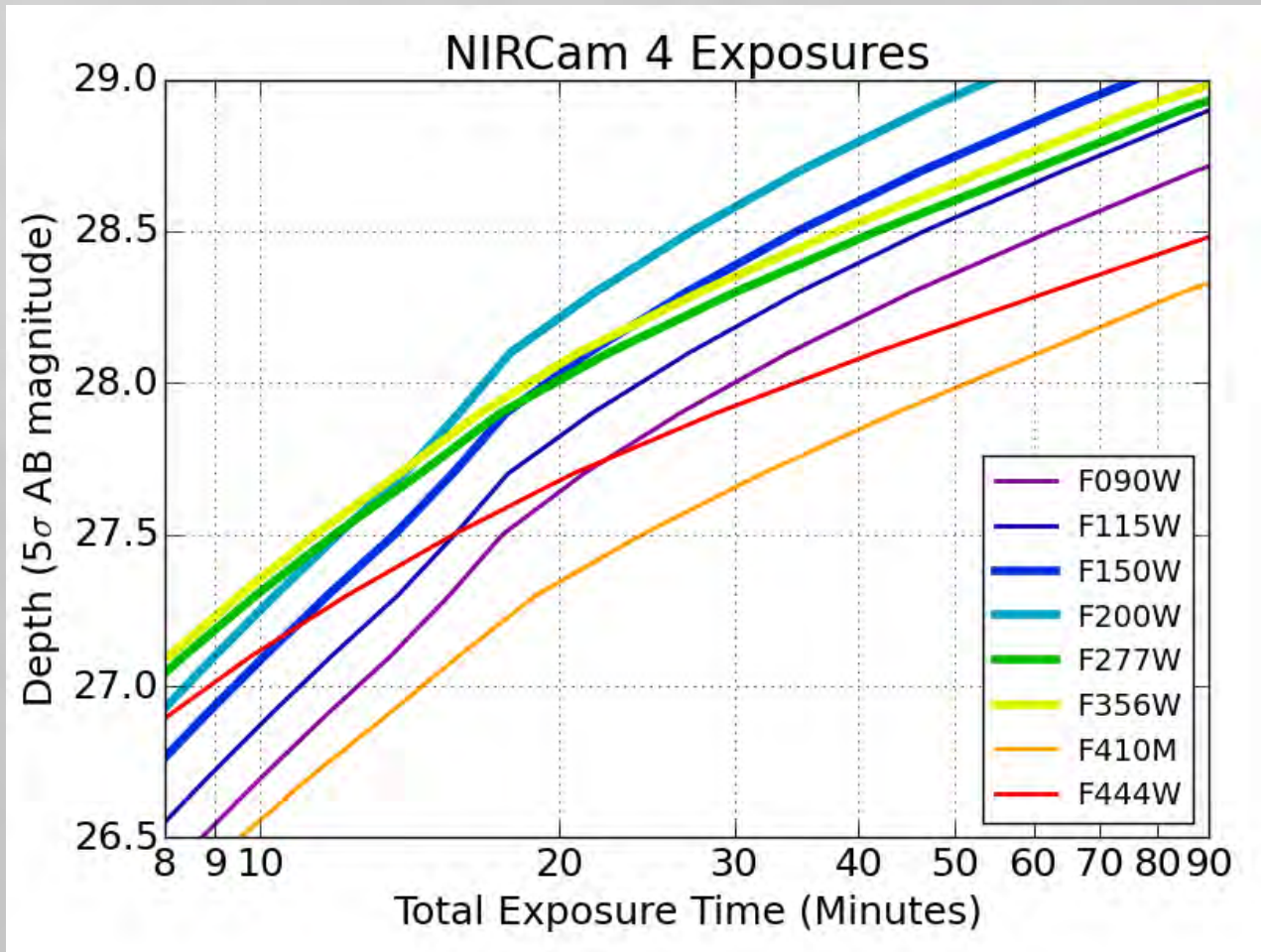


5 σ Depth from Interpolation





Depth vs. Exposure Time



Requires many loops and interpolations

Background:

Abell 370 (RA 02:39:50, Dec -01:35:08)

2019-08-30

(similar to Default: Medium RA=0 Dec=0)

Short wavelength apertures:

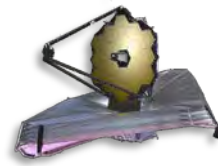
$r = 0.08''$; sky annulus $0.6'' - 0.99''$

Long wavelength apertures:

