

CURVED FOCAL PLANE TELESCOPE FOR OBSERVATION OF ULTRA-LOW SURFACE BRIGHTNESS OBJECTS

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on behalf of the ICARUS (ERC) team @LAM

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The low surface brightness universe, SF2A, Nice

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WIDE FIELD ASTRONOMY

Wide field optical system (typically Schmidt designs):
observation of transients, planets, ...



CURVED FOCAL PLANES



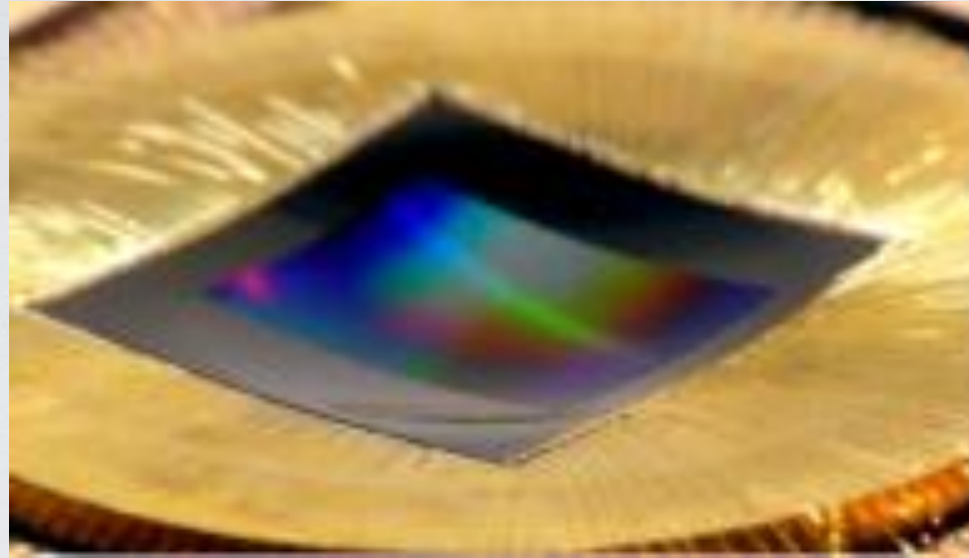
Additional field flatteners



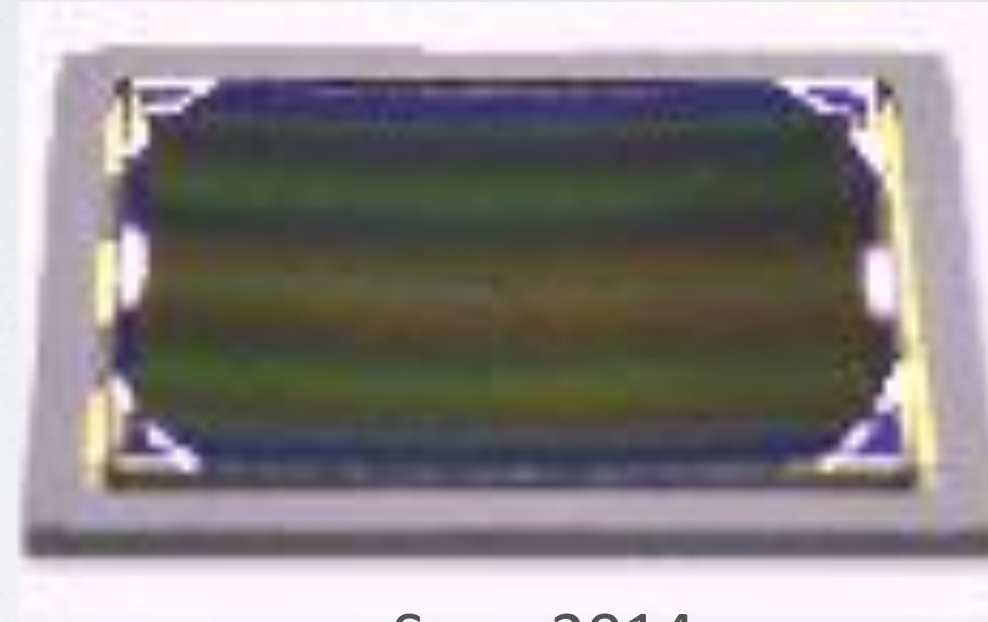
Kepler focal plane,
42 flat CCDs

CURVED DETECTORS DEVELOPMENT

A new way of solving the problem



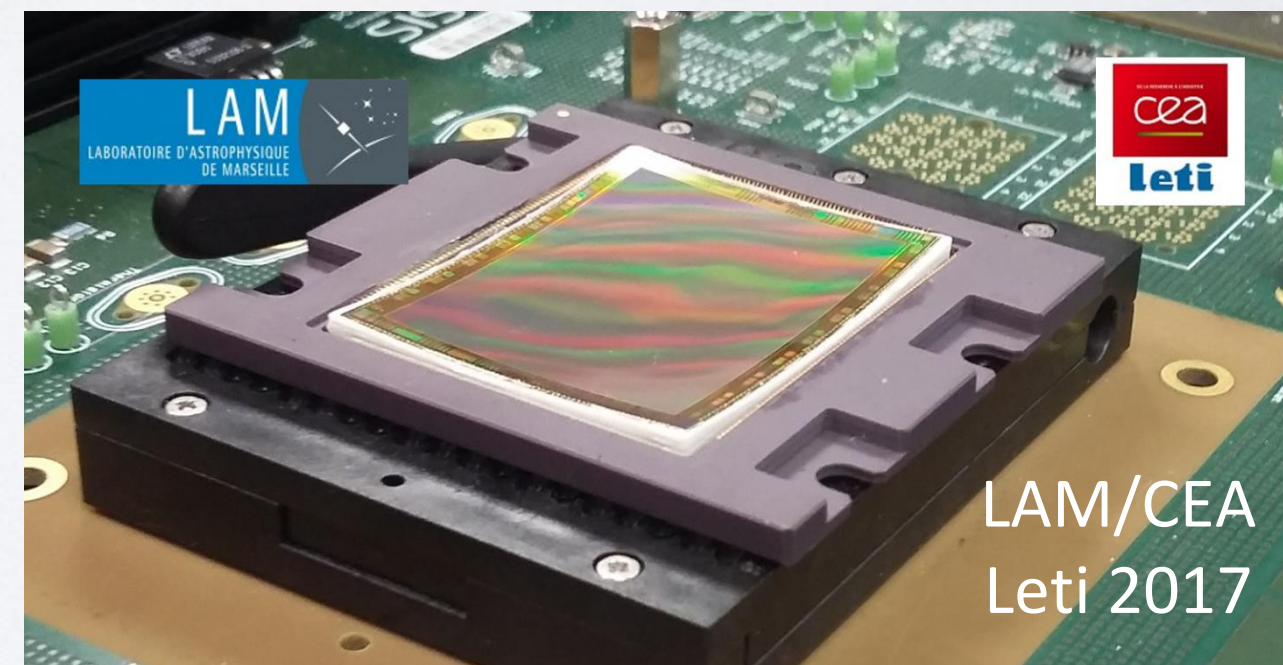
Microsoft 2017



Sony 2014

Many advantages:

