

# PTDR Discussion: Simulations and Justification

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2/24/2012  
CTA-SCT Mtg, SLAC

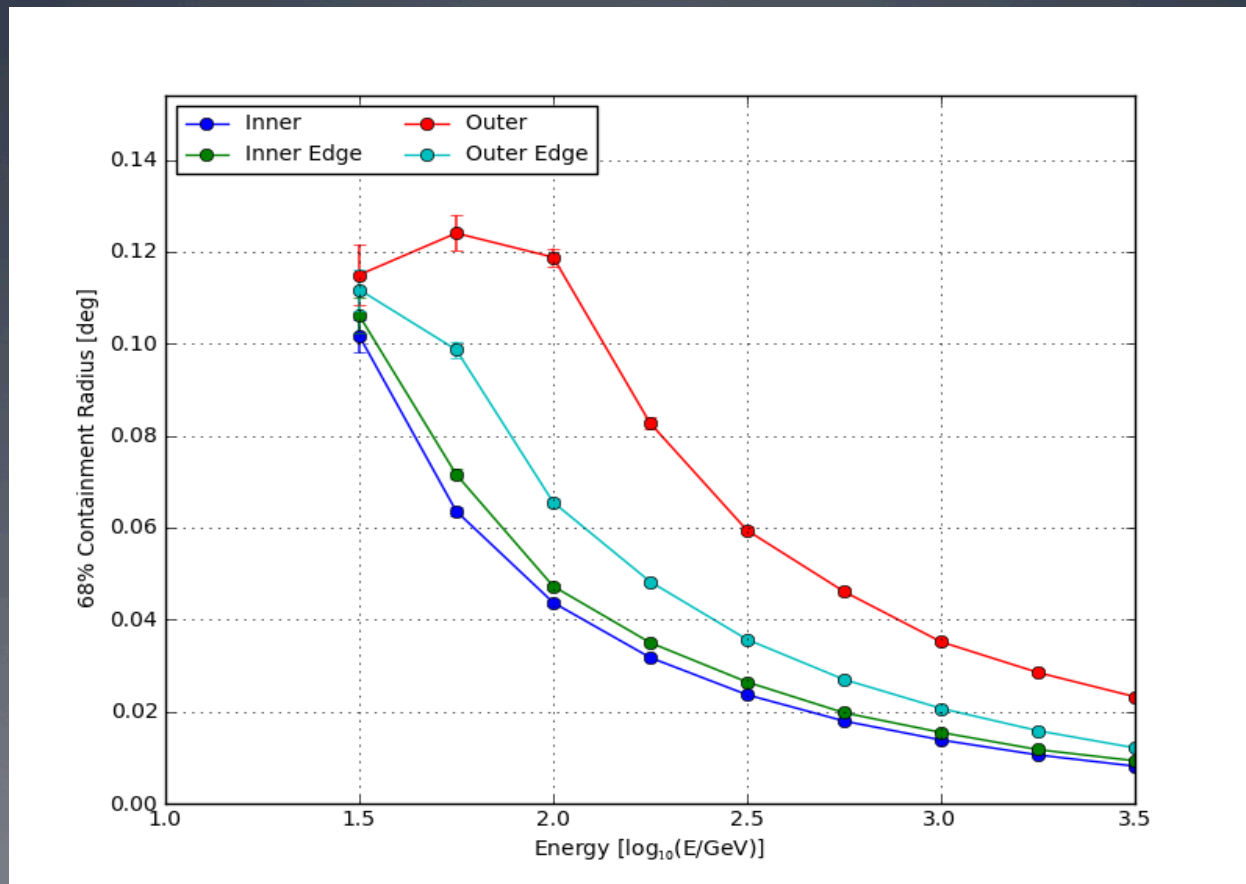
# Justification Section: Big Picture

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- Idealized Simulations & Likelihood Model analysis
- Benefits of a large array (25 → 61 telescopes)
- Benefits of SCTs
- Hybrid-1 Simulations & Performance of SCTs
- Specifications