$r = 0.16''$; sky annulus $1.2'' - 1.98''$

JWST ETC Pandeia Python engine example: NIRCam Imaging

<https://github.com/dancoe/pandeia-imaging>



```
# Import relevant libraries
from pandeia.engine.perform_calculation import perform_calculation
import json
import astropy.io.fits as pyfits

# LOAD DEFAULT PARAMETERS for NIRCam Imaging
jsonfile = 'nircam_imaging.json'
with open(jsonfile) as f:
    imgr_data = json.load(f)

# LOAD BACKGROUND for RA, Dec, and date (computed by online ETC GUI and exported)
bg_file = 'backgrounds_Abell370_20190830.fits'
bg_table = pyfits.getdata(bg_file)
imgr_data['background'] = [bg_table['wavelength'],bg_table['background']] # wavelength in micron, SB in MJy/sr

# SCENE: Object magnitude
imgr_data['scene'][0]['spectrum']['normalization']['norm_flux'] = 28.1
imgr_data['scene'][0]['spectrum']['normalization']['norm_fluxunit'] = 'abmag'

# PHOTOMETRIC APERTURE FOR DETECTION
imgr_data['strategy']['aperture_size'] = 0.08 # radius (default 0.1")
imgr_data['strategy']['sky_annulus'] = 0.6, 0.99 # (default 0.22" - 0.4")

# OBSERVATIONS: FILTER
filt = 'f200w'
ch = 'sw' # Short Wavelength Channel
imgr_data['configuration']['instrument']['filter'] = filt
imgr_data['configuration']['instrument']['aperture'] = ch
imgr_data['configuration']['instrument']['mode'] = ch+'_imaging'

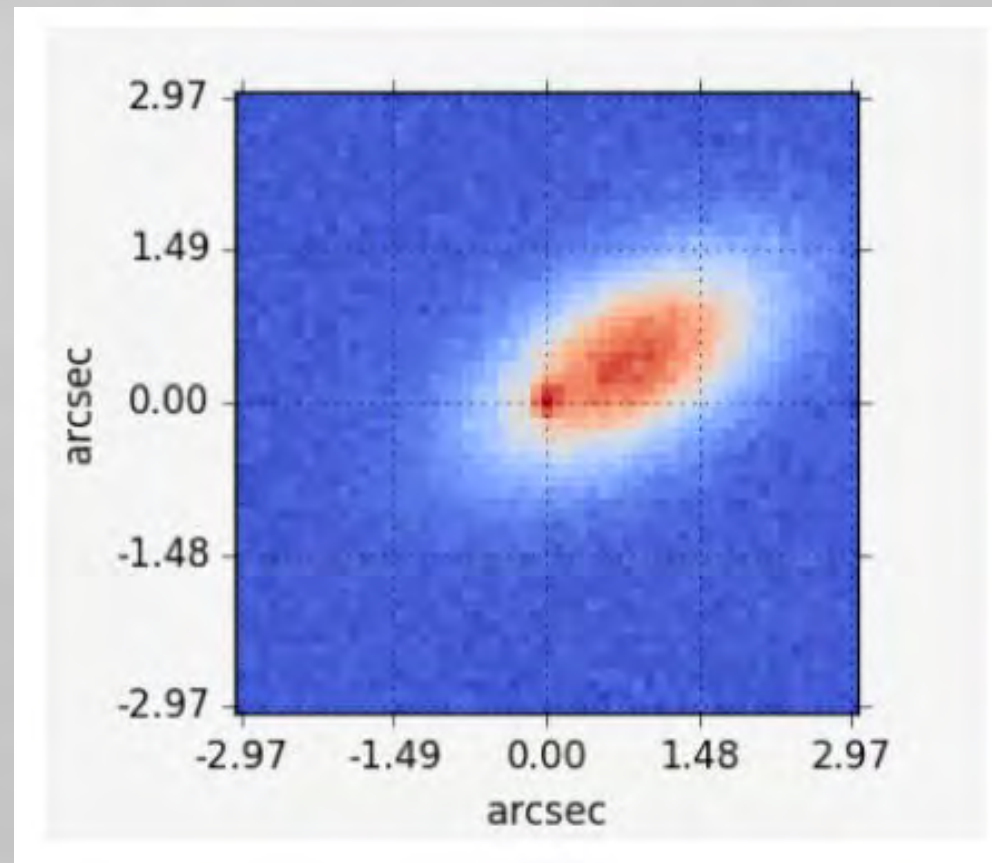
# OBSERVATIONS: Detector Readout (Exposure Time)
imgr_data['configuration']['detector']['readmode'] = readmode = 'deep8'
imgr_data['configuration']['detector']['ngroup'] = ngroup = 5
imgr_data['configuration']['detector']['nint'] = nint = 1
imgr_data['configuration']['detector']['nexp'] = nexp = 6 # dithers

# RUN ETC
results = perform_calculation(imgr_data)

# RESULTS: SUMMARY
exptime = results['scalar']['exposure_time']
snr = results['scalar']['snr']
line = '%s %s %2d %2d %2d %8.2f %7.2f' % (filt, readmode.ljust(8), ngroup, nint, nexp, exptime, snr)
print 'filter pattern ngroup nint nexp exptime snr'
print line
# f200w deep8 5 1 6 5735.16 14.87
```