- smaller and more compact systems
- better throughput



LAM/CEA
Leti 2017

SCIENCE CASE



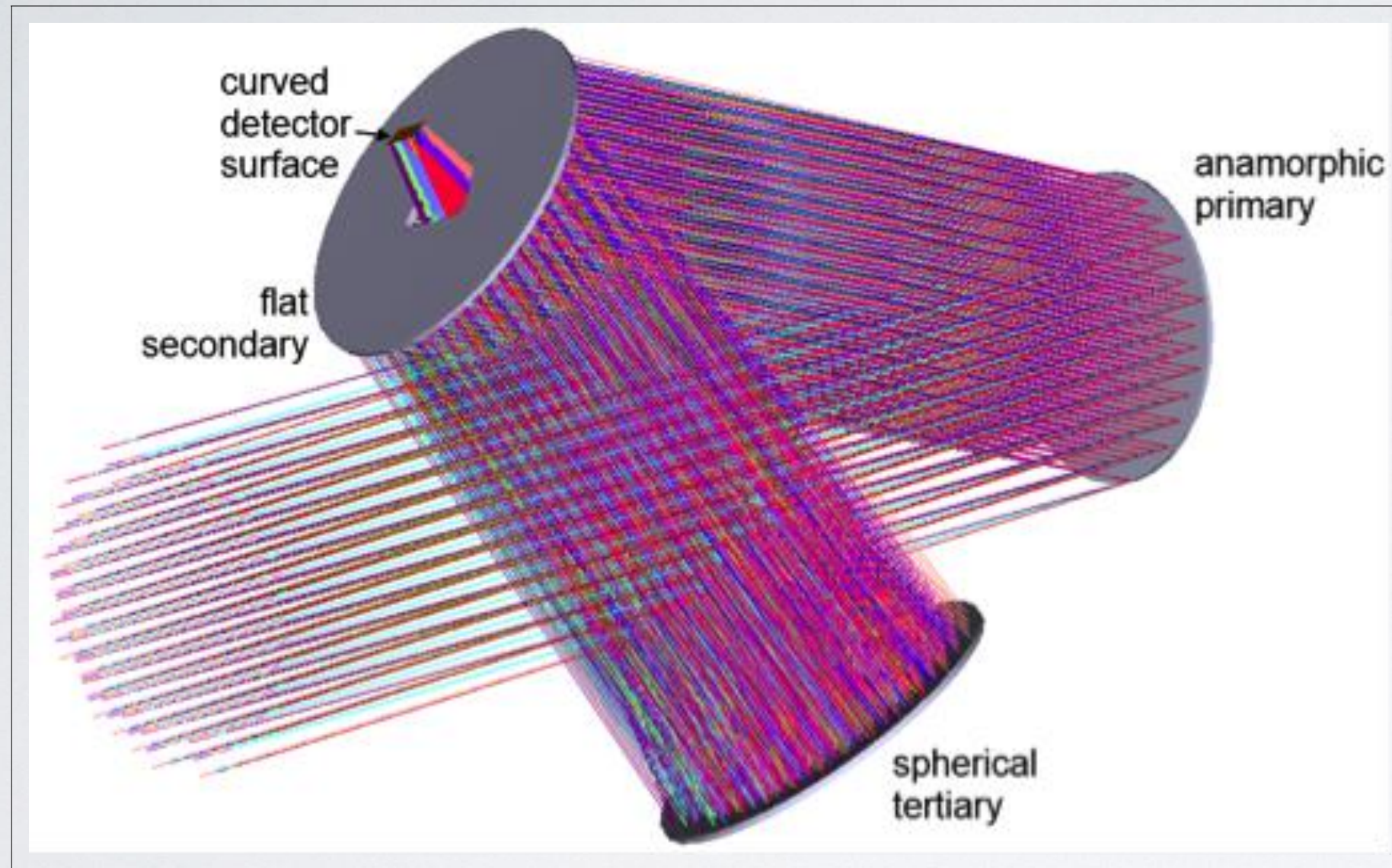
Martinez-Delgado et al., 2008

REQUIREMENTS:

- Low PSF wings
(need to reach the faintest LSB levels)
