



HDR Application in Quality Assurance

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About us, HELLA

www.hella.info

- HQ in Abfattersbach, Tirol, Austria
- 60 yrs anniversary 2019
- family owned
- Full line distributor:
everything for daylight mgmt, its integration into facades & controls
 - Roller shutters
 - Venetian Blinds (int, ext)
 - Roller Blinds (int, ext)
 - Box systems, Soffit systems, window attached boxes (top mounted)
 - awnings.
 - Outdoor living (Pergola)
 - ONYX



Venetian Blinds in CCF

Bishopsgate, London



josef-gartner.permasteelisagroup.com

100 Mount Street, Sydney



https://www.permasteelisagroup.com/media/2756/2017_annualreport_en.pdf

What's a roller shutter?

Roller Shutters





Why QA HDR?

Night Shift

22:00 – 06:00

Sleeping anytime between

06:00 – 22:00

BUT:

A roller shutter is no obscuration device, by definition.



Roller Shutter: Hinge System

Full contact in closed position

Stretched whenever moving

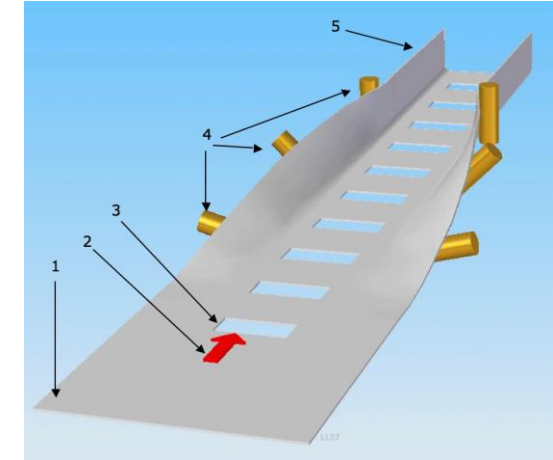


Aluminum slats

Process Quality – Manufacturing Tolerances

Starting point: Aluminum Coil incl. tolerances

- Lengthwise curvature (x & y)
- Lengthwise Torsion (z)
- Tolerances in Section x,y-plane
 - Roll dies
 - PUR hardening pressures
- Position of punches
- Burrs
 - Slat ends
 - punches
- Tolerances in Band surface



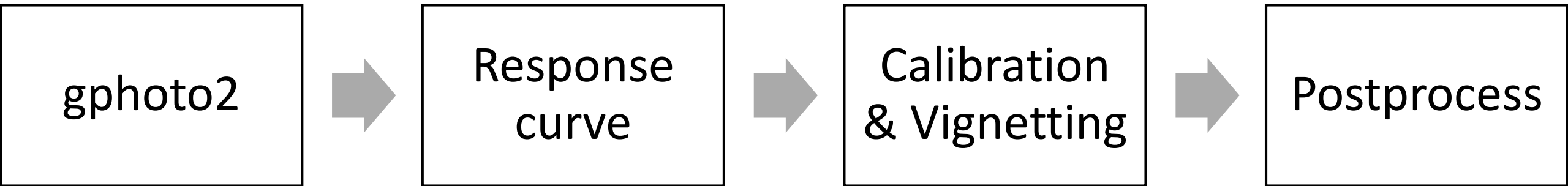
The issue is

- a. Transmission through guiderails
- b. Transmission through hinges
- c. Transmission through slats

This work focuses on (b) Transmission through hinges.



Objective: Cancel out subjective evaluation



Testbox



Testbox

LED PWM dimmable, 6500K

$E = 16\text{-}23\text{klx}$ @ 100% (-> reasonable daylight scene)

$L = 4\text{-}5\text{kcd/m}^2$ @ 100%

Diffusor is not completely lambertian!

Dedicated, completely dark room is needed!

Fixed Position of Camera (in future)

$f/4.5$, ISO 800 or 1600; A-Mode (Aperture fixed, Time adjusted);
AF mechanically deactivated



Gphoto2

Nikon D40 Version 1.10 – stick to this ancient device

Canon EOS 800D

-> well known and described all over the web

Response Curve

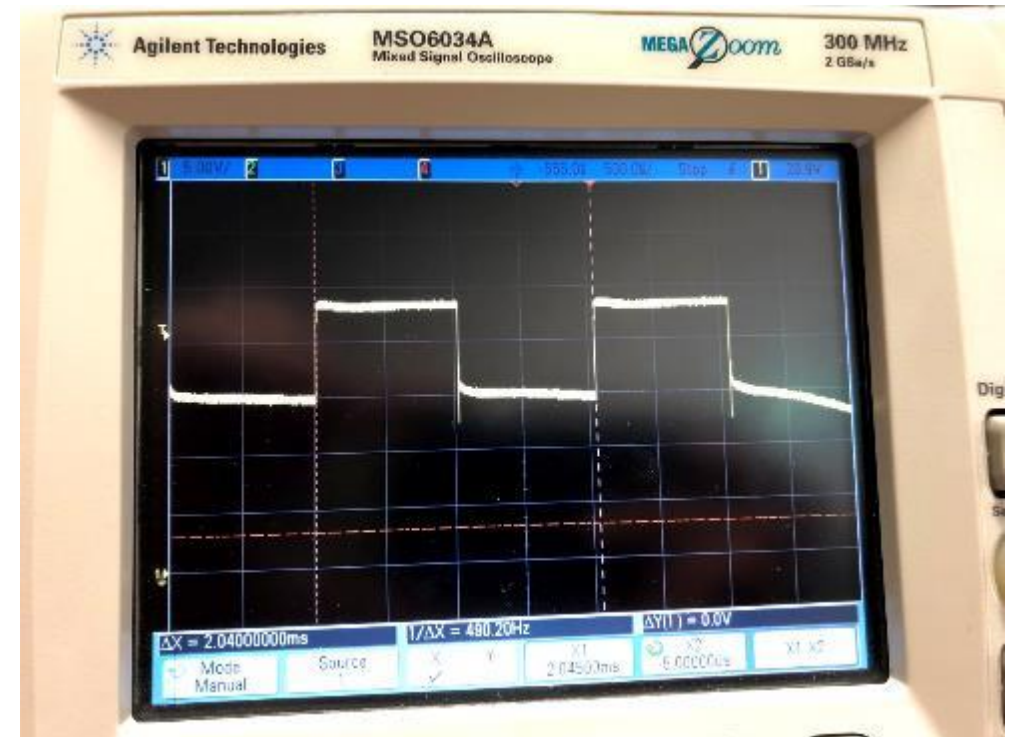
PWM Dimming on LED Sources!