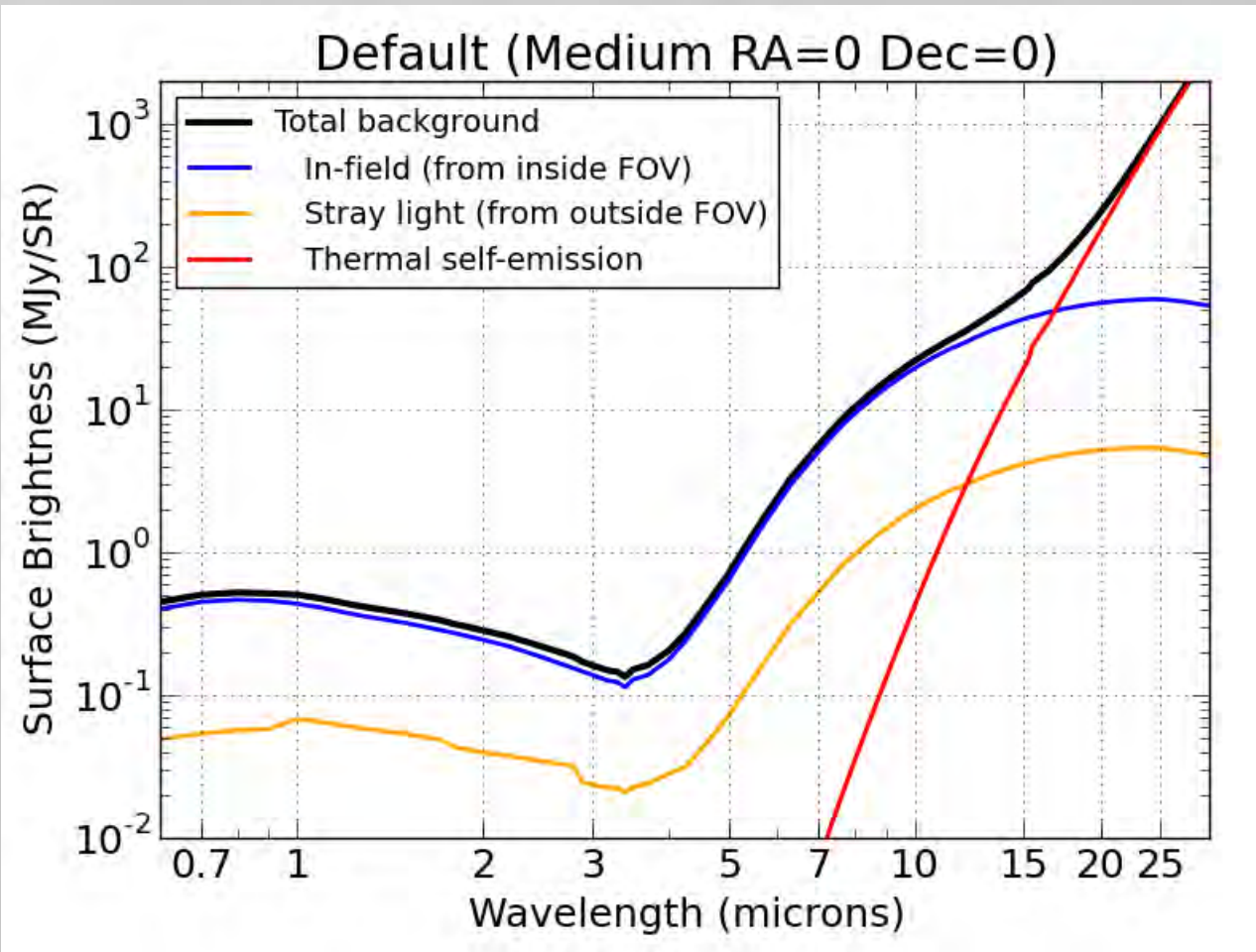


Cluster galaxies will decrease signal-to-noise for high-redshift galaxies