- No refractive elements
(no internal scattering)
- Observing from space
(no molecular scattering)

TELESCOPE DESIGN

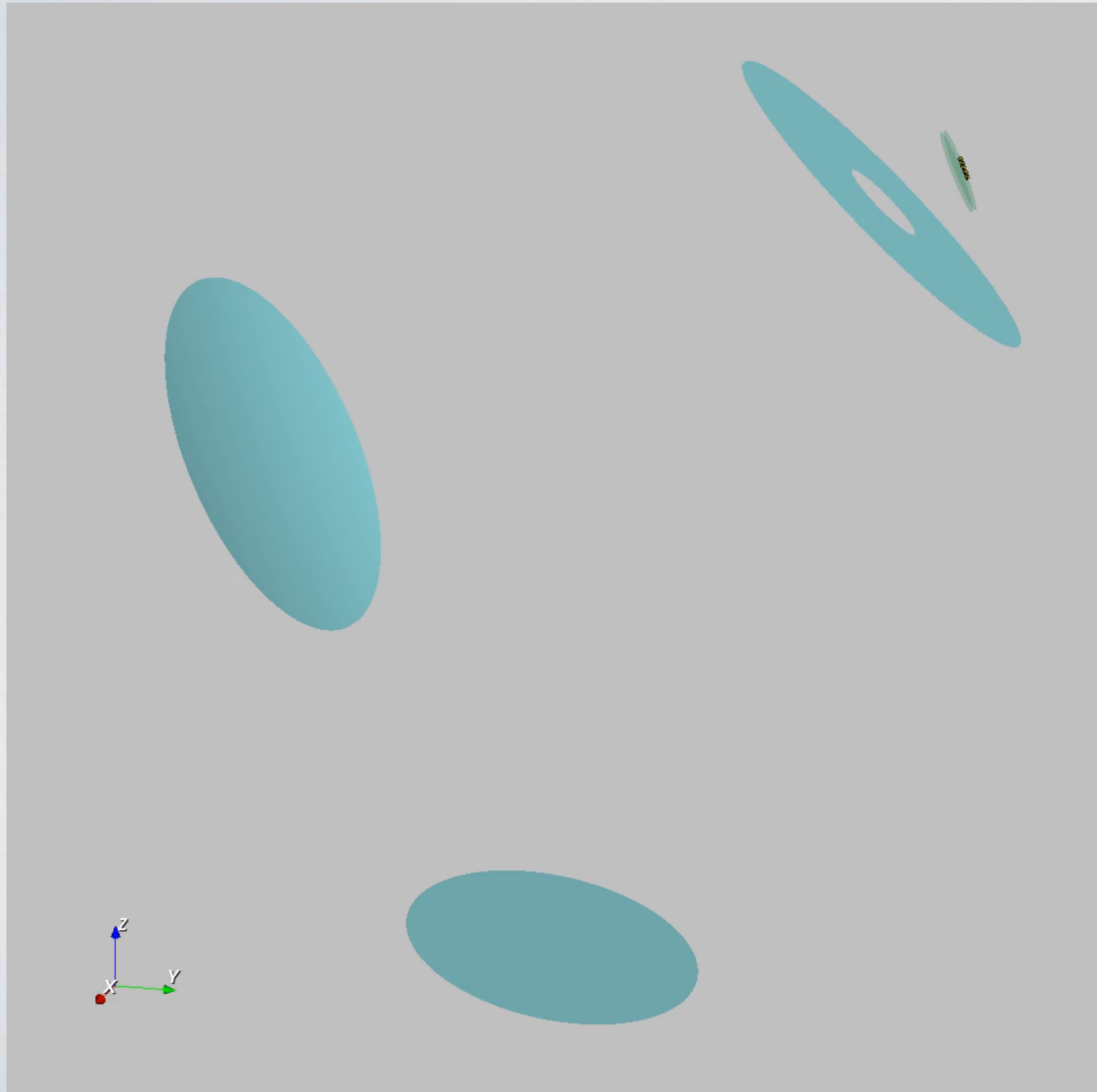
Fully reflective Schmidt design to be installed in Calar Alto (robotic telescope)



