SNAP SuperNova Acceleration Probe
at the University of Michigan

Spot-o-Matic

Testing Intrapixel Variation in the SNAP Detectors

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REU 2004

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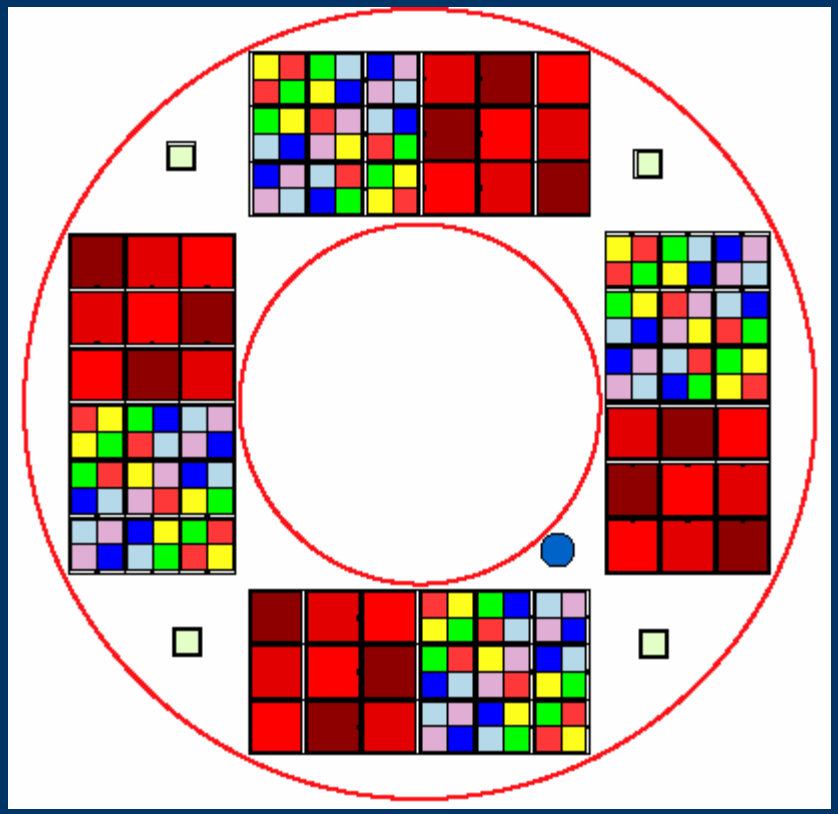
SNAP Detector Design

36 HgCdTel 2k x 2k NIR detectors with 18μm pixels

Allows us to see all the way to z=1.7μm



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The Problem of Undersampling

SNAP uses 18μm pixels

We need greater resolution than this, or else any structure under 18μm is lost!

An image of a galaxy which is 40μm wide will not look like a galaxy, it'll look like 4 lit up pixels!