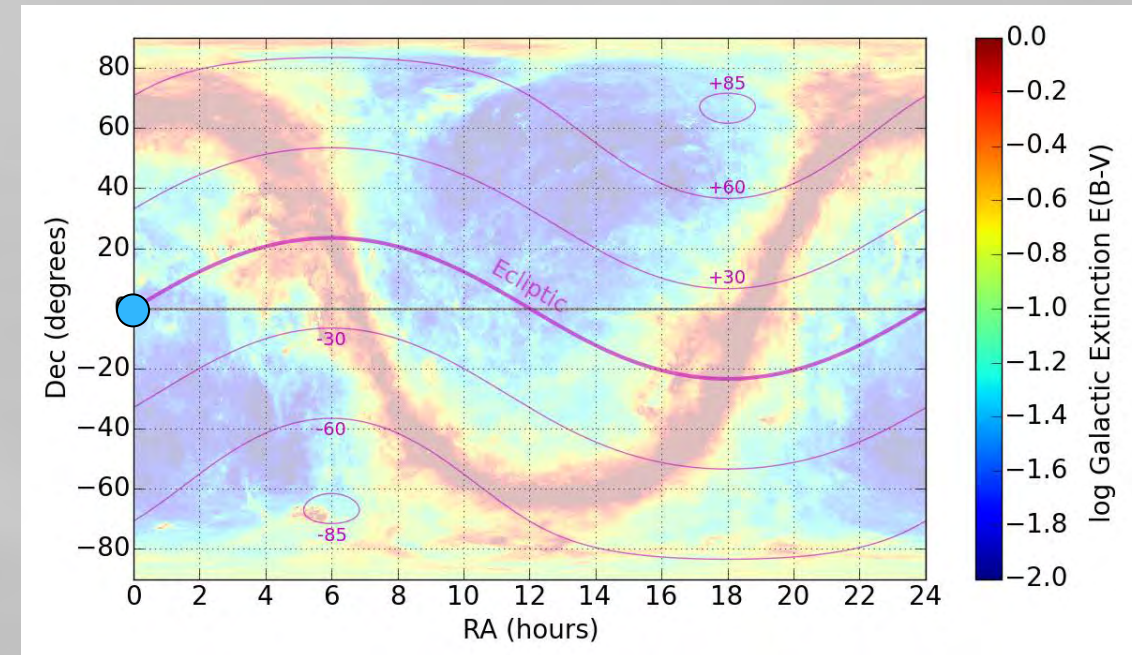




Backgrounds

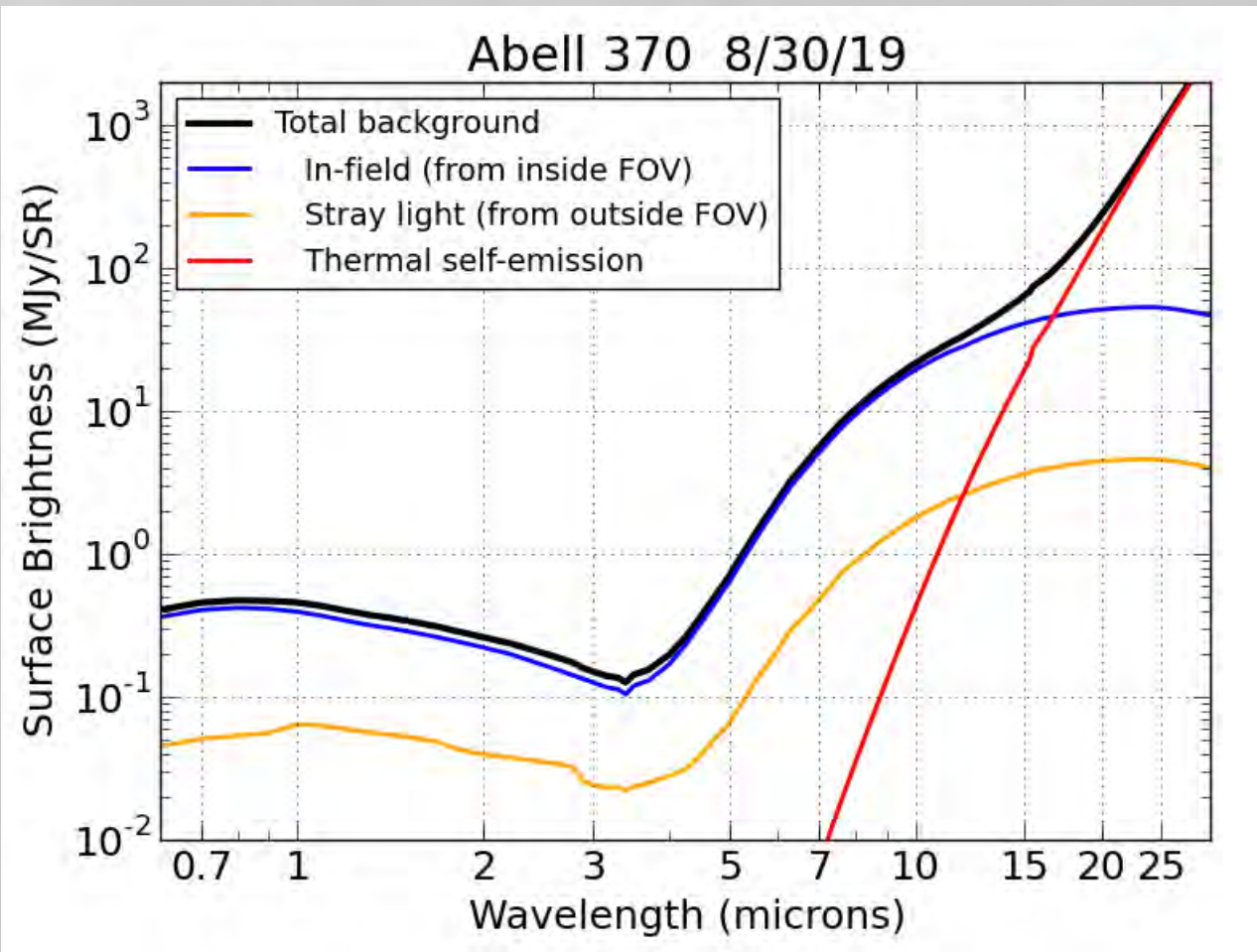


Default is on the ecliptic