- FoV: $1.6^\circ \times 2.6^\circ$
- F/# : 2.5
- Primary diameter: 356 mm

Muslimov et al., 2017,
Applied Optics, 56, 8639

PHOTON MONTE CARLO SIMULATIONS



Pathfinder with one **necessary**
refractive element:

g-band filter + cryostat window

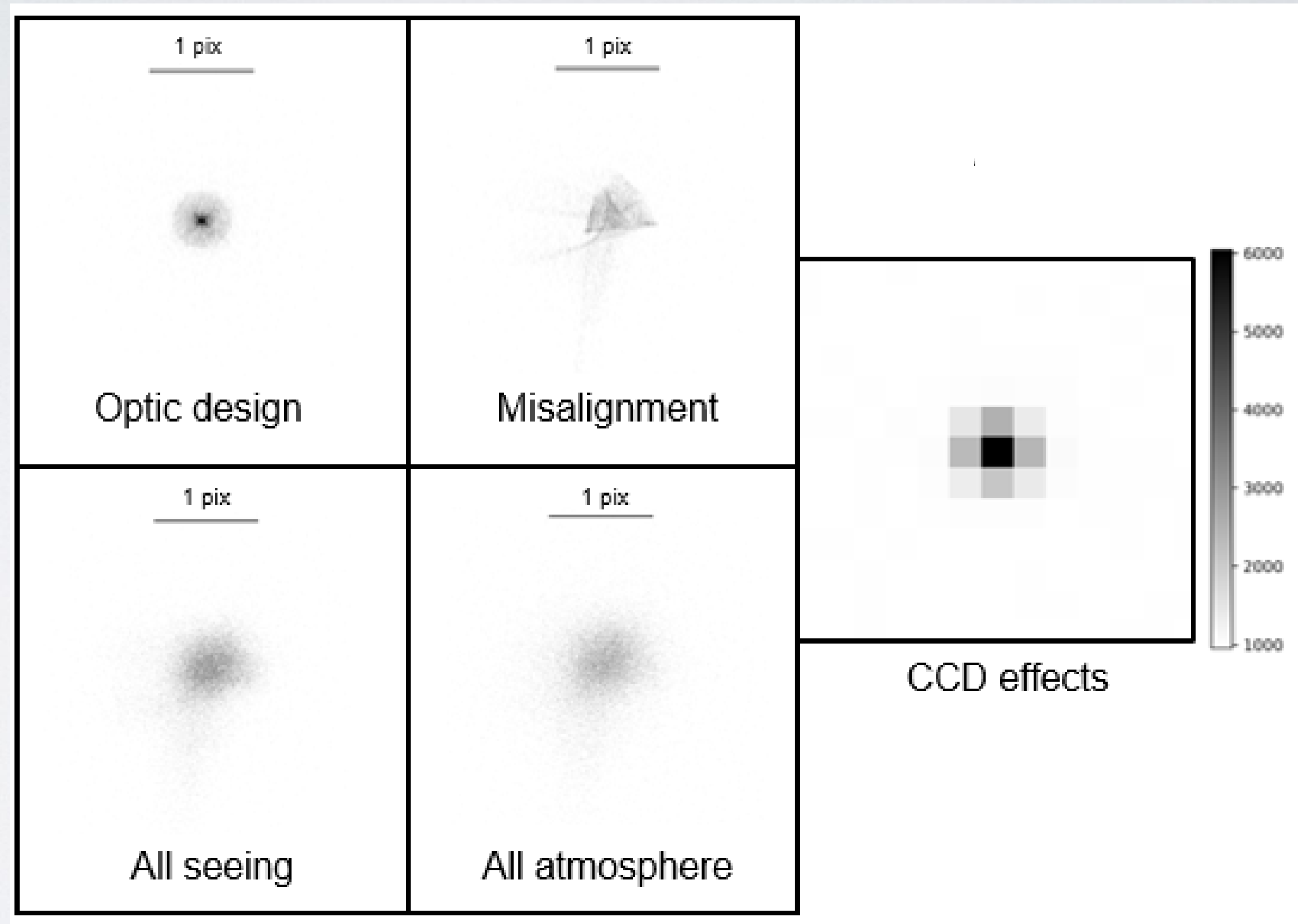
Curved CCD detector

Peterson et al., 2015, PhoSim

<https://www.lsst.org/scientists/simulations/phosim>

SINGLE STAR AT THE CENTER OF THE FIELD OF VIEW

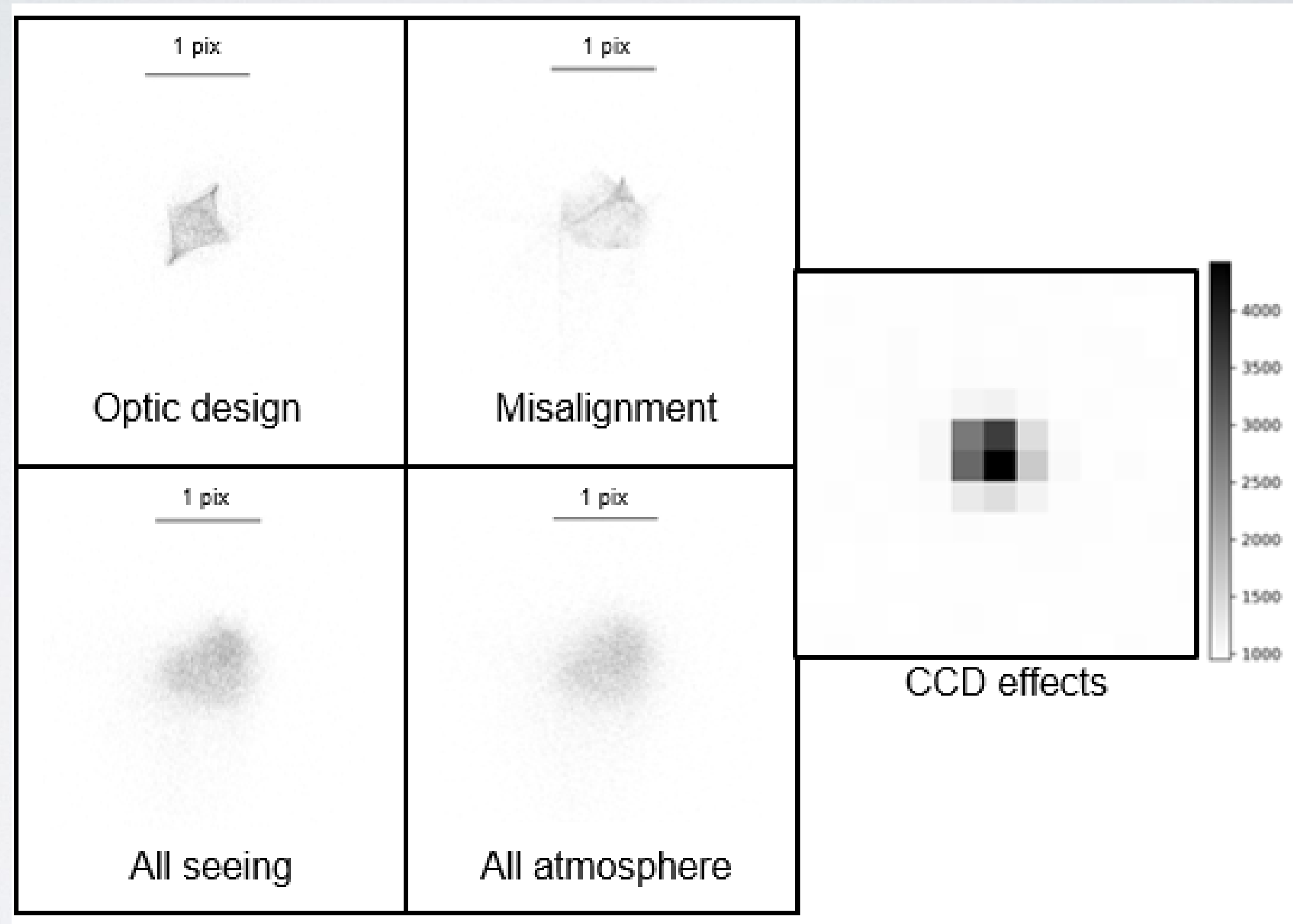
1 pix = 2.32"
FoV 1.6°x2.6°