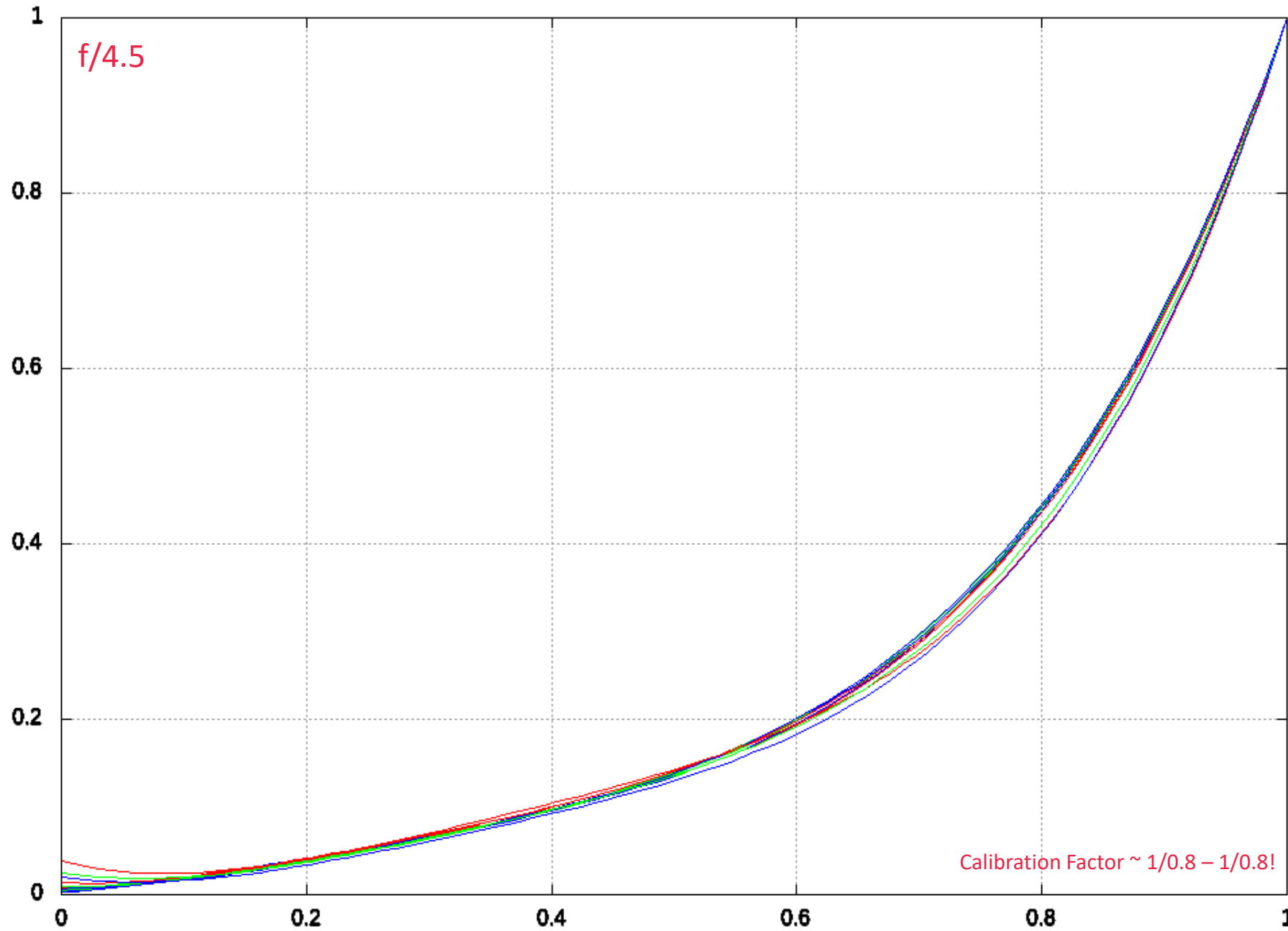
Finetuning due to the $20 < \text{RGB value} < 200$ constraint no dimming allowed!

99%



50%



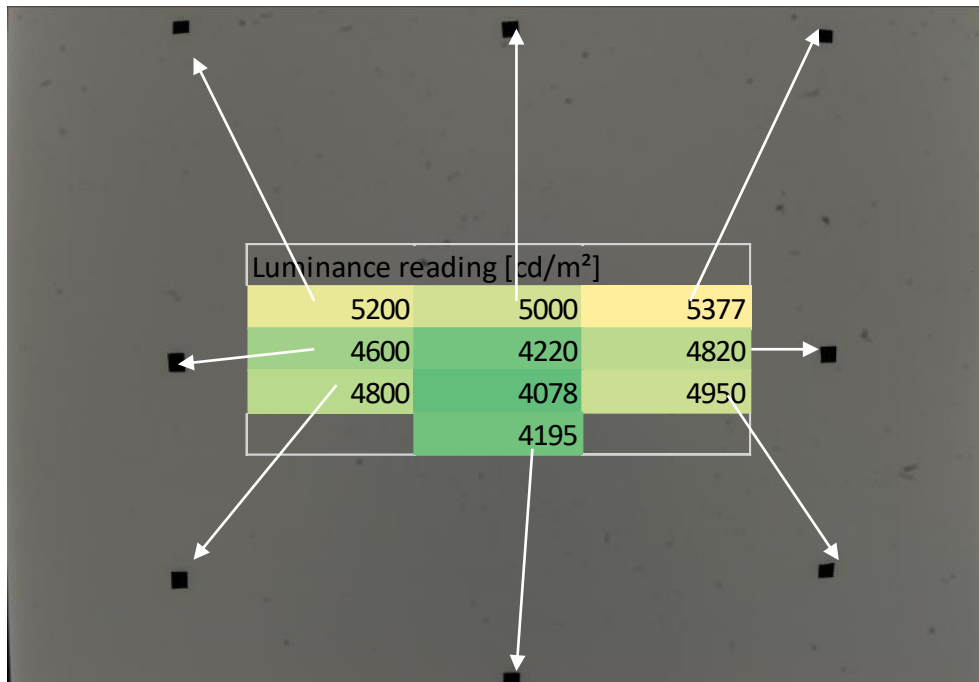


Vignetting & Calibration Factor



Vignetting testing

Different apertures



fototest45 f/9						
1746	1782	1803	0,33576923	0,3564	0,33531709	
1648		1698	0,35826087		0,35228216	
1668		1717	0,3475		0,34686869	
	1517			0,36162098		
fototest45 f/8						
1526	1531	1538	0,29346154	0,3062	0,2860331	
1639	1733	1525	0,35630435	0,41066351	0,31639004	
1615		1520	0,33645833		0,30707071	
	1778			0,4238379		
fototest45 f/5.6						
3297	3393	3370	0,63403846	0,6786	0,62674354	
3135	3040	3233	0,68152174	0,72037915	0,67074689	
3159		3221	0,658125		0,65070707	
	2894			0,68986889		
fototest45 f/4.5						
3721	3780	3819	0,71557692	0,756	0,71024735	
3562	3460	3636	0,77434783	0,81990521	0,75435685	
3612		3677	0,7525		0,74282828	
	3276			0,78092968		

