Independent Testing of Silicon PIN Detector Arrays for LSST

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We report detector characterization of prototype silicon PIN detector arrays for astronomical applications, with a special emphasis on their use for the Large Synoptic Survey Telescope (LSST). For the first time, we present independent measurements of dark current, read noise, linearity, persistence, quantum efficiency, well depth, and crosstalk. These properties are measured as functions of temperature (100-240K), wavelength, and read mode.

The LSST requires a ~3.5 Gpixel optical camera with a relatively high quantum efficiency near 1 μm, good imaging quality, a very flat imaging surface, and a capability for few second exposures. Silicon PIN hybrid arrays may offer the required performance for the LSST focal plane. The table gives requirements and measured performance of one such device provided by Rockwell Scientific Company.

Parameter	*Req.*	*Goal*	*Meas.*
Dark Current	4 e-/s/pix	2 e-/s/pix	<1 e-/s/pix
Read Noise	10 e-	6 e-	4-20 e-
QE@1000nm	25%	45%	25-40%
Flatness	10 μm	5 μm	<10 μm
Persistence	0.005%	0.001%	0.004%
Exposure Time	10+10 sec	10+10 sec	selectable
Frame Read Time	3 sec	2 sec	1.25 sec

LSST CMOS Testing Program

Program goal: measure detector properties against LSST detector requirements

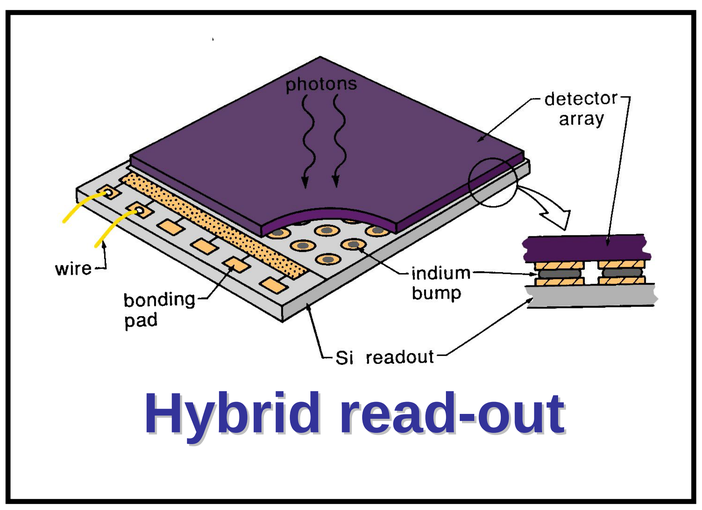
- three devices tested (4th in fabrication):
  - H1RG-018-SIPIN (18 μm pixels)
  - H1RG-021-SIPIN (9 μm pixels on 18 μm centers)
  - H2RG-003-SIPIN (18 μm pixels)
- the third device satisfies most LSST requirements.

Performance that meets or exceeds requirements:

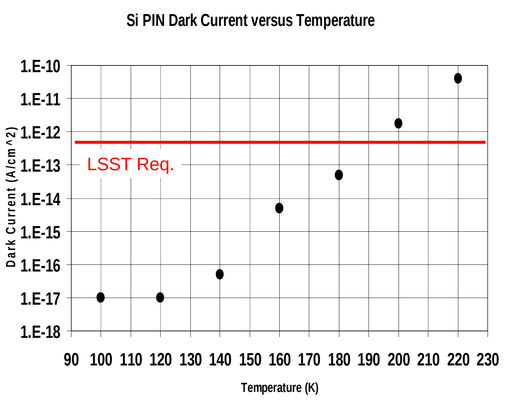
- dark current
- read noise (on reference pixels, science pixel data pending)
- long-wave QE
- cross-talk through diffusion
- well depth

Performance that needs more testing and/or development

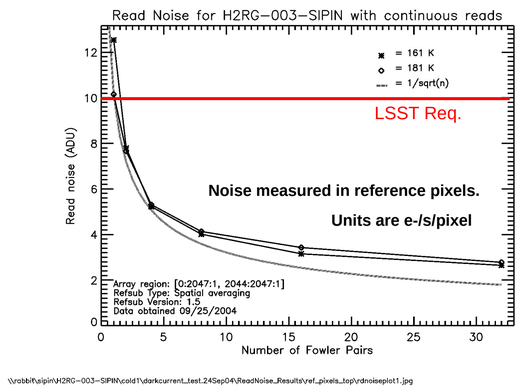
- read noise: may be within requirements (needs more filtering and testing)
- defects that produce excess dark current
- 9-10 μm pixels



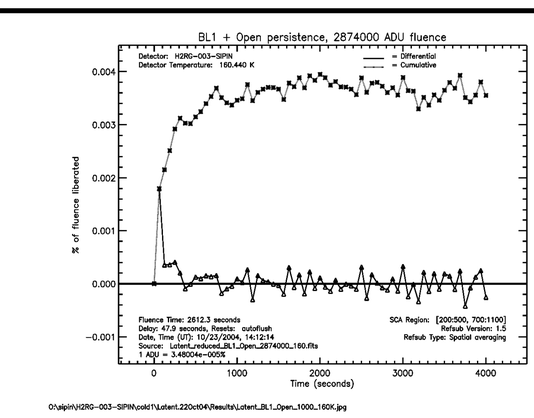
Hybrid read-out



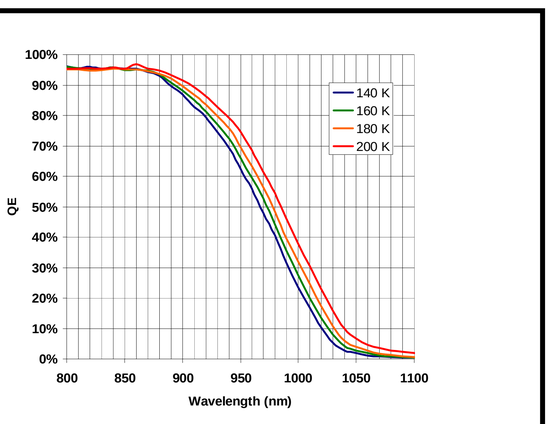
Dark current



Read noise

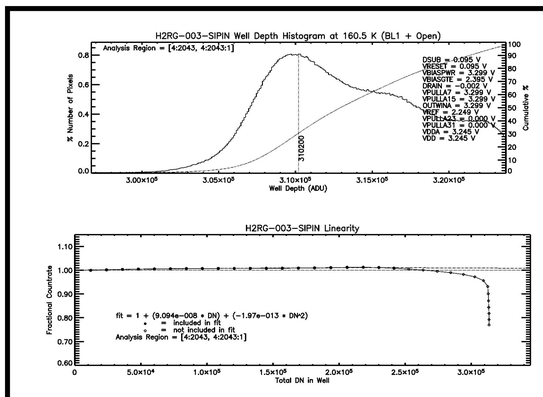


Persistence



QE

Flatness



Well-depth/Linearity

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