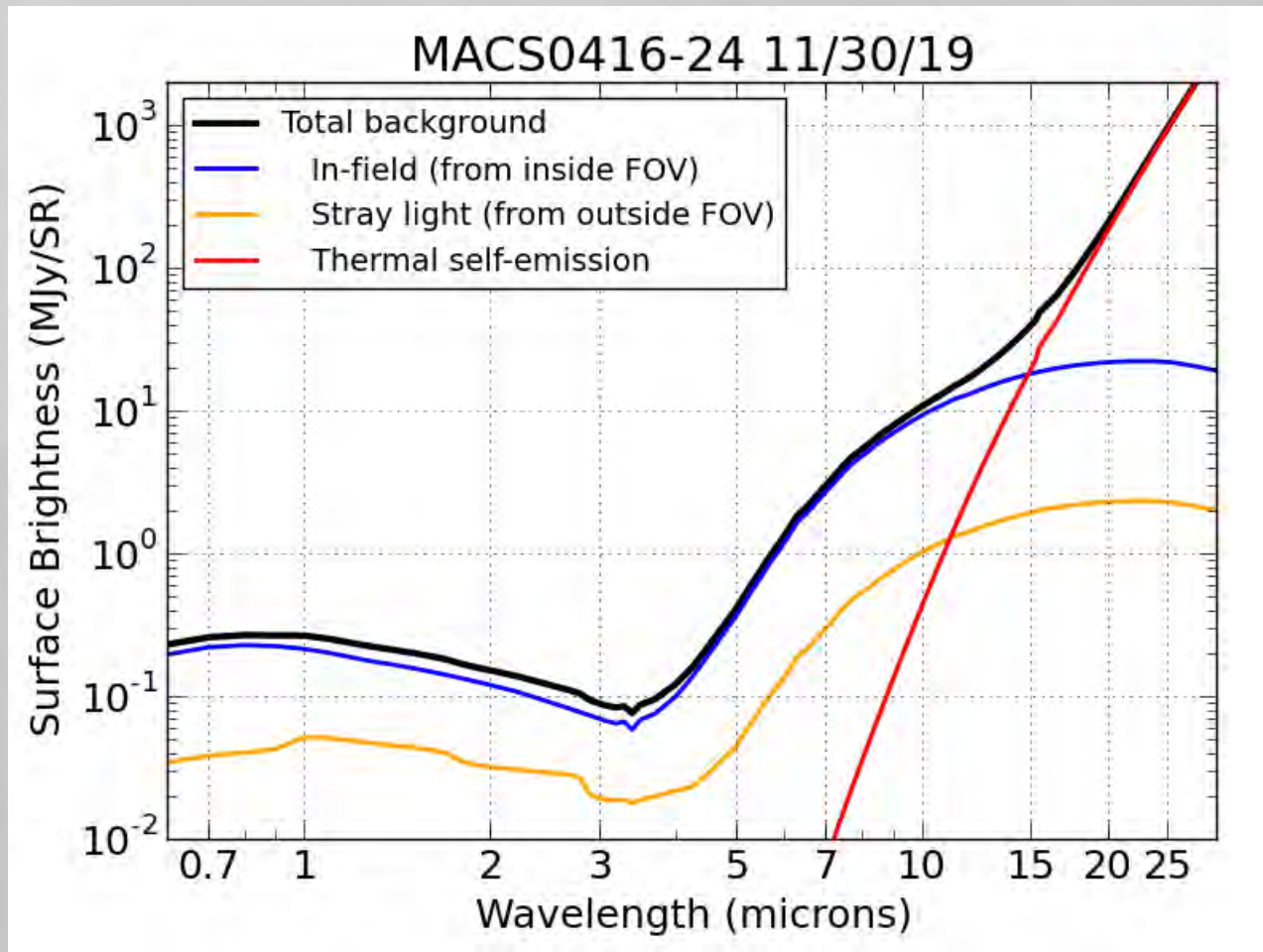
Backgrounds



Similar to the default
(RA 02:39:50, Dec -01:35:08)