Vignetting + calibration

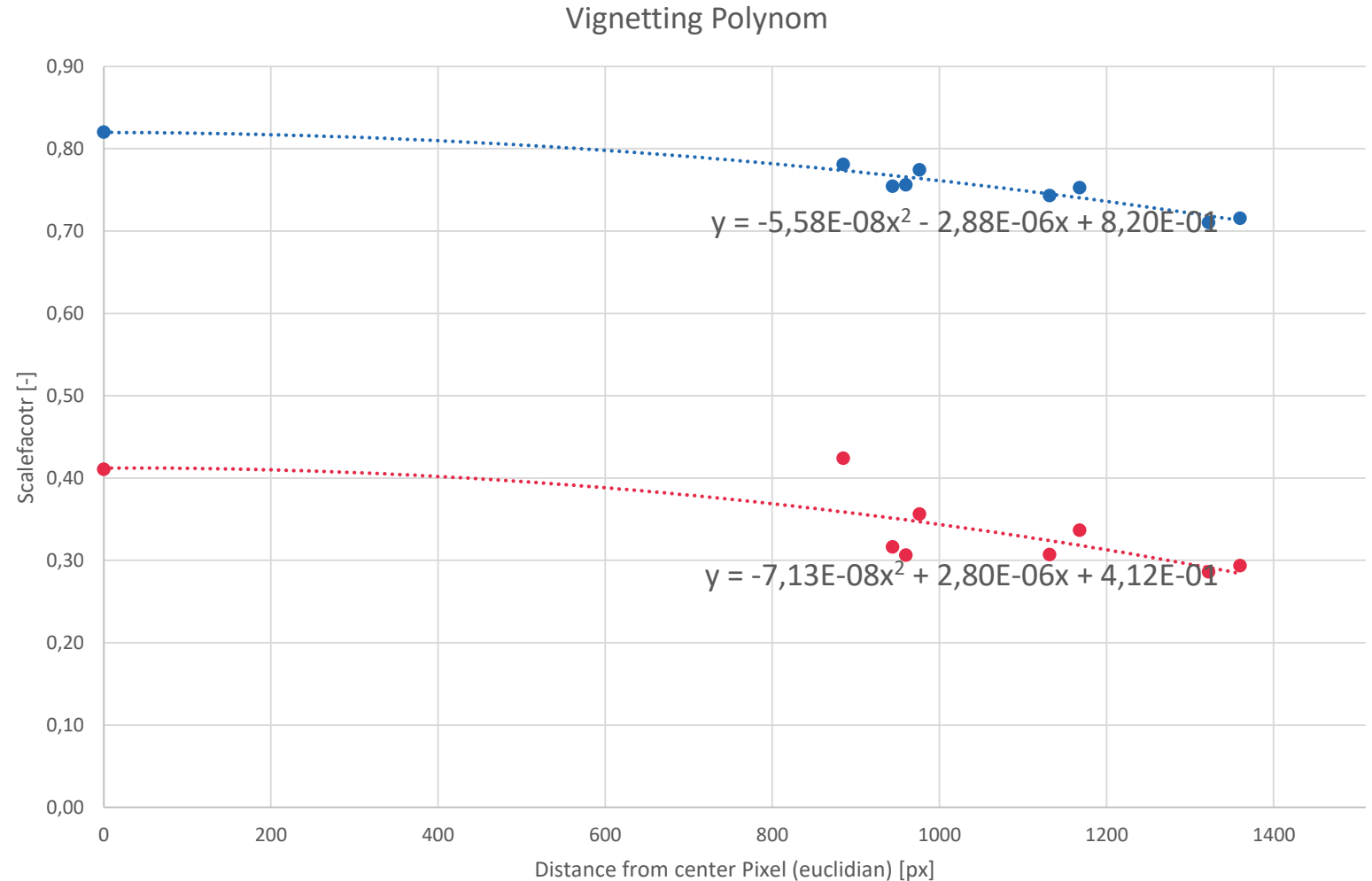
Depending on Aperture setting!

- f/4.5
- f/8

@18mm

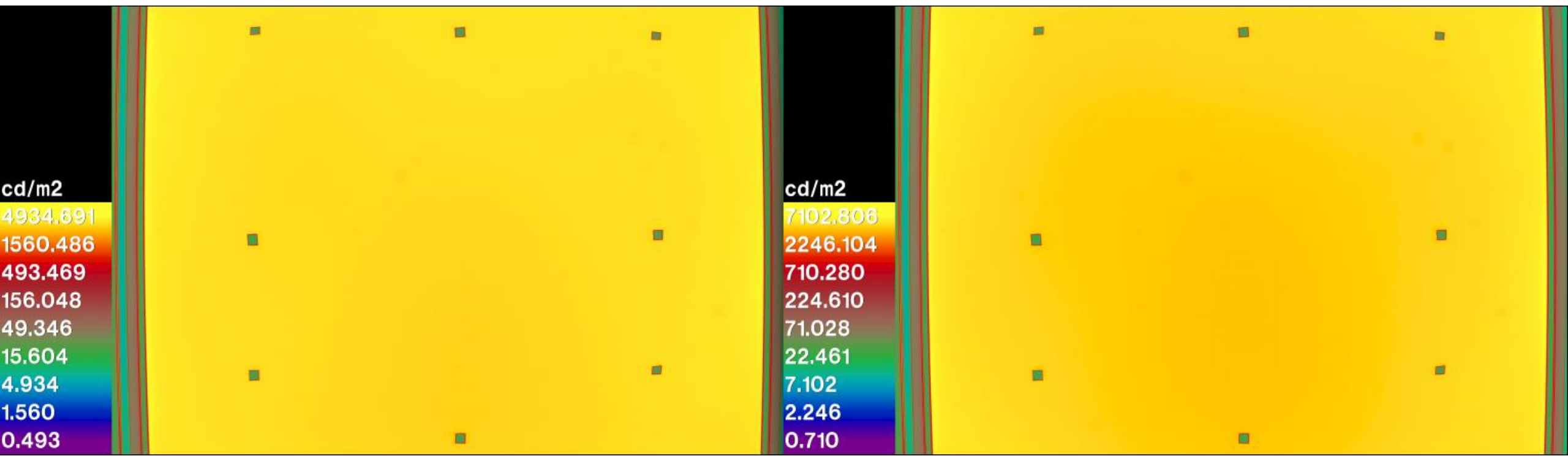
Assumption:

Radially symmetric



Vignetting corrected

Still an max. error of approx. 3.5%



Luminance reading [cd/m²]		
5200	5000	5377
4600	4220	4820
4800	4078	4950
	4195	

fototest 45 f/4.5 antivignetted			ratio		
5059	4837	5259	0,97288462	0,9674	0,97805468
4543	4210	4720	0,9876087	0,99763033	0,97925311
4674		4835	0,97375		0,97676768
	4154			0,99022646	