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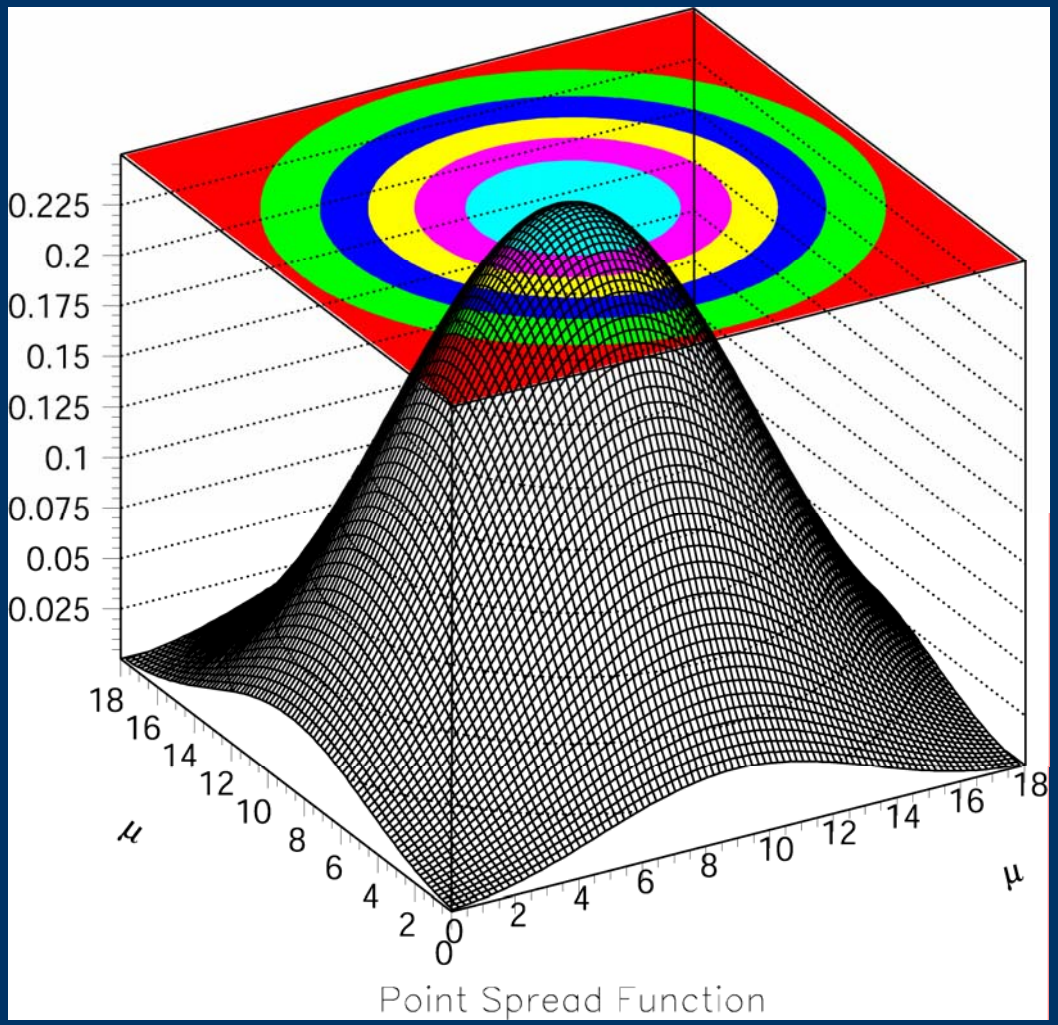

Airy disk for $\lambda = 1\ \mu m$

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There are ways around this problem!

- Dithering

- Dithering requires accurate knowledge of the pixel response function (QE vs. position), which we do not know

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Enter the Spot-o-Matic!

The pixel response function can be extracted by shining a very small spot of NIR light onto the detector, and measuring the readout at different points on the pixel itself!

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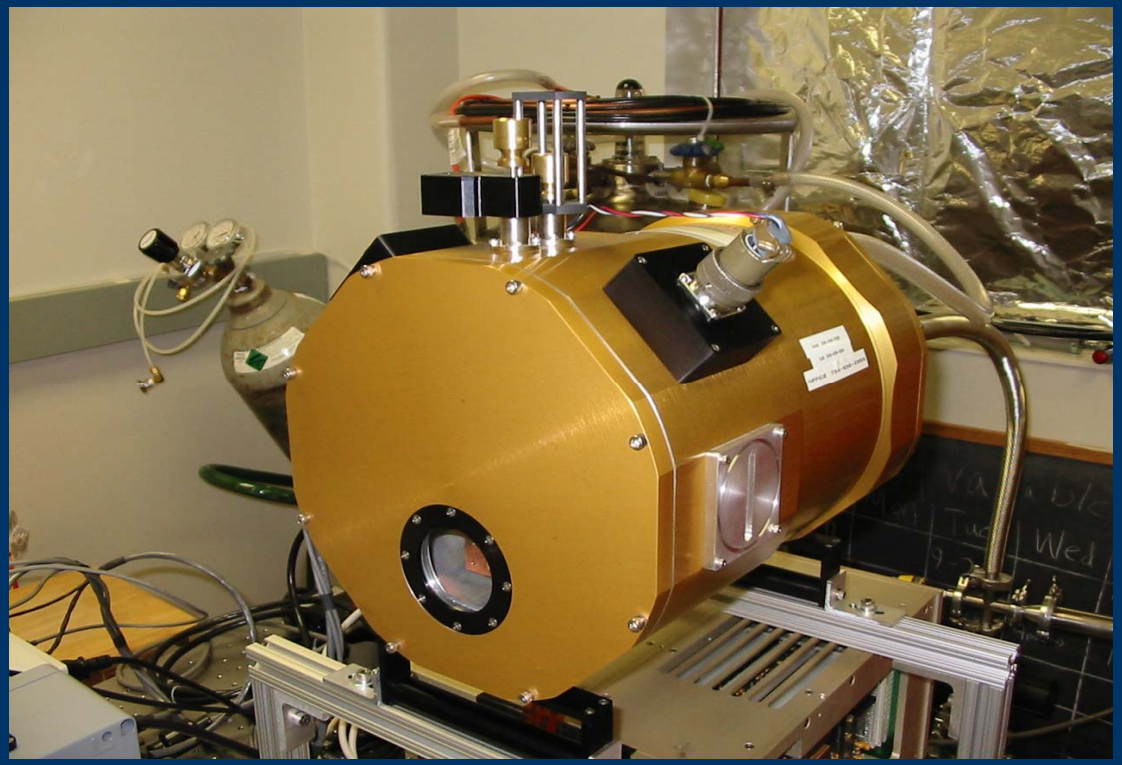
Testing Setup