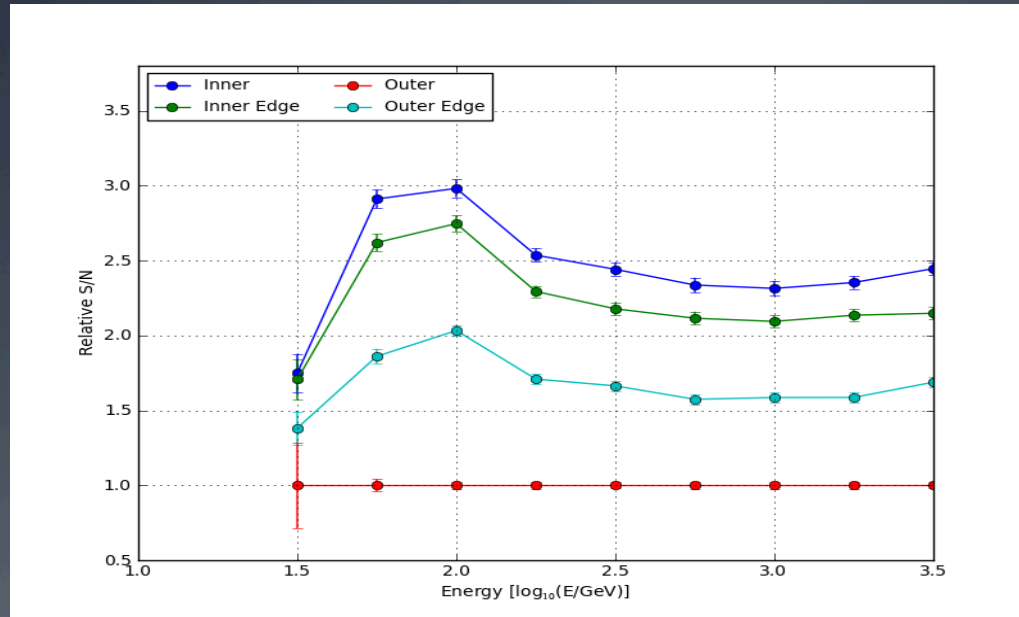
# Contained vs Uncontained Events

- Emphasize difference in event quality as a function of core location. Angular resolution:



# Contained vs Uncontained Events

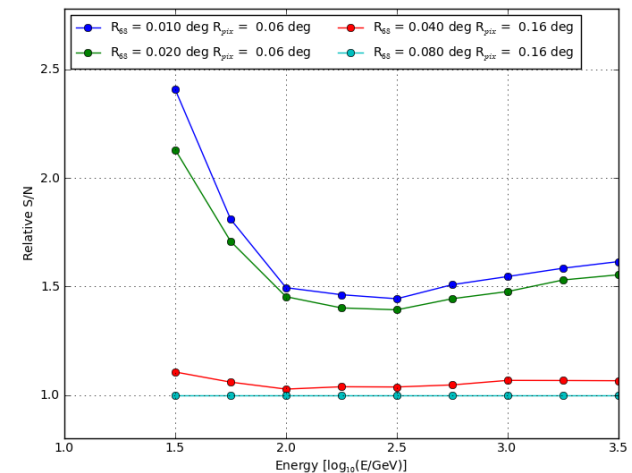
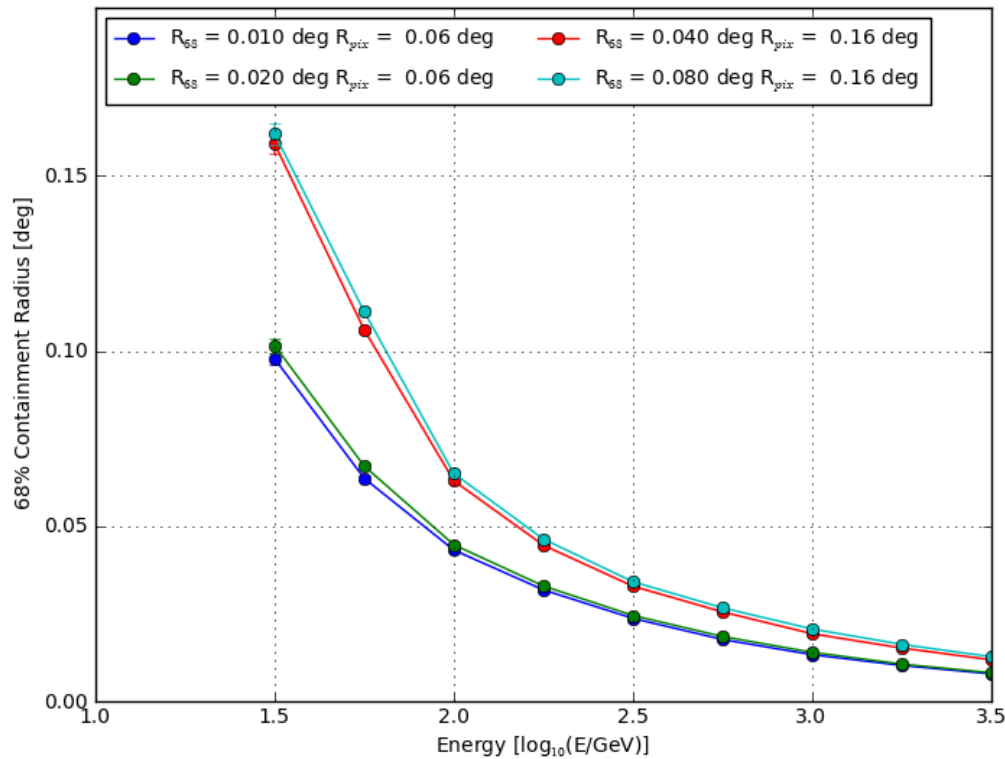
- Signal to noise ratio:



- 25 → 61: Anticipate better sensitivity from improved background rejection (better sampling of light pool), better angular resolution, increased area of contained events.

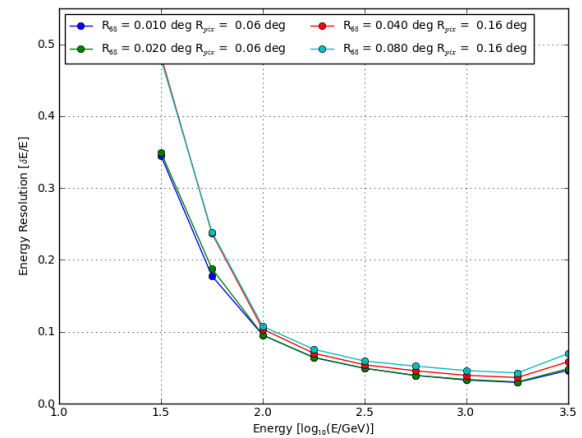
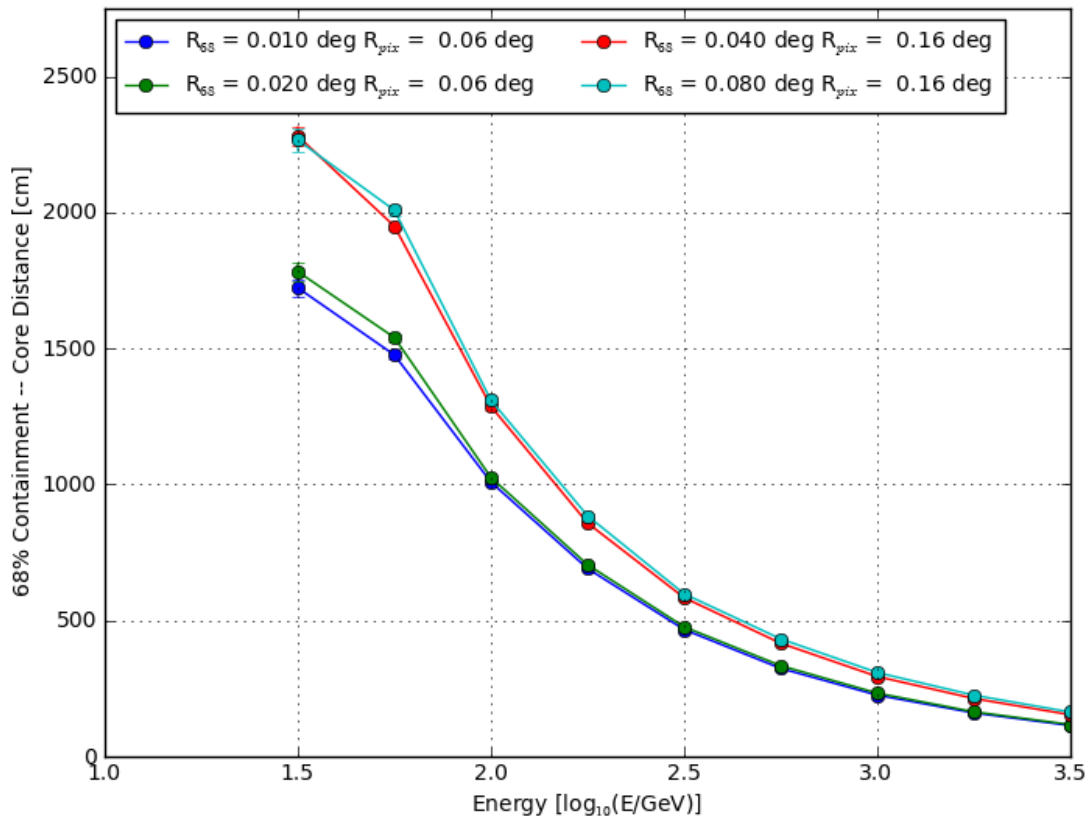
# Optical PSF and Pixel Size