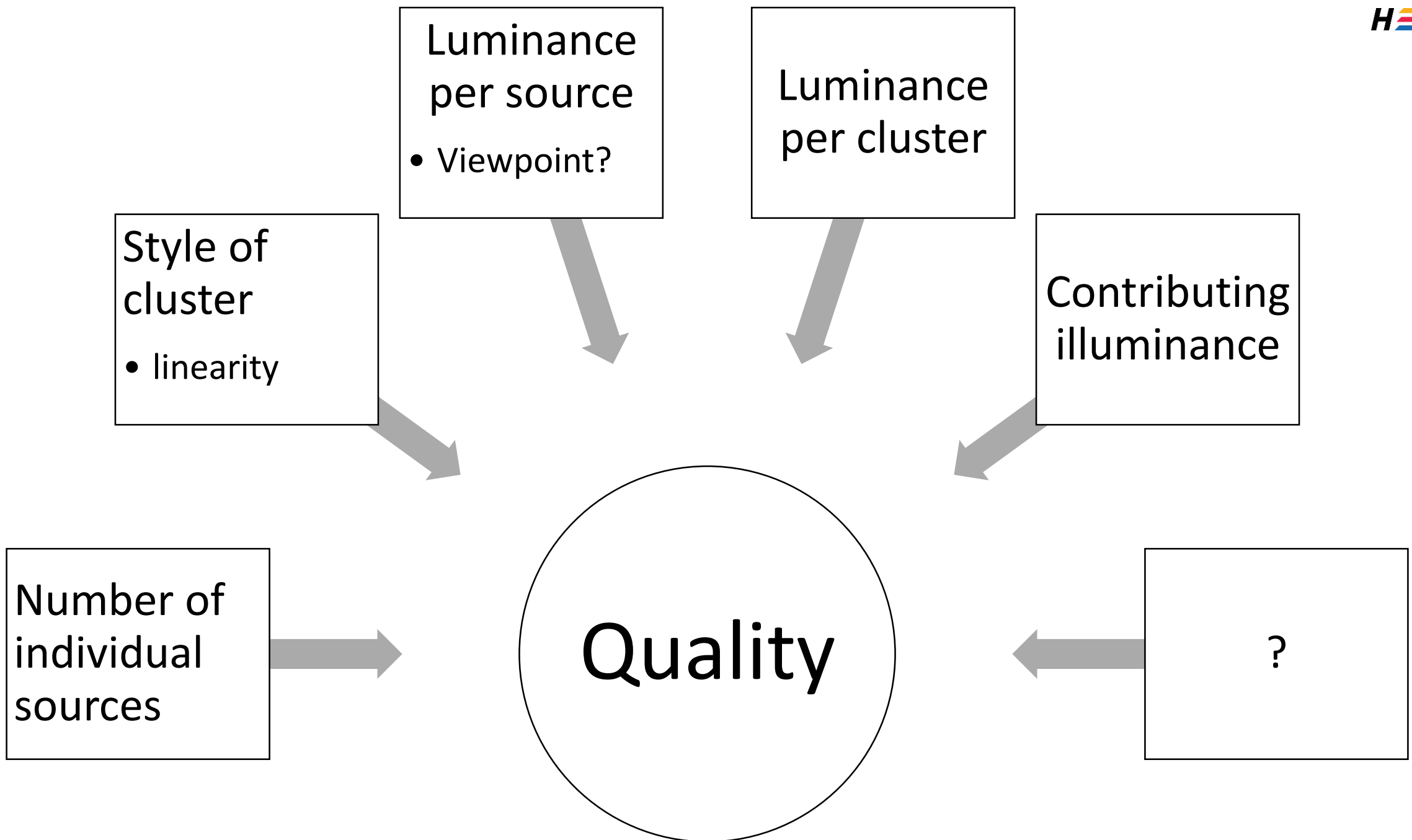
Distortion

Up to now neglected but open issue

-> All luminance data is obviously affected by it!

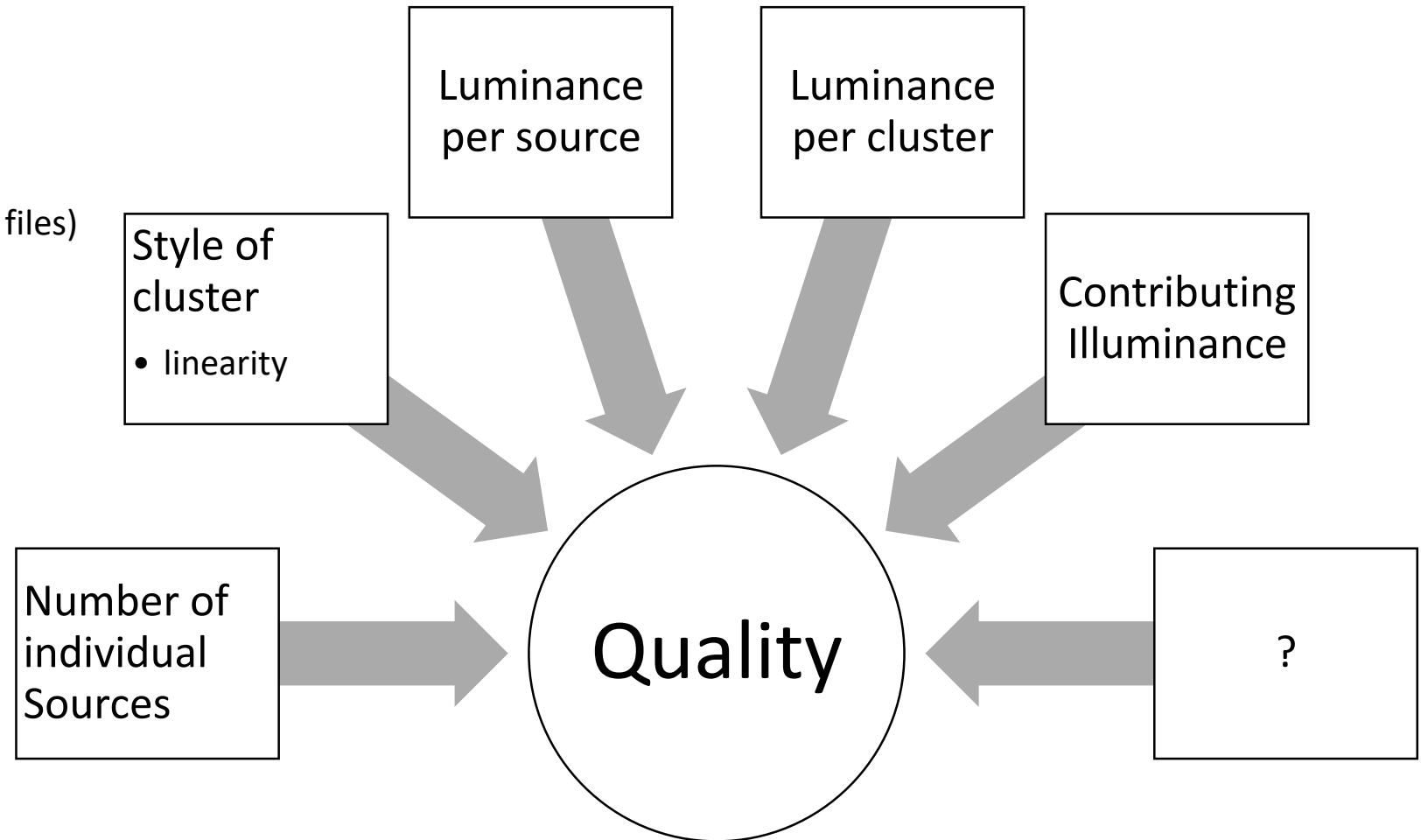
Quality Indicators





Tools considered or tested

1. Matlab readhdr (missing in octave)
2. Pvalue -> *.dat -> gnuplot (terrible files)
3. Findglare (not on hdr?)
4. evalglare