Devices are mounted in a dewar and kept at 140K to reduce dark current and simulate deep space conditions

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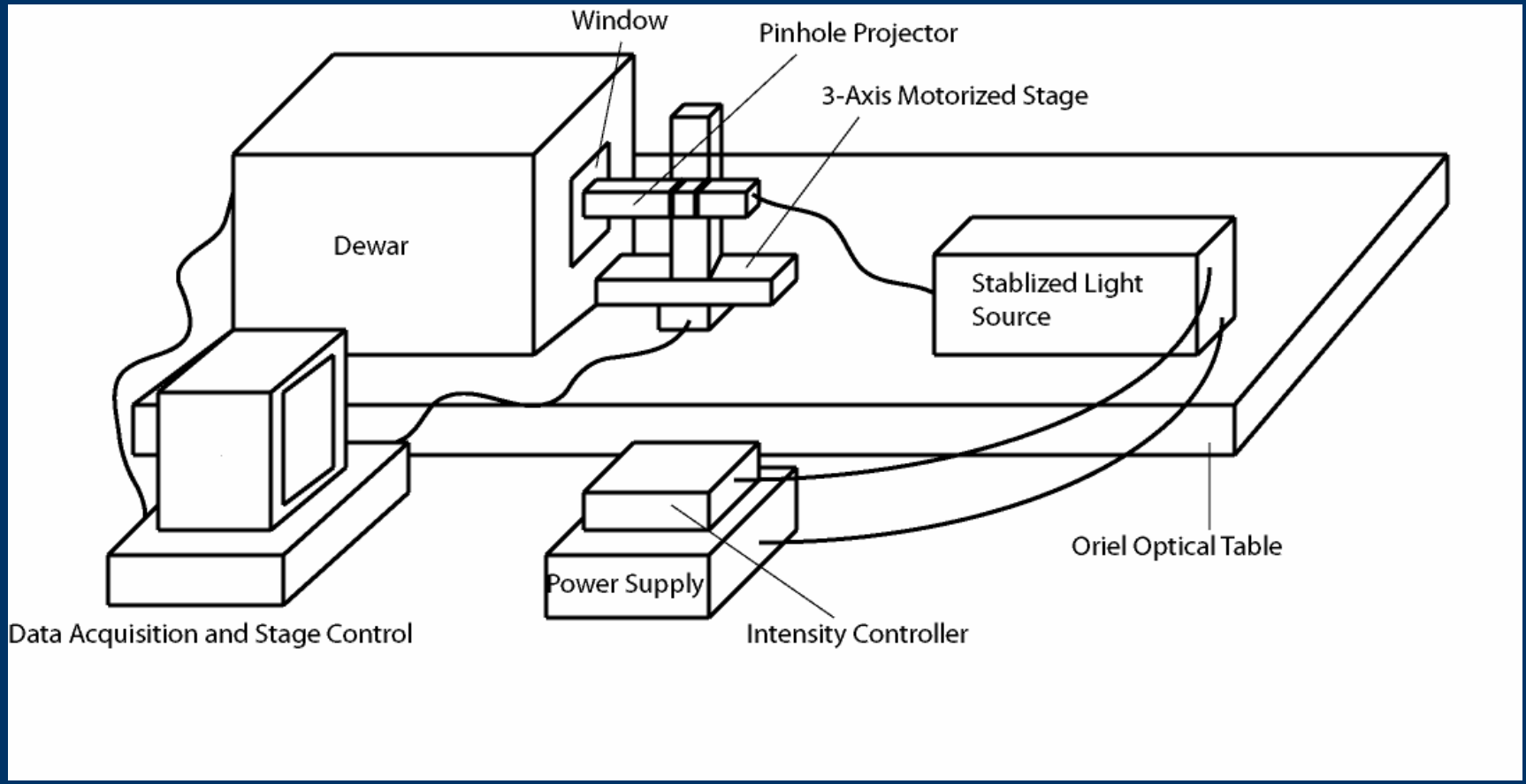
Testing Setup