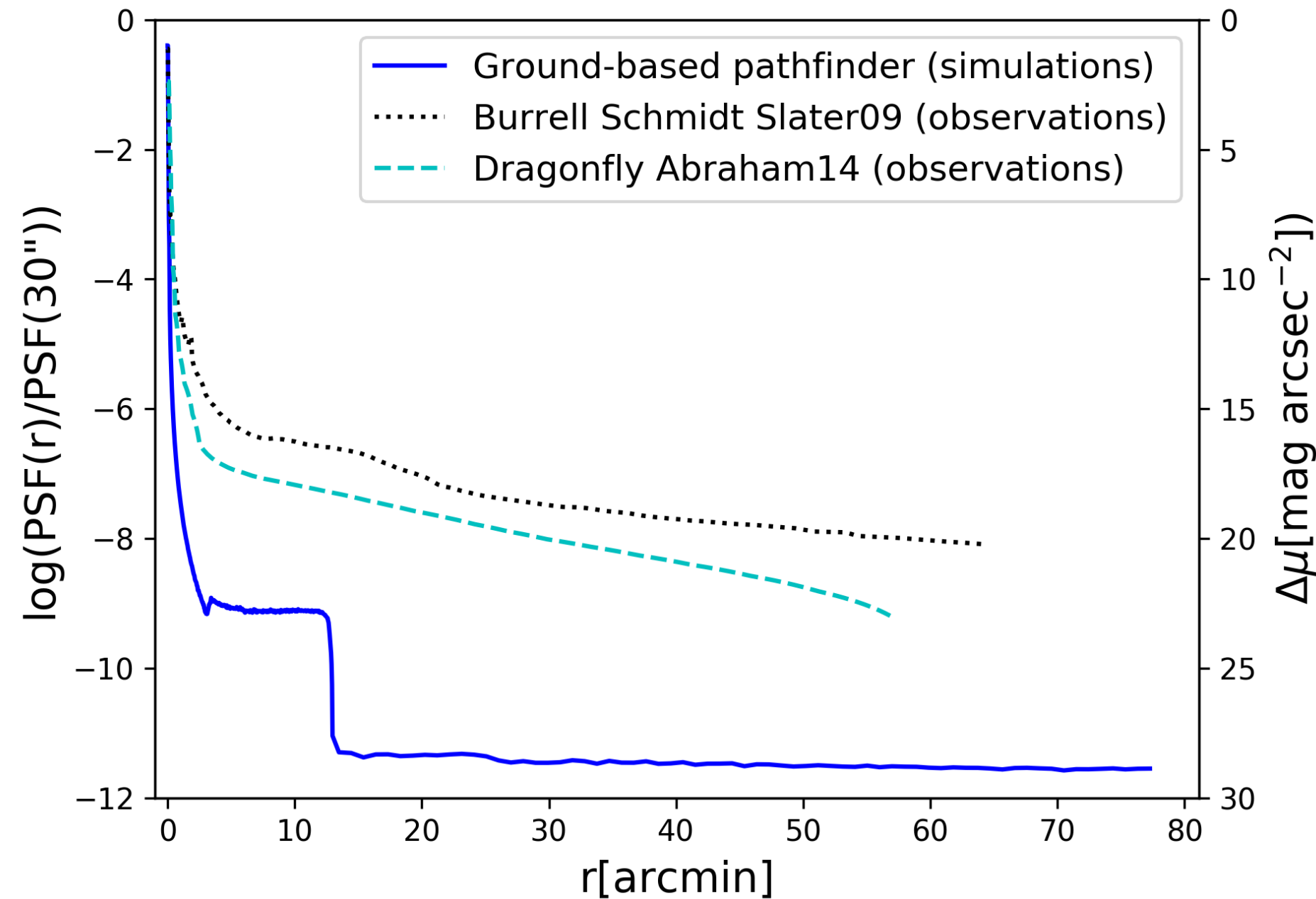
SINGLE STAR AT THE CORNER OF THE FIELD OF VIEW

1 pix = 2.32"
FoV 1.6°x2.6°

The image in the focal surface is **uniform in the full field!**



SINGLE STAR SIMULATION



Data binned every 2.32" (1 pixel)