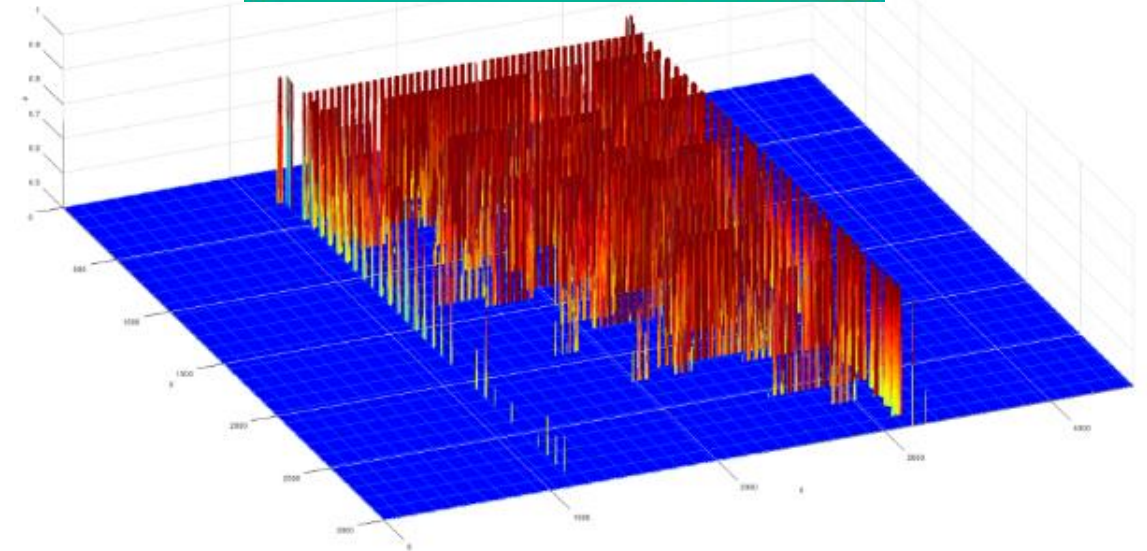
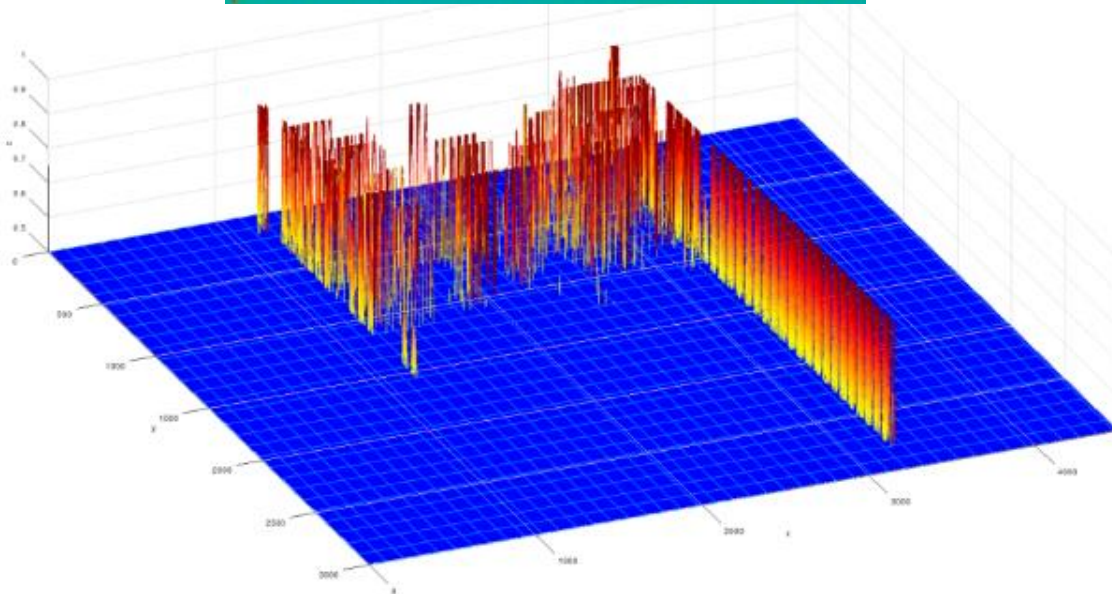
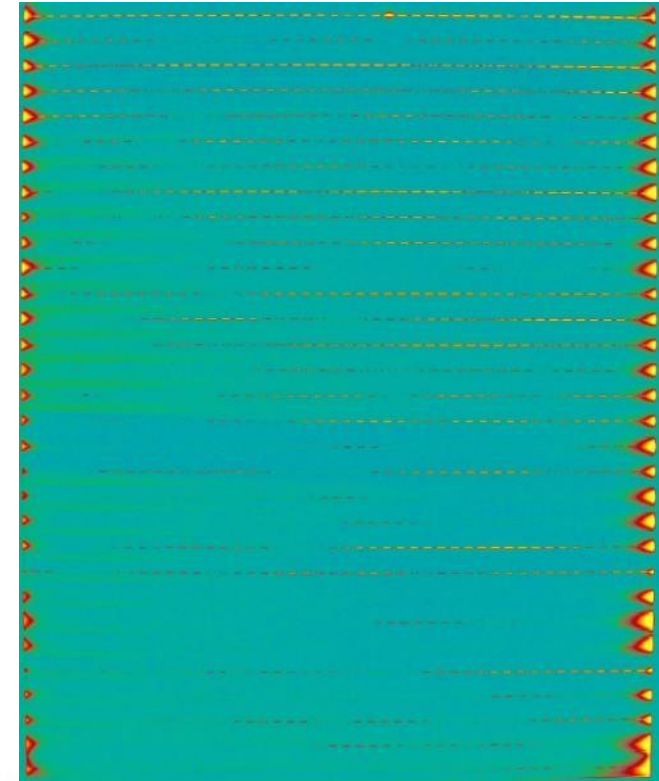
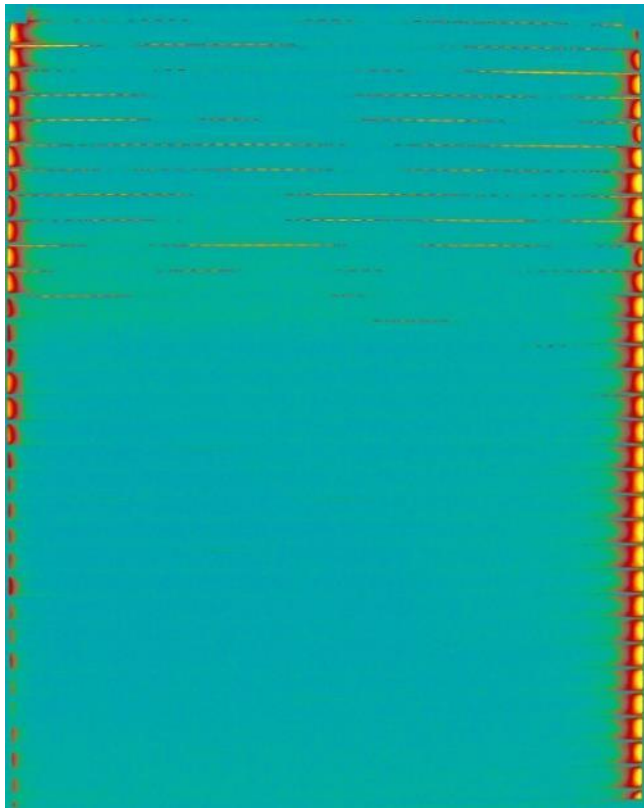


Qualitative Criteria & Tools

				Matlab	pvalue->gnu	Evalglare
Number of sources	small		High	per pixel only	per pixel only	ok, clustered
Style of Cluster	linear		Random	unknown	missing	missing
Luminance of source	small		High	ok	ok	ok
Luminance of Cluster	small		High	missing	missing	ok
...						