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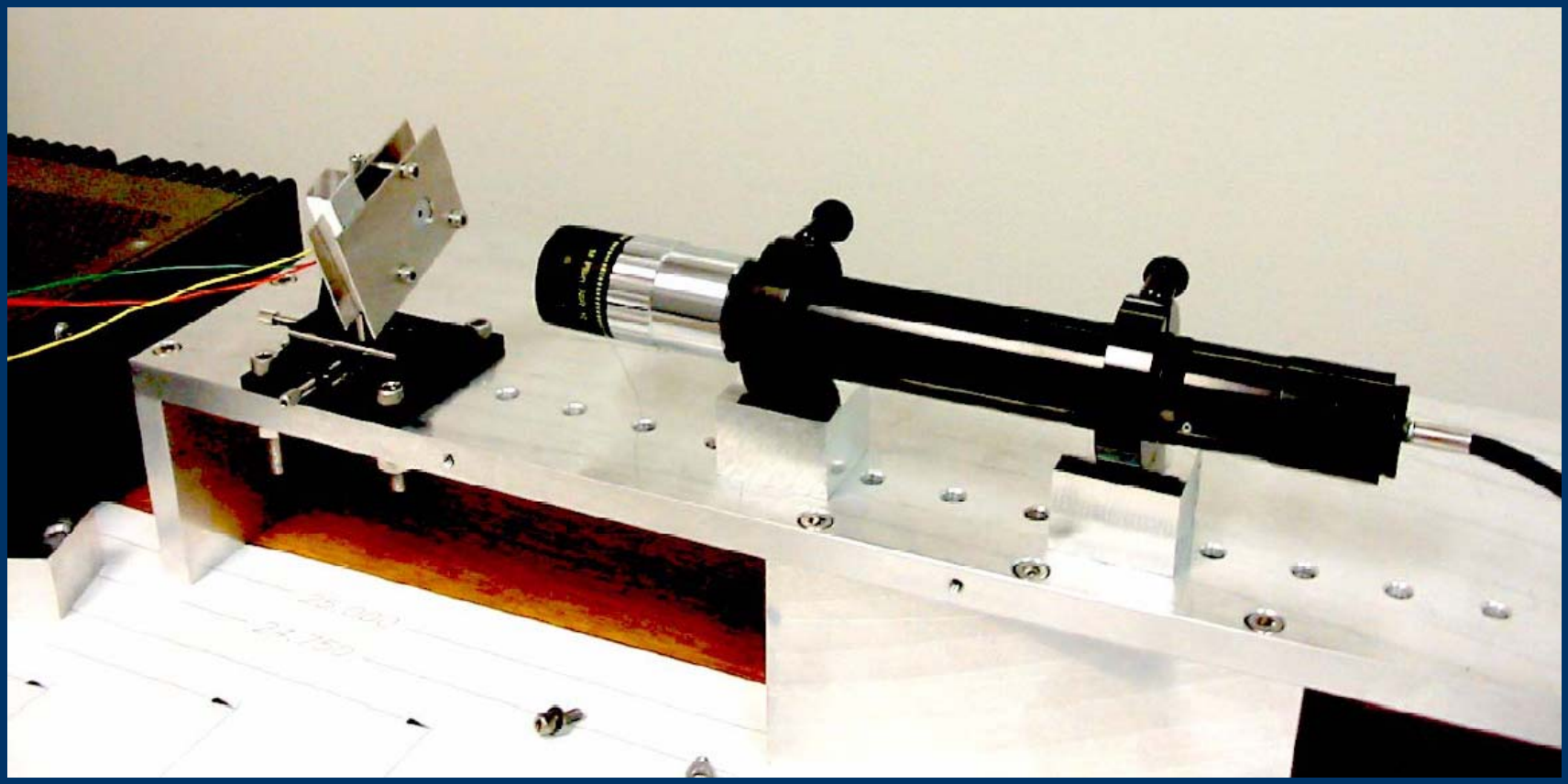
Progress as of REU 2003:



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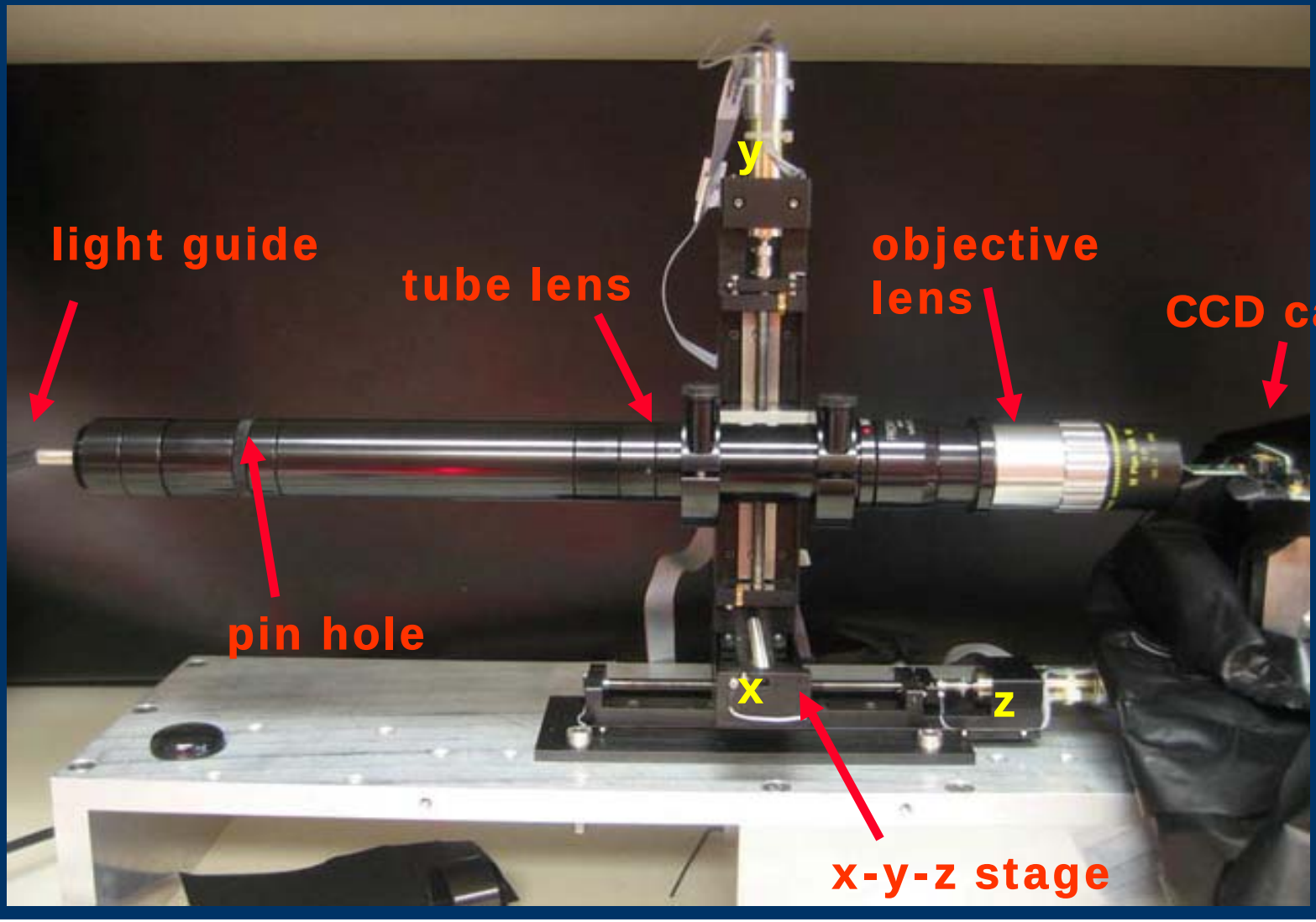