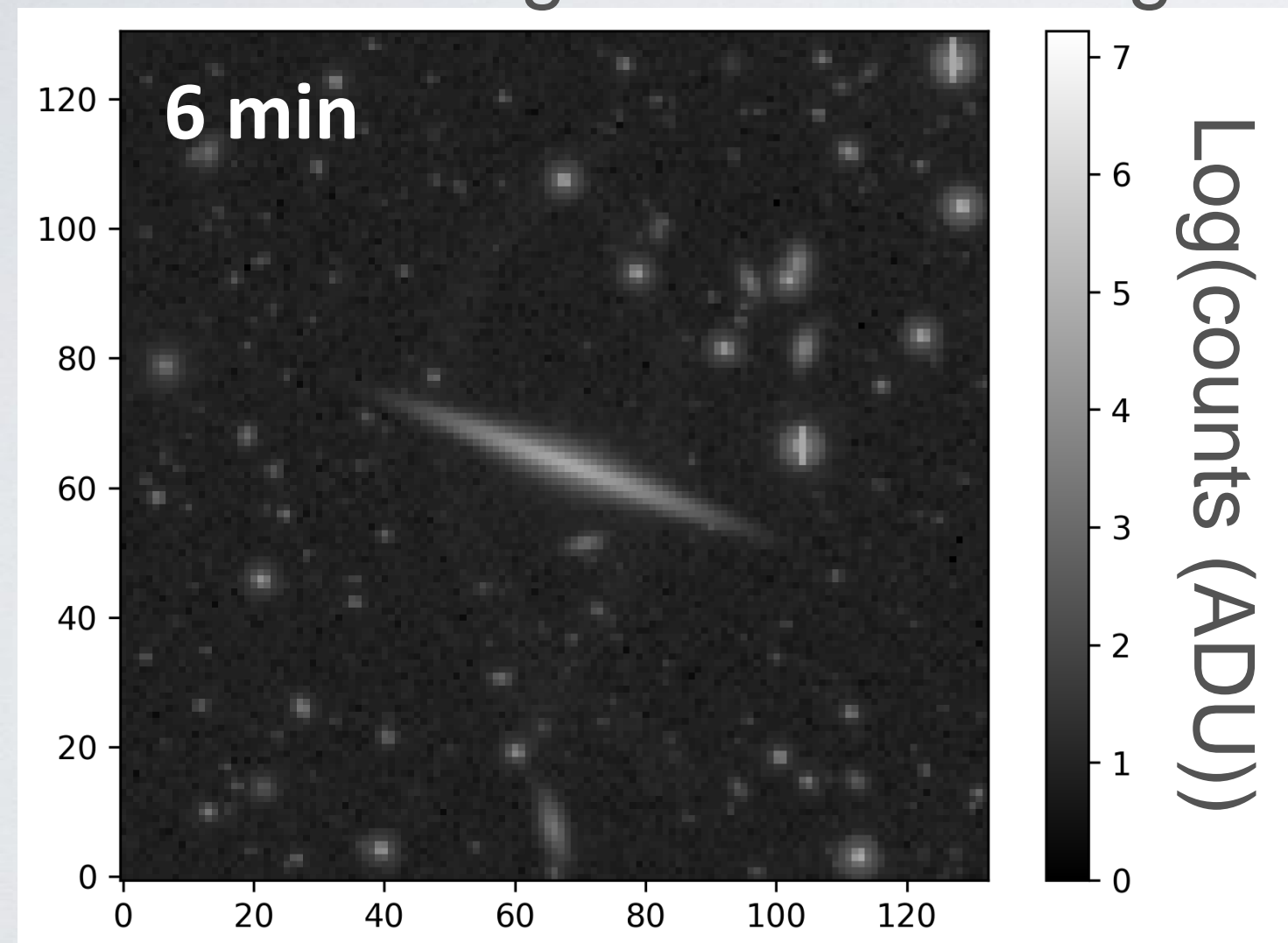
Star at the center of FoV

VERY LOW PSF WINGS IN
FULL FoV

Lombardo et al. (submitted)