Matlab readhdr

Contribution from our intern Marco Bachmann

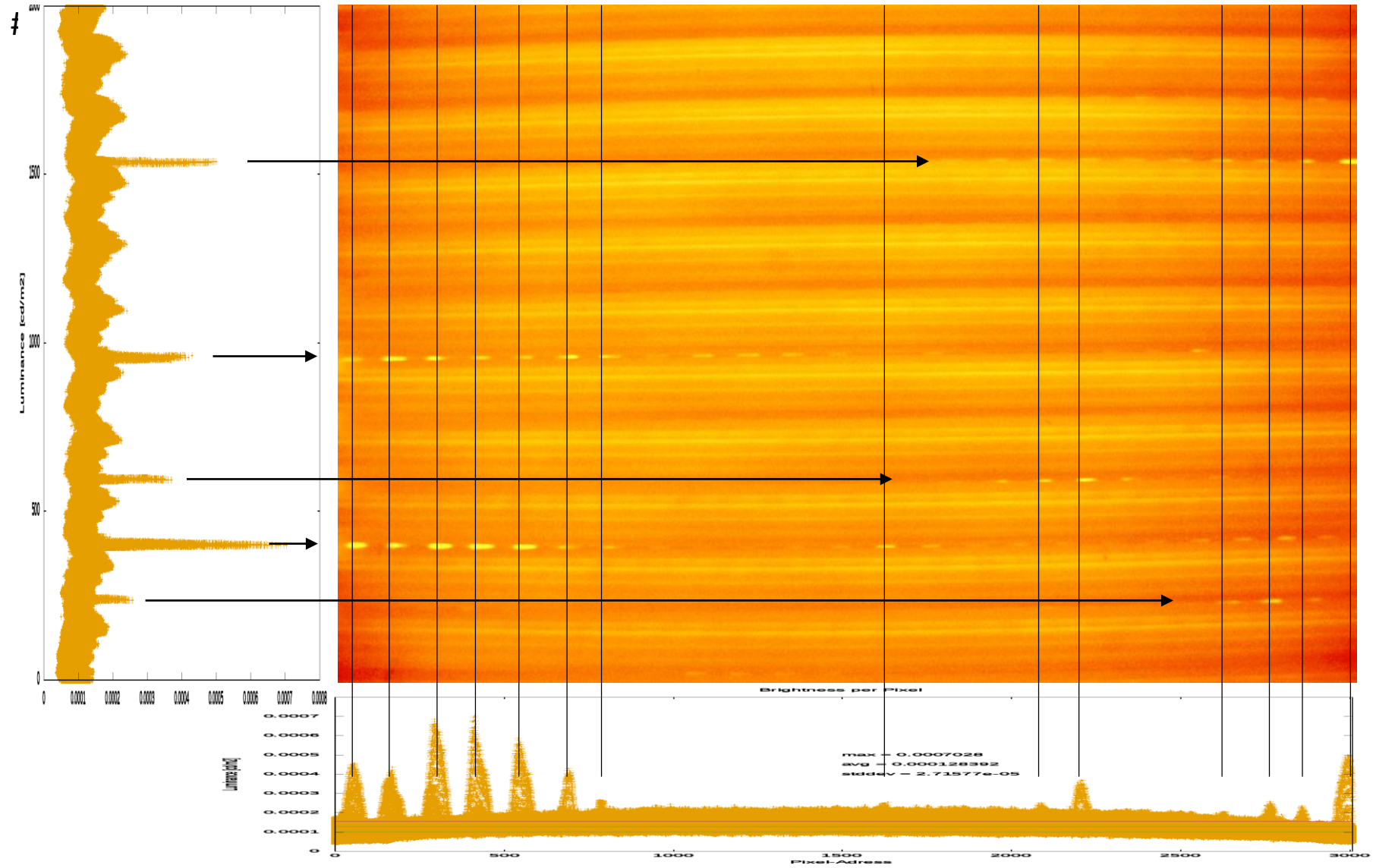


Pvalue - gnuplot

Using pvalue + gnuplot

```
pvalue -o -b -h -H hdr_in.hdr > data_out.txt
```

- Lars mailing list entry 2006



Evalglare

```
evalglare -f -A mask.hdr -d -b $b -r $r -i $evlx -c checkfile.hdr in.hdr > detail_output.dat
```