- Smaller pixels, improved optical PSF: shower imaging and reconstruction near the limit of shower fluctuations.



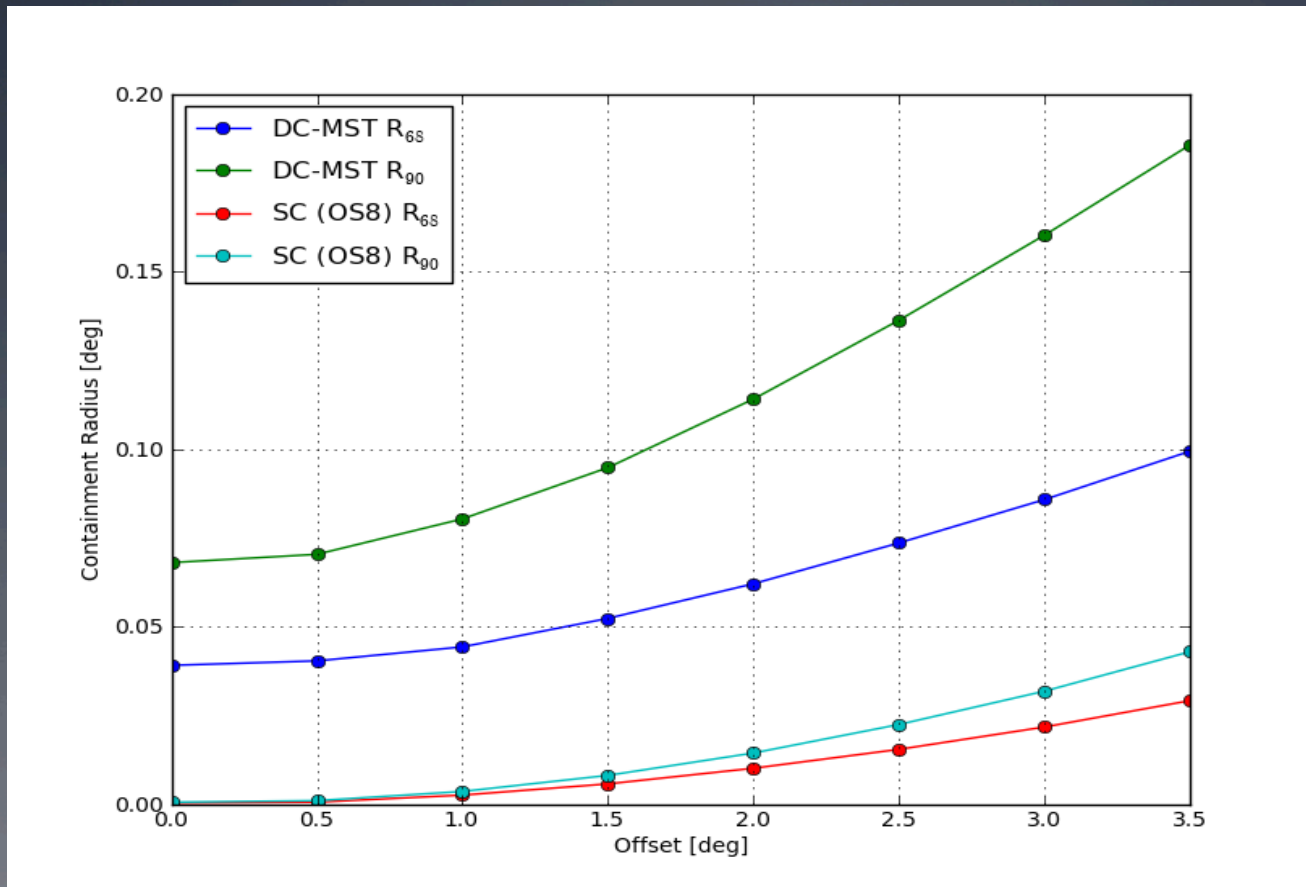
- Also reduced plate scale  $\rightarrow$  reduce camera cost.