U-LSB OBJECTS SIMULATION

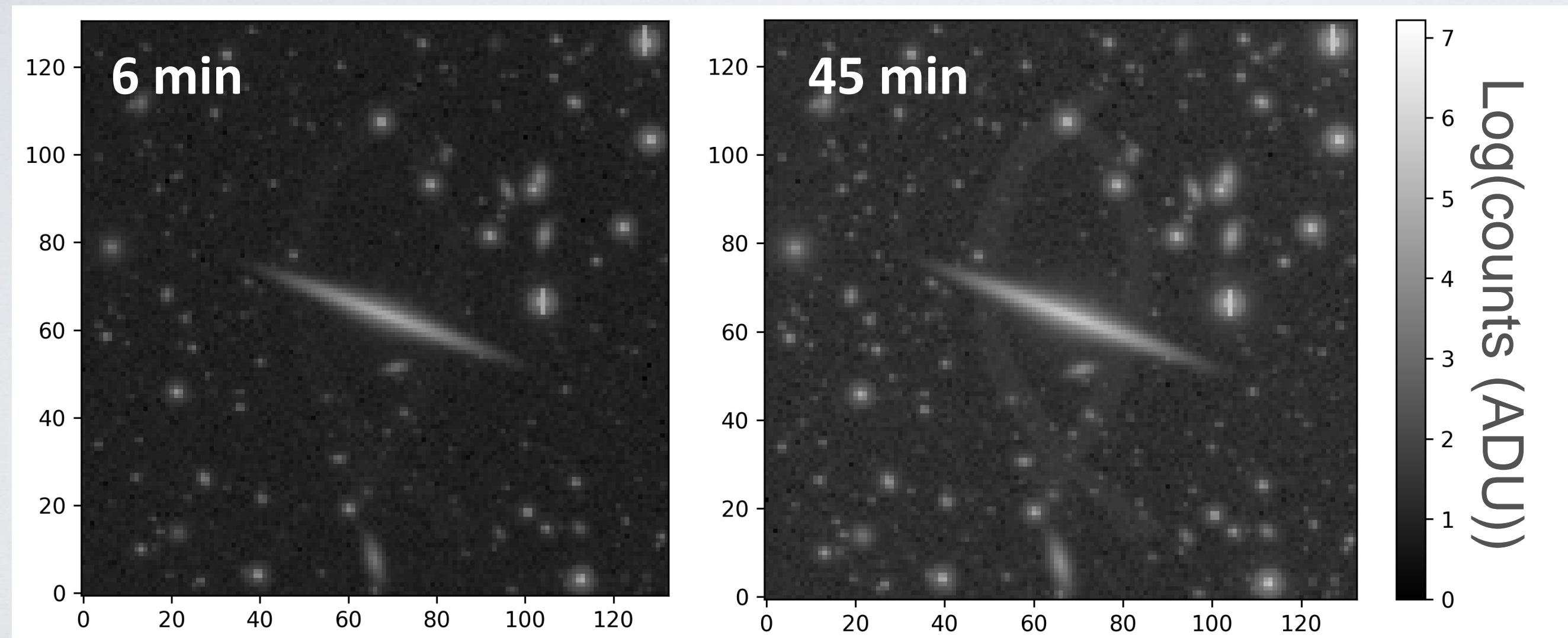
Dimension of field: 5'x5'
Max star mag: 30 mag
Min star mag: 15 mag



Lombardo et al. (submitted)

U-LSB OBJECTS SIMULATION

Dimension of field: 5'x5'
Max star mag: 30 mag
Min star mag: 15 mag

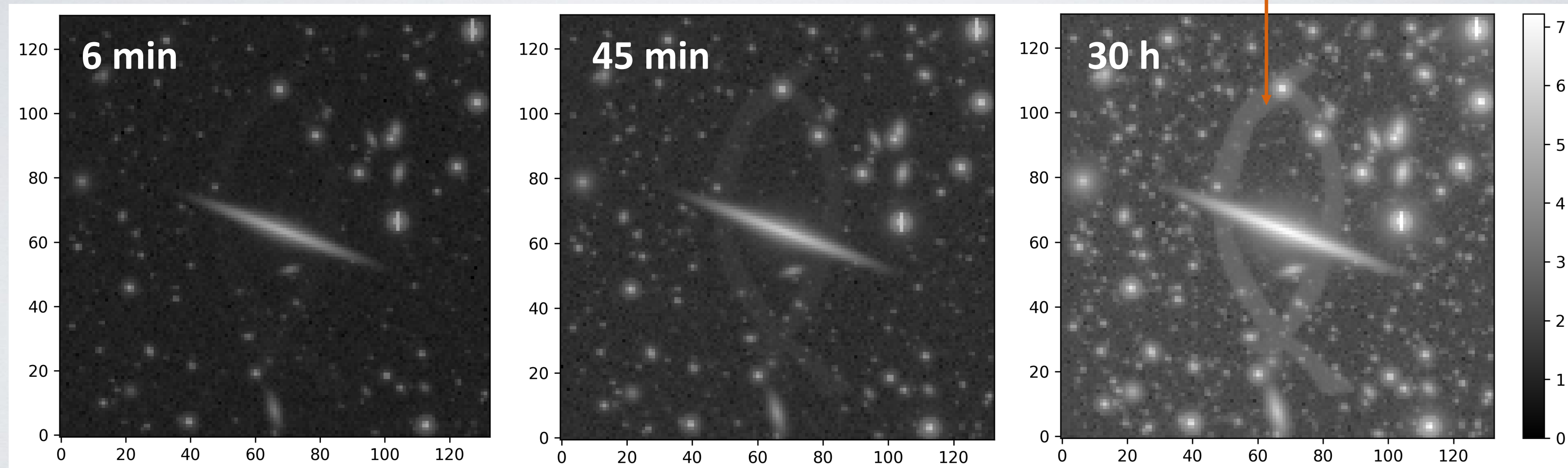


Lombardo et al. (submitted)

U-LSB OBJECTS SIMULATION

Dimension of field: 5'x5'
Max star mag: 30 mag
Min star mag: 15 mag

Loop: 29 mag/arcsec²



Lombardo et al. (submitted)

NEXT STEPS

Simulations mostly done

REQUEST FOR QUOTATION FOR THE OPTICS IS OUT

ONGOING PROTOTYPING OF CURVED DETECTORS @LAM

THANK YOU!