evalglare

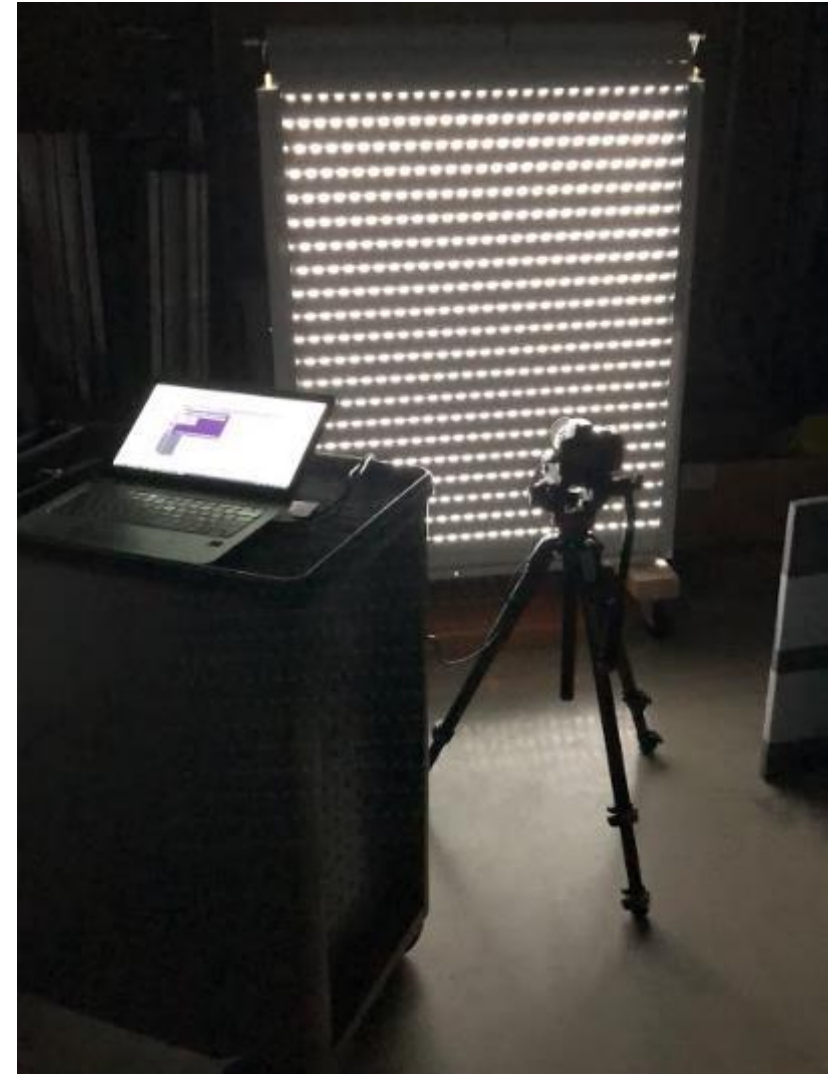
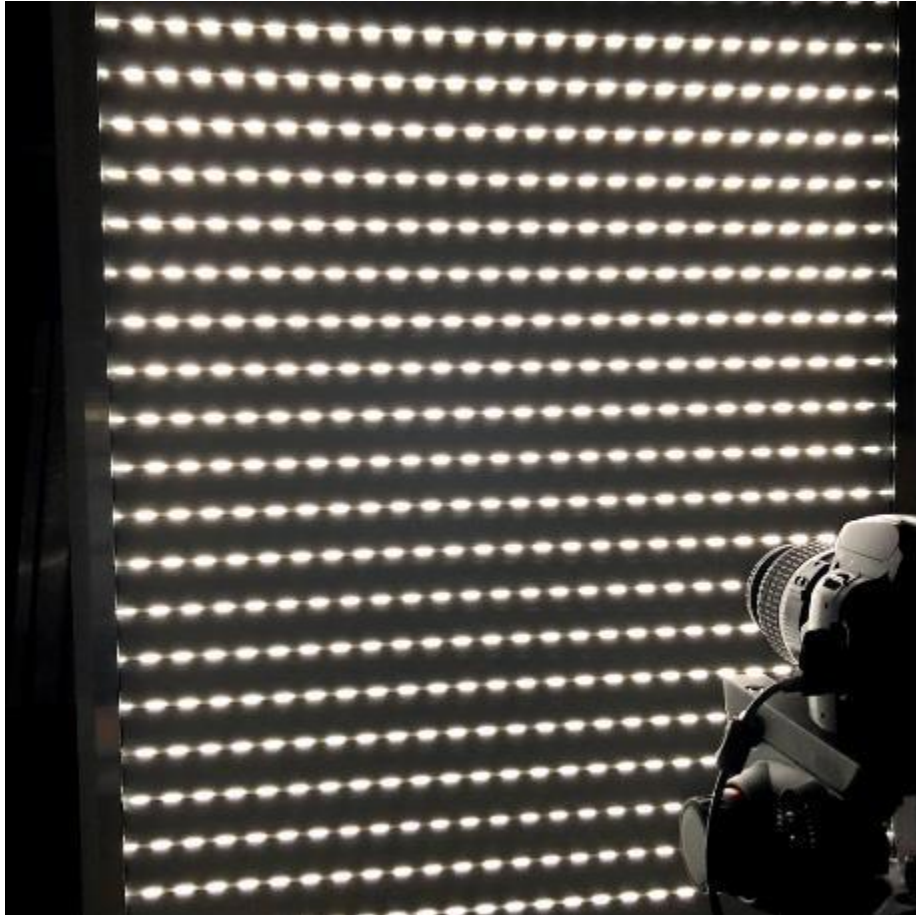
```
evalglare -f -A mask.hdr -d -b $b -r $r -i $evlx -c checkfile.hdr in.hdr > detail_output.dat
```

- f ... force to work on no-fisheye images and wrong headers
- A ... mask file (statistics on this area but no changes in source detection -> crop image for masking of source detection algorithm)
- d ... enables output of source description -> piped into a *.dat file
- b ... multiplier of source above mean luminance
- i ... measured vertical illuminance – in our application below measurement threshold 0.1
- c ... enables the generation of the *.hdr showing the sources color shaded

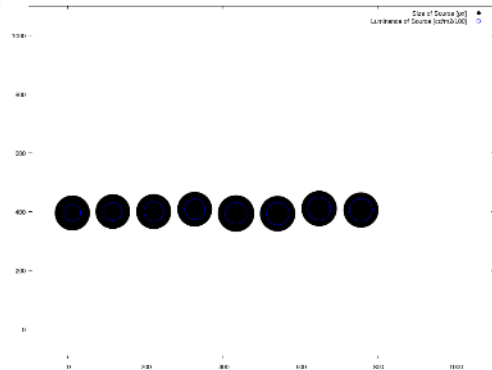
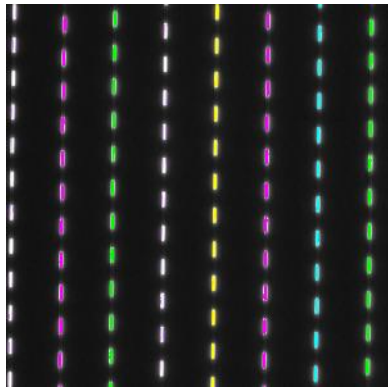
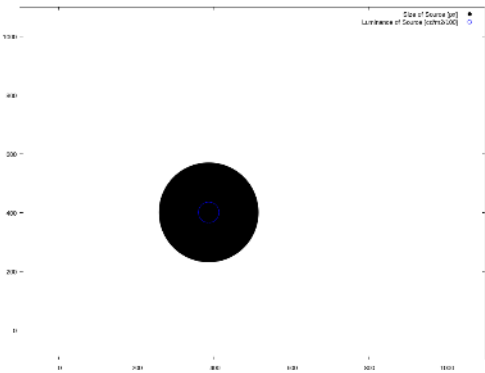
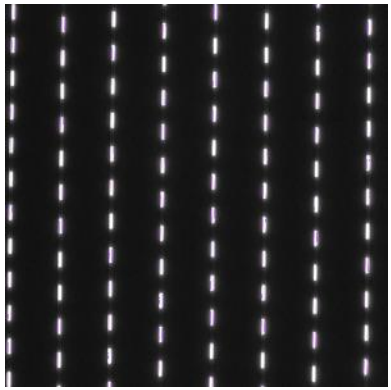
Parameter setting b & r

