

To maximize Rubin's science potential, we need to measure camera performance and identify ways to calibrate images and potentially remove anomalies/defects. My work in this effort includes: measurements. We have added color dependence to PIFF, the default PSF modeling package for Rubin and the Dark Energy Survey (DES). Preliminary DES Year 6 PSF diagnostics show **significant reductions in color-dependent systematics**.

- building and operating electro-optical (EO) test equipment for **camera commissioning**
- contributing to key pipeline software, including Rubin's default point-spread function (PSF)
   modeling package, PIFF (PSFs in the Full Field-of-View)<sup>1</sup>
- investigating particular camera sensor
   anomalies such as so-called "tree rings"

# Flat field illumination for camera commissioning

We need flat field images, i.e. nearly uniform light in every pixel, to test and calibrate for:

- pixel defects
- non-uniform gain between amplifiers
- non-linear signal response





Investigating "tree ring"

#### • correlations due to the brighter-fatter effect



Credit: A. Rasmussen



The flat field apparatus AKA Camera Calibration Optical Bench-Wide Beam (CCOB-WB):

- repurposes the CCOB-WB light source developed by the LPSC Grenoble group<sup>†</sup> for earlier focal plane testing
- has one LED for each *ugrizY* filter
- tests sensors' full dynamic range in flux

### sensor anomalies

When the sensors' silicon substrate is being grown, changes in temperature, humidity, etc, can cause fluctuations in doping concentration.  $\Rightarrow$  Tree ring patterns in our sensors!

We create "pseudo images" by dithering a grid of synthetic point sources to measure the tree rings' effect on astrometry (0.4-1 mas) and shape measurements (0.02-0.05%) before correction<sup>3</sup>.



# **Looking ahead**

### Prototyping and testing are underway!

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More R&D is required for the CCOB-WB before full camera EO testing at SLAC and on summit.

- Rubin PSF estimation will likely require more sophisticated color-dependent modeling.
- Camera commissioning will be an exciting opportunity to demonstrate LSST Camera's performance and delve into its many quirks!

## References

<sup>1</sup> https://github.com/rmjarvis/Piff
<sup>2</sup> M. Jarvis et al., Mon. Not. R. Astron. Soc. 501, 1282 (2020).
<sup>3</sup> J. Esteves et al., in prep

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