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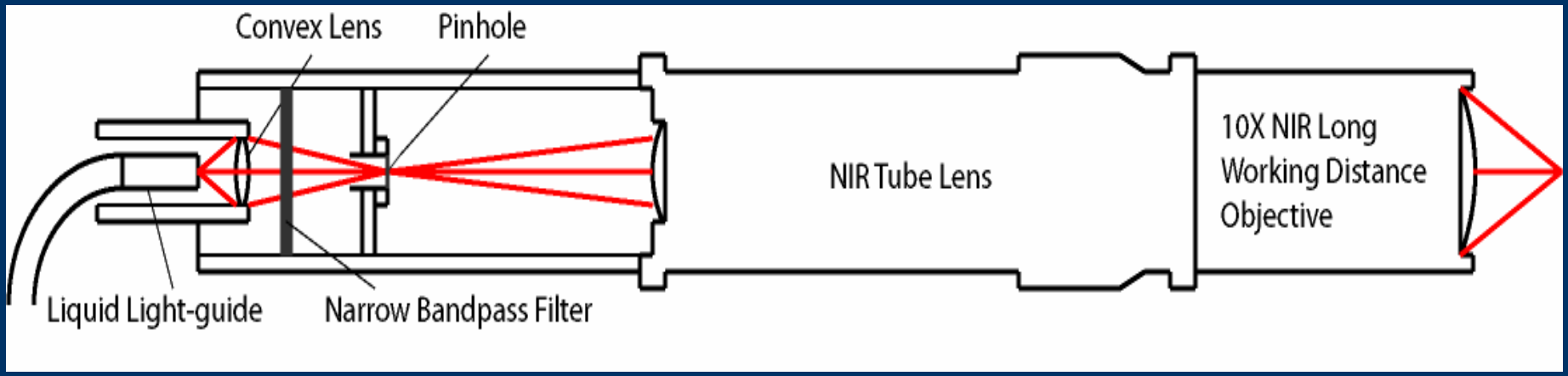
How it works



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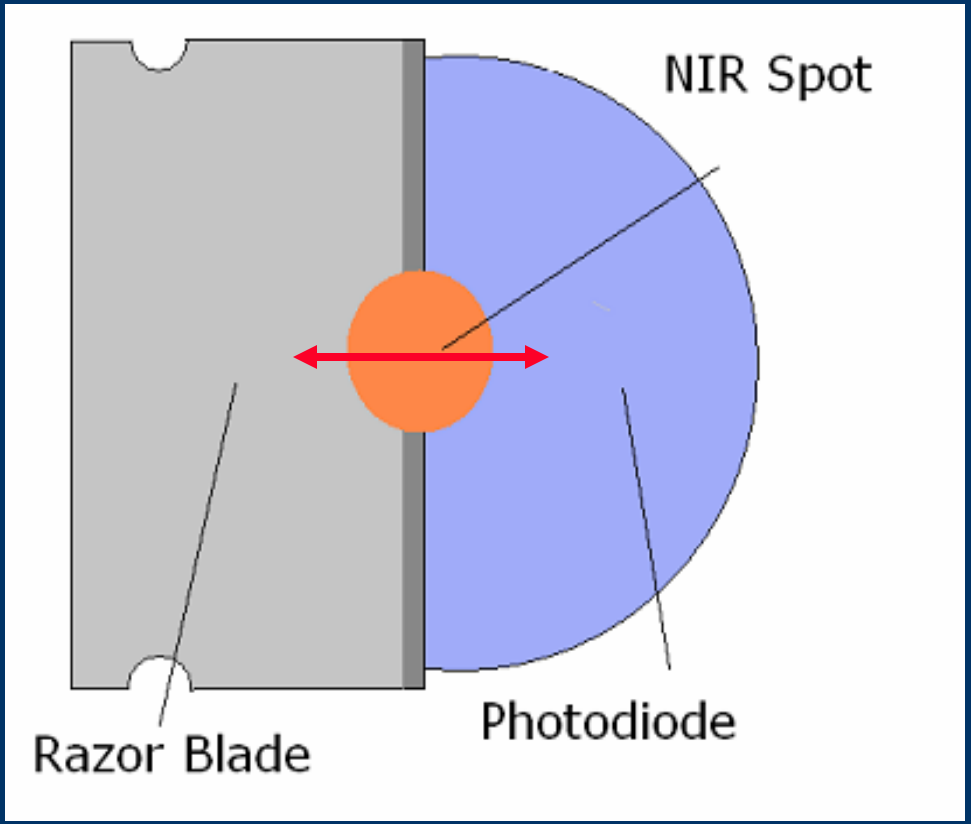
Accurately determining the PSF

In order to determine the response of a pixel, we need to know the exact size of the spot that we shine on the detector