Stretched shutter = visible punch holes

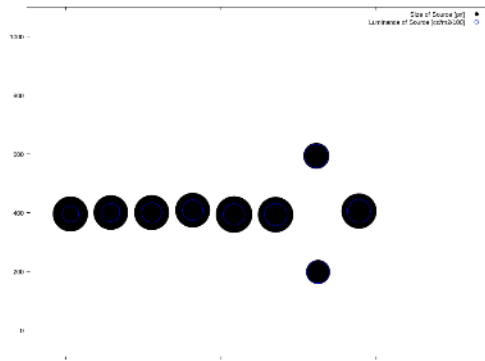
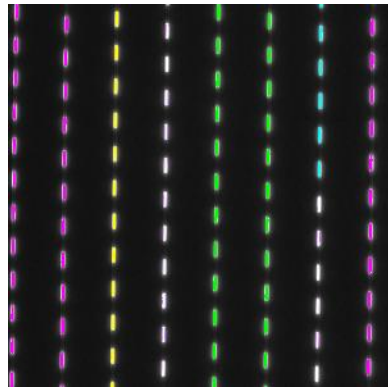
Two types of slats (52 mm & 37 mm)



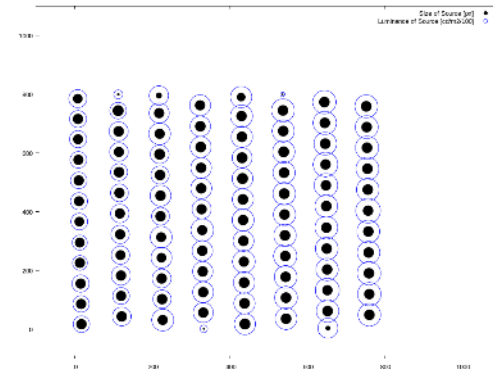
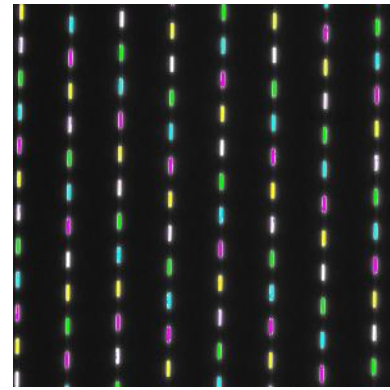
K52 slat



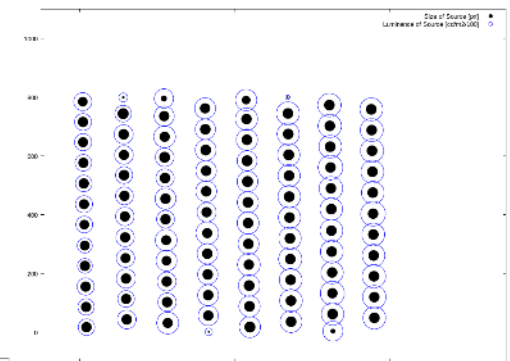
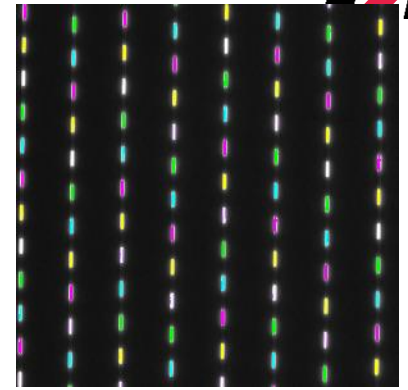
-b 2 -r 0.2



-b 2 -r 0.05



-b 2 -r 0.02



-b 2 -r 0.01

K52 closed with artefacts
Peaks approx. 55pixel in x &
9 pixel in y-direction

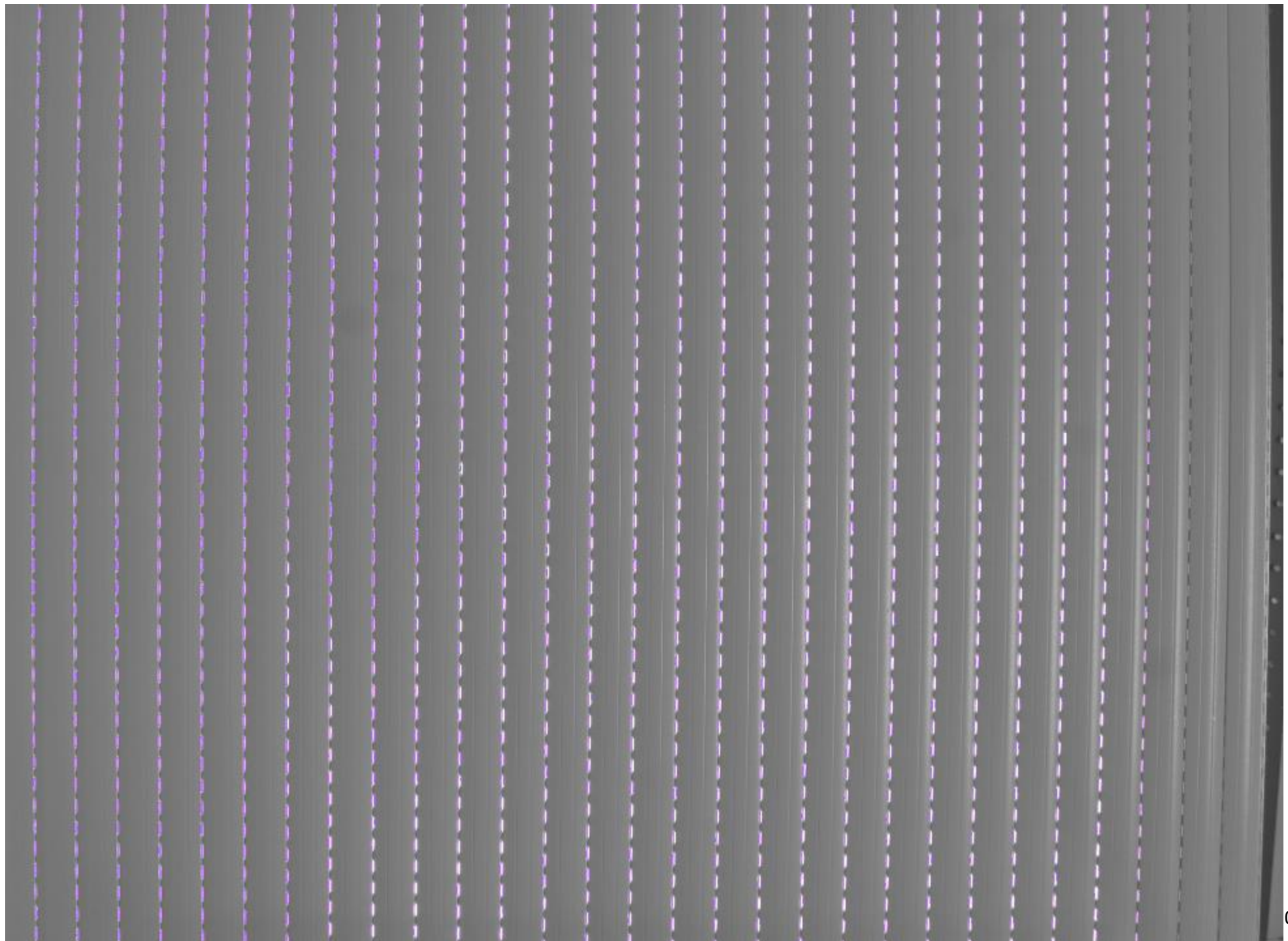
@3x2Megapixel Resolution