# Shower Core / Energy Resolution



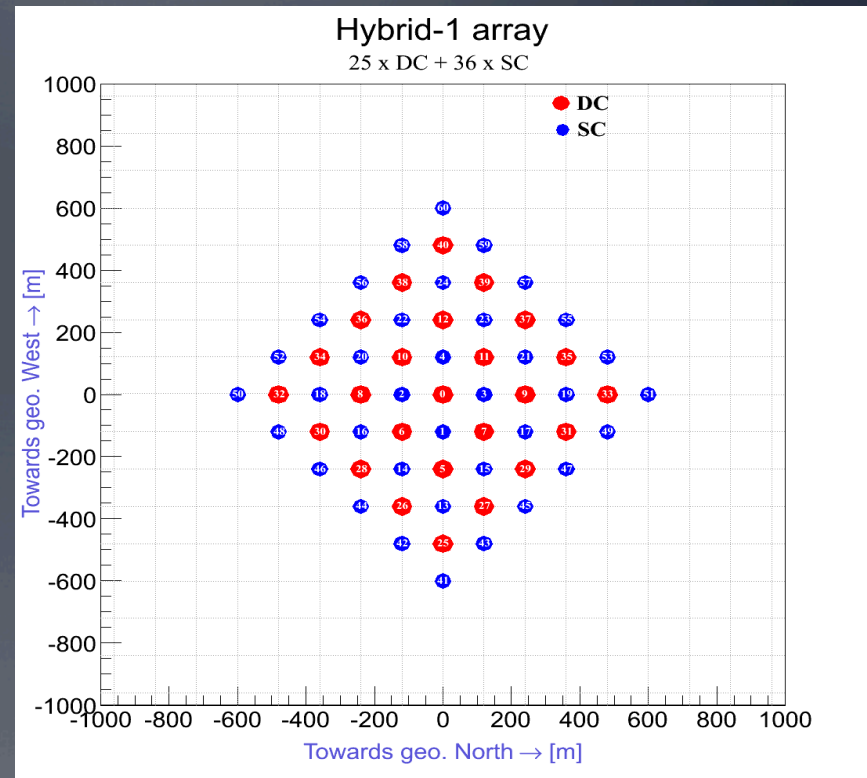
# Optical PSF

- Optical point spread function (both 68% and 90% containment radii) for DC and SC designs.



# Hybrid-1 Simulations

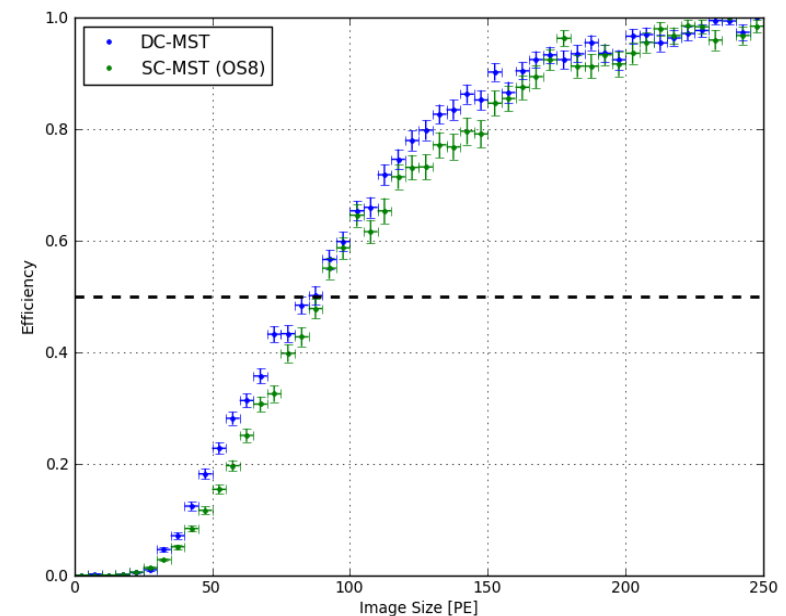
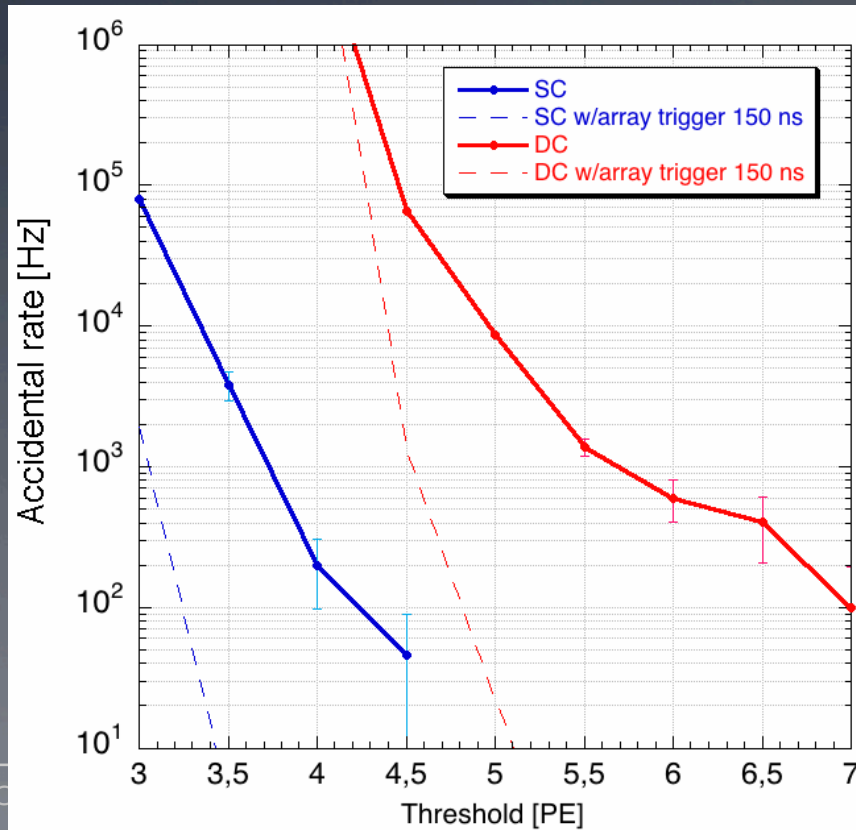
- First large-scale mixed-array simulations.
- Using modified DC optics design to reduce time spread.
- Eventdisplay-based analysis still at moment-analysis level.
  - Much room for improvement!
  - What results to show on PTDR timescale?





# Low-Level Performance

- Rate vs. Threshold and Trigger Efficiency vs. Image Size for SC-MST and DC-MST.
- Rate vs. Threshold curve shows utility of array trigger.



# Specifications

- Beginning a long table, mostly empty so far...
  - Parameters, values, justifications?
    - Can discuss in more detail in “Task List” discussion next.
  - Do we want this here, or distributed through hardware sections?

Parameter	Value	Notes
<b>Structure</b>		
Mechanical structure holding the mirrors		No dynamic alignment needed. Alignment corrections on a seasonal basis is enough
Mounting points of the mirror segments	3-point	
<b>Optics</b>		
	[primary] [secondary]	
Surface figure error	~100 $\mu\text{m}$ ~120 $\mu\text{m}$	Over a scale of ~1 m. Similar to sub-mm radio telescopes.
Primary surface roughness, RMS	1.2 nm 2-5 nm	On spatial scales $\leq$ 330 nm.
Segment Spot Size		
Segment-to-Segment Alignment (scatter of normals)	0.1 mrad 0.25 mrad	At 330 nm. Assumed Gaussian
Vignetting allowed		Unvignetted size 3.5 deg
Reflectance	$\geq$ 92% at 330 nm [same]	$\geq$ 85% for 280 - 450 nm
<b>Camera</b>		
Number of Pixels	11328	To provide an 8° diameter FoV.
Pixel Angular Size	0.067°	Set by physical size of available devices.
Trigger Pixel Angular Size	0.134°	2x2 analog clipped sum of physical pixels.
Readout Speed	1 GSPS	
Buffer Depth	8 $\mu\text{s}$	
Optical Crosstalk		
Electronic Crosstalk		
Eigen frequency		
Size/weight/power consumption?		

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