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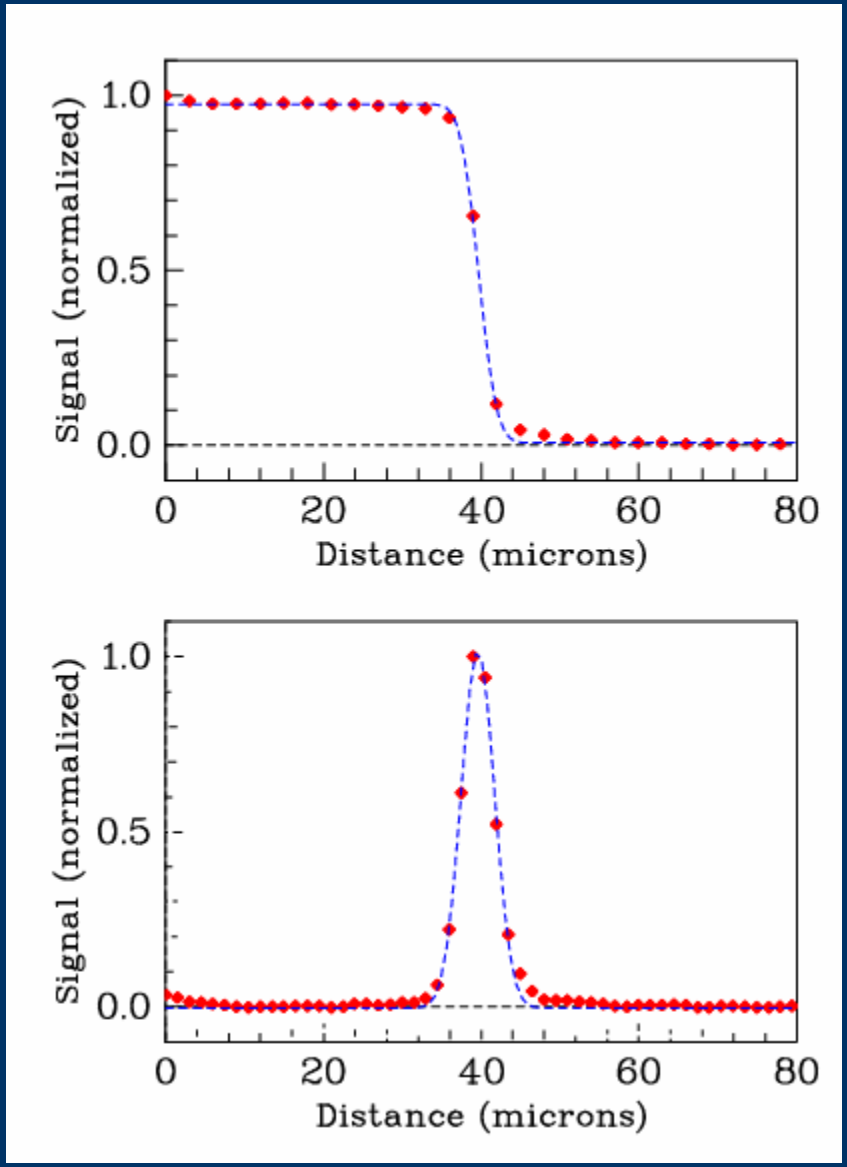
At $\lambda = 1550$nm, we have a spot profile with $\sigma = 2.10$ μm