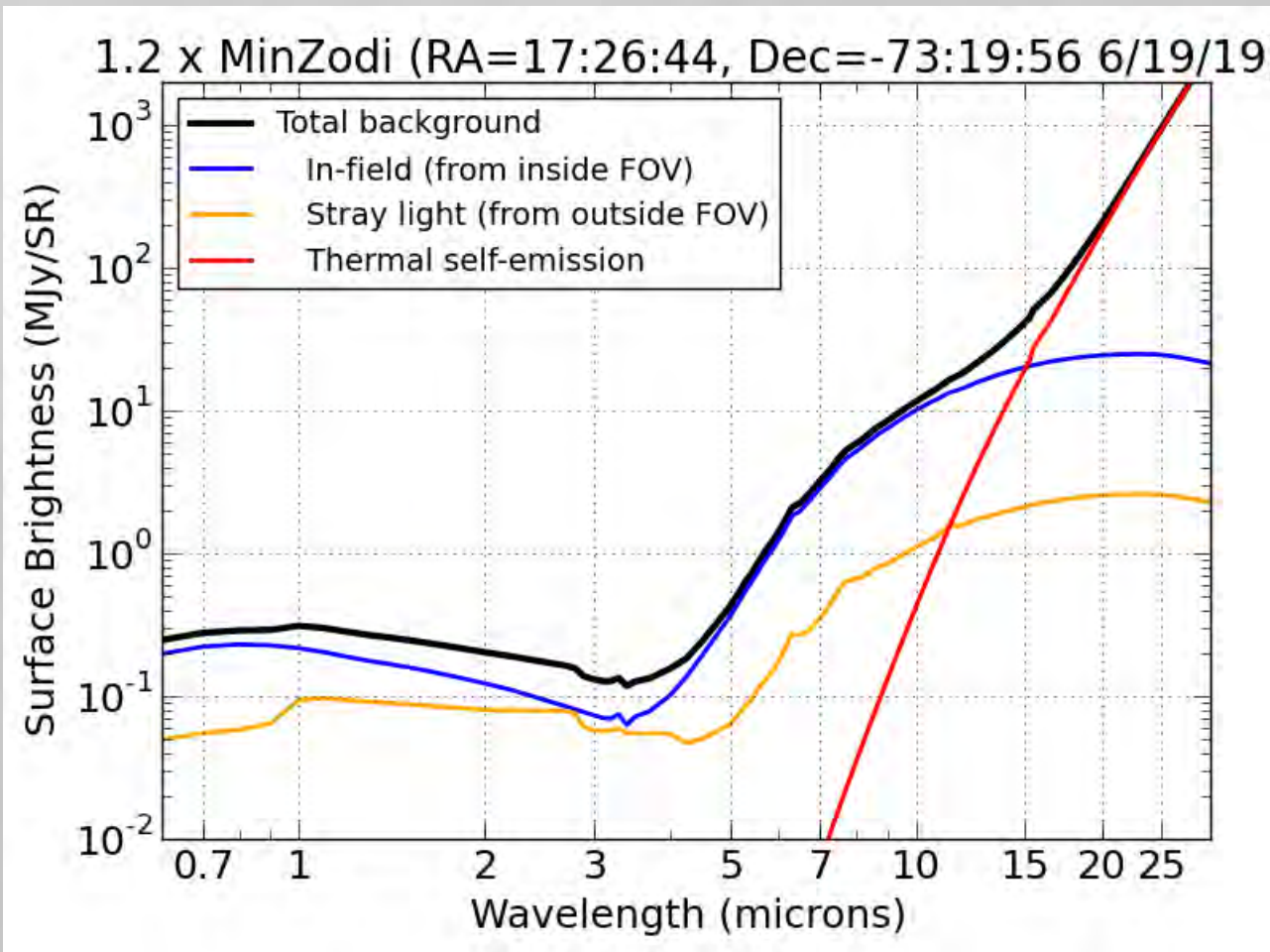


Backgrounds



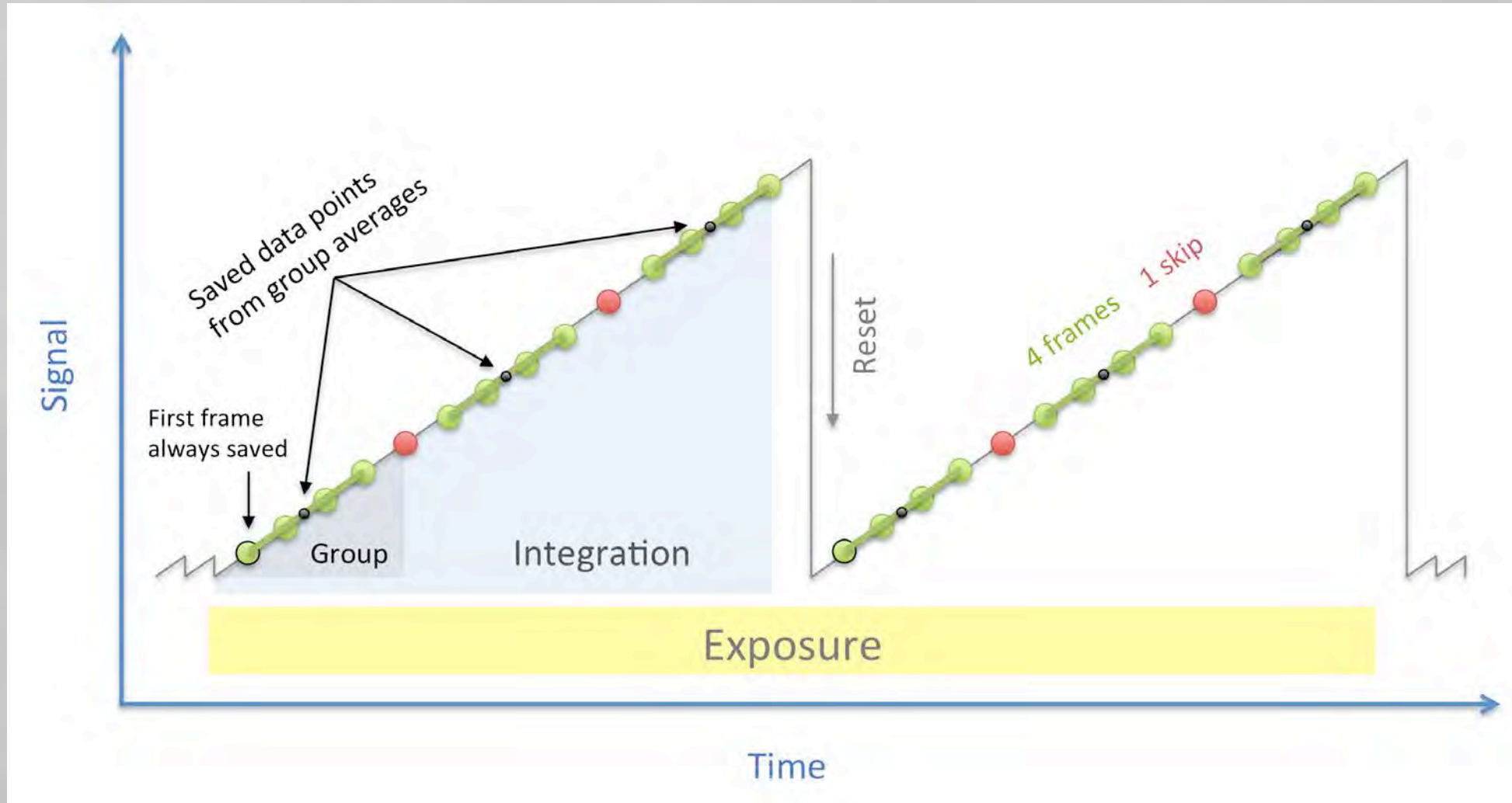


Backgrounds



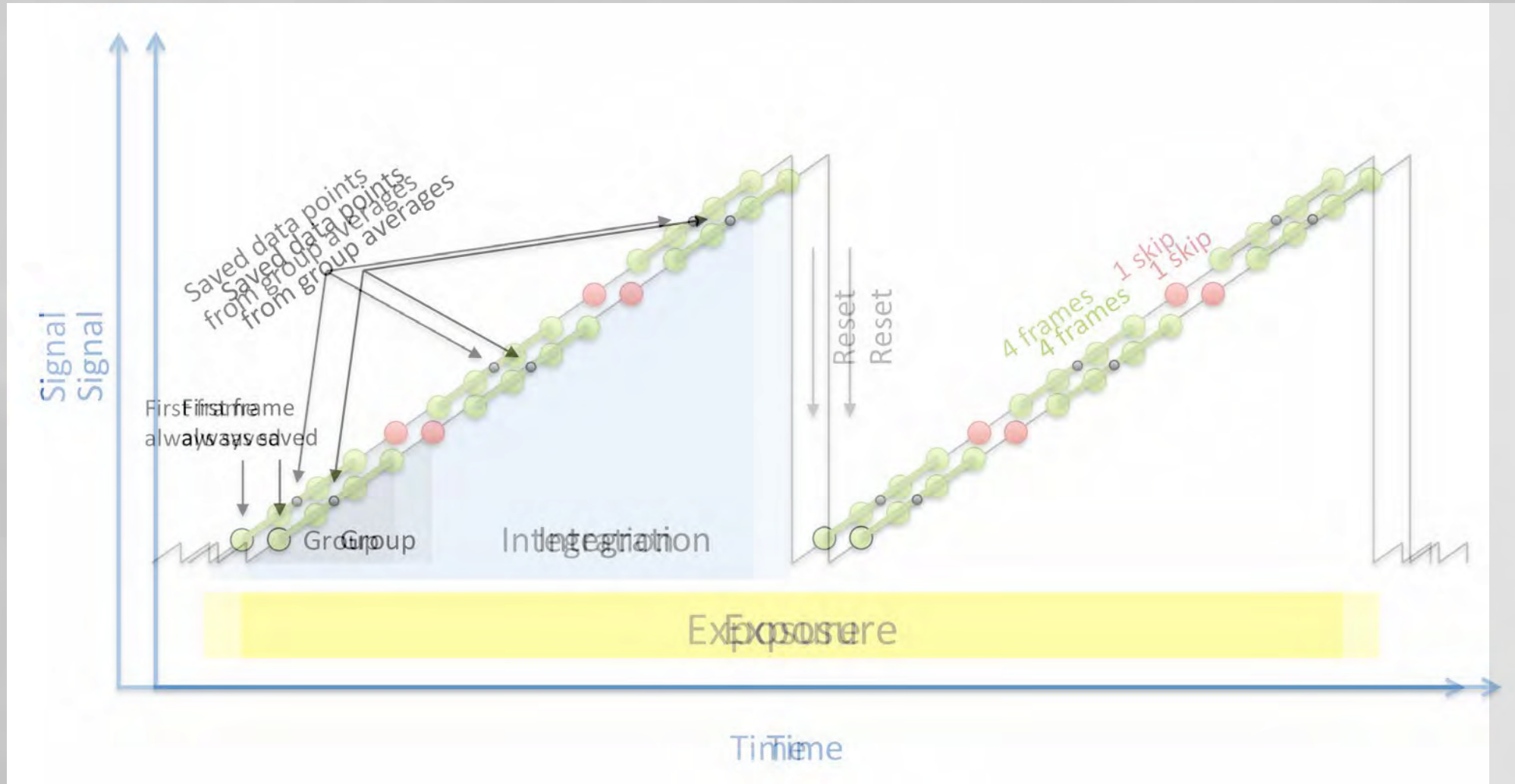


Exposure times defined by readout patterns





Detector completes exposure 1 frame later



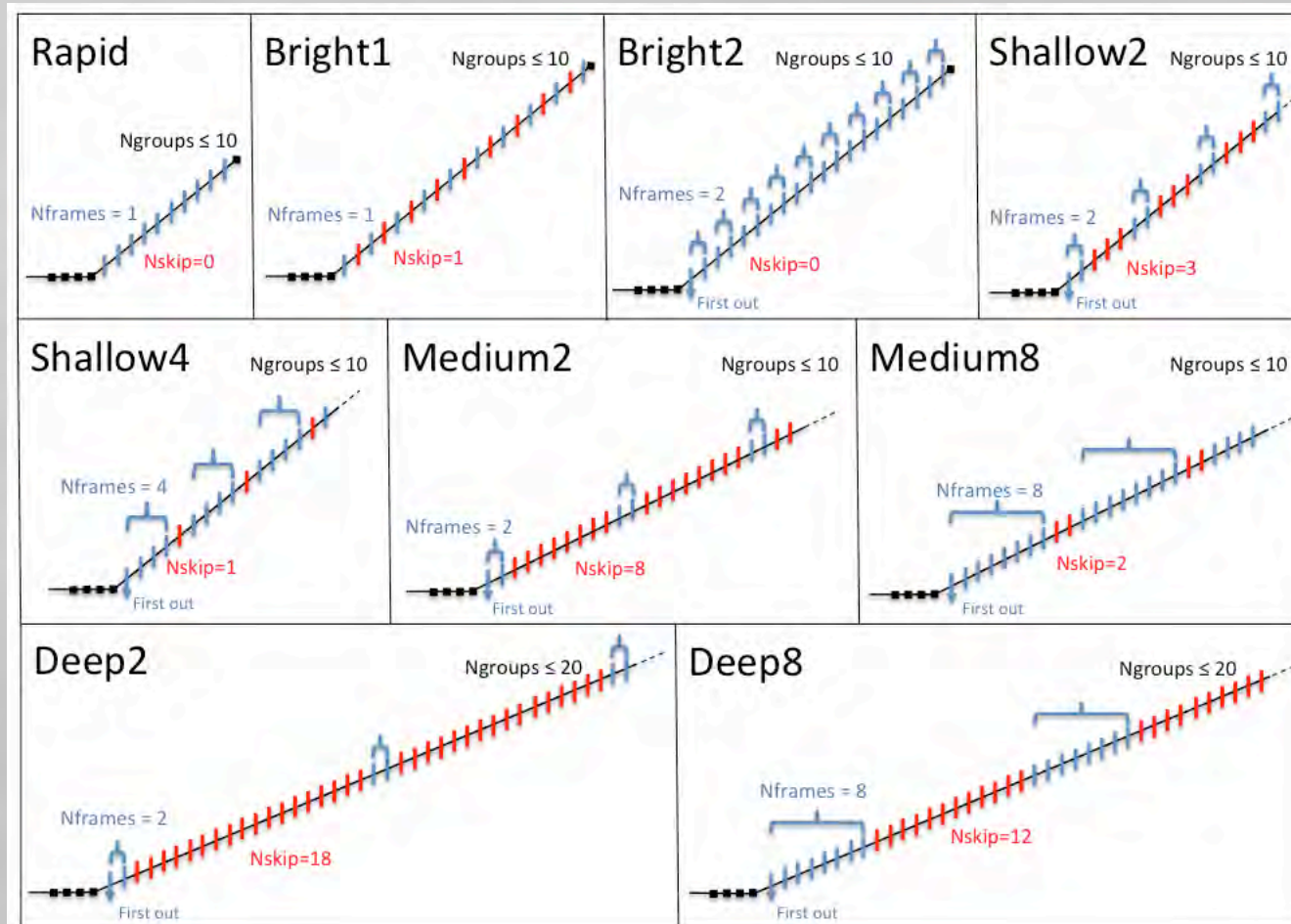


Consistent Exposure Times in APT 25.1 and ETC

Example: 2 integrations, 3 groups, SHALLOW4
 $2 \times (2 \times 5 + 4 + 1) = 2 \times 15 = 30$ frame times
= 322.1028 seconds (full detector)
single frame time = 10.73676 s
(ETC currently assumes 10.74 s \rightarrow 322.2 total)



9 NIRCam Readout Modes



M. Robberto



NIRCam Readout Modes are Familiar

Times for full detectors (not subarrays)

WFC3/IR Readout Mode	first group (s)	subsequent groups (s)
SPARS5	2.932	5
SPARS10	2.932	10
SPARS25	2.932	25
SPARS50	2.932	50
SPARS100	2.932	100
SPARS200	2.932	200

NIRCam Readout Mode	first group (s) (approx.)	subsequent groups (s) (approx.)
RAPID	10.7	10.7
BRIGHT	10.7 or 21.4	21.5
SHALLOW	21.5 or 42.9	53.7
MEDIUM	21.5 or 85.9	107.4
DEEP	21.5 or 85.9	214.7