This is definitely small enough to probe a 18 μm pixel



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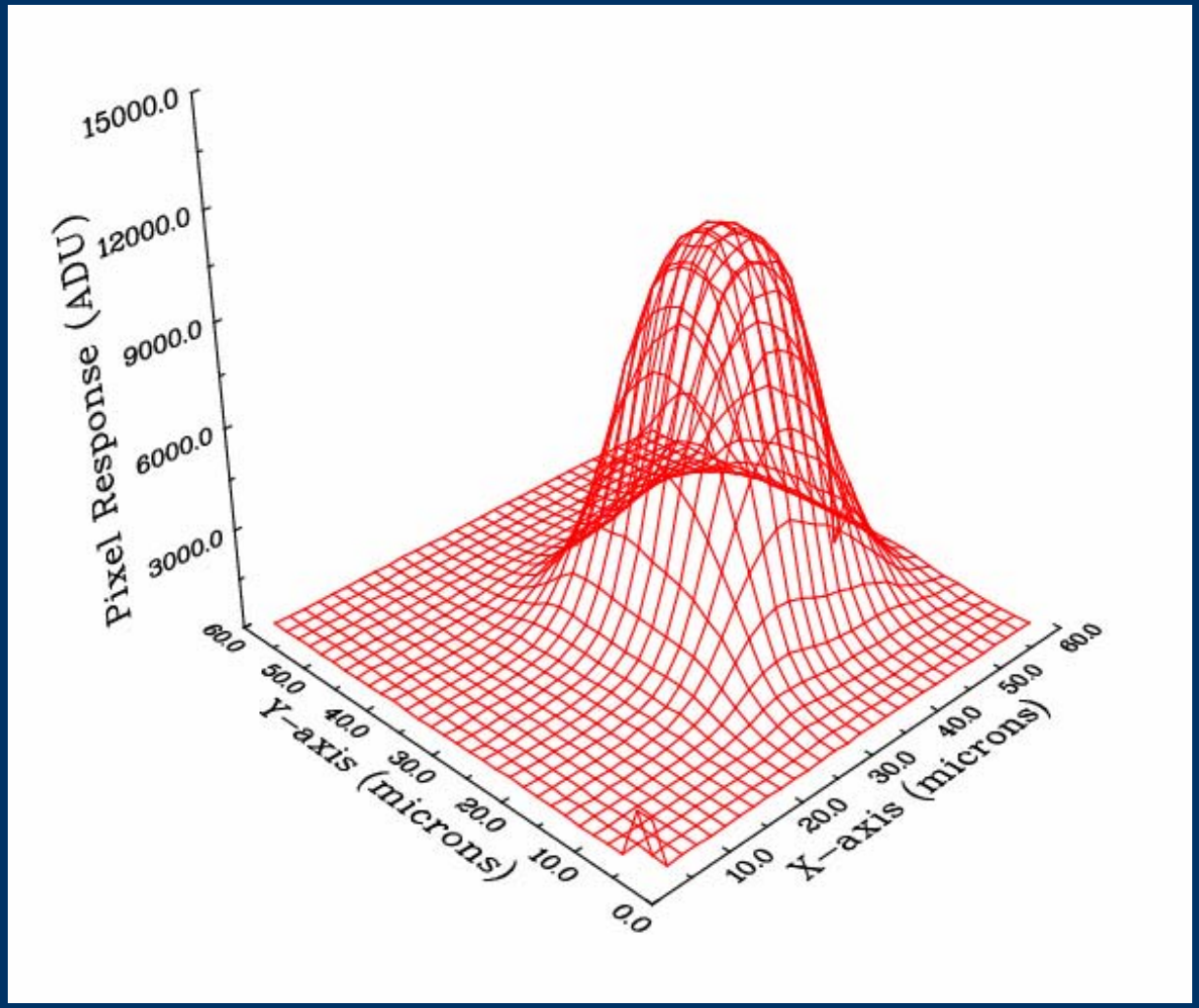
Pixel Scan



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What do we notice about the pixel?

- Pixel response is quite smooth and uniform over its area (no significant dip in QE)

- The response of the pixel extends beyond the physical size of the pixel itself!

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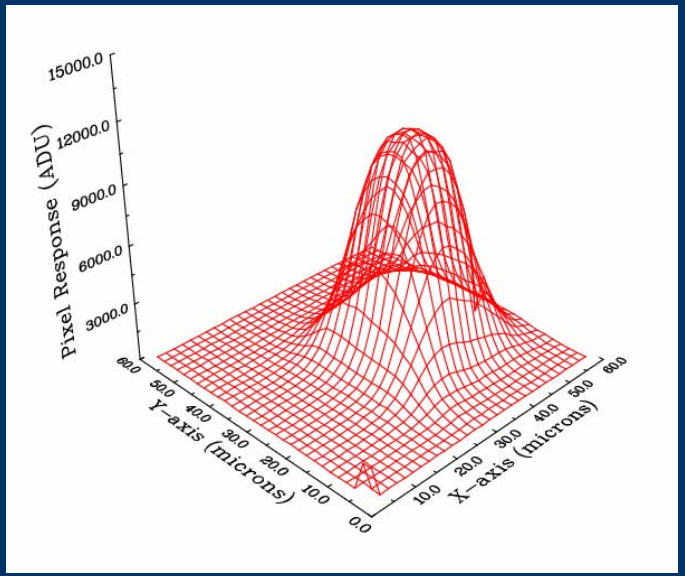
What does this mean?

Lateral charge diffusion



This doesn't mean we can't dither to achieve precision photometery, as long as we know exactly how much charge diffusion we have

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Deconvolution of PRF

The results we obtained are not actually the PRF, but rather a convolution of the PRF and the PSF

Deconvolution is necessary to determine the true PRF

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The future of the Spot-o-Matic

- UM now has the only NIR spot projection system with the ability to precisely resolve the PRF of these detectors

- Can be used for a variety of experiments, including simulation of an actual PSF that SNAP will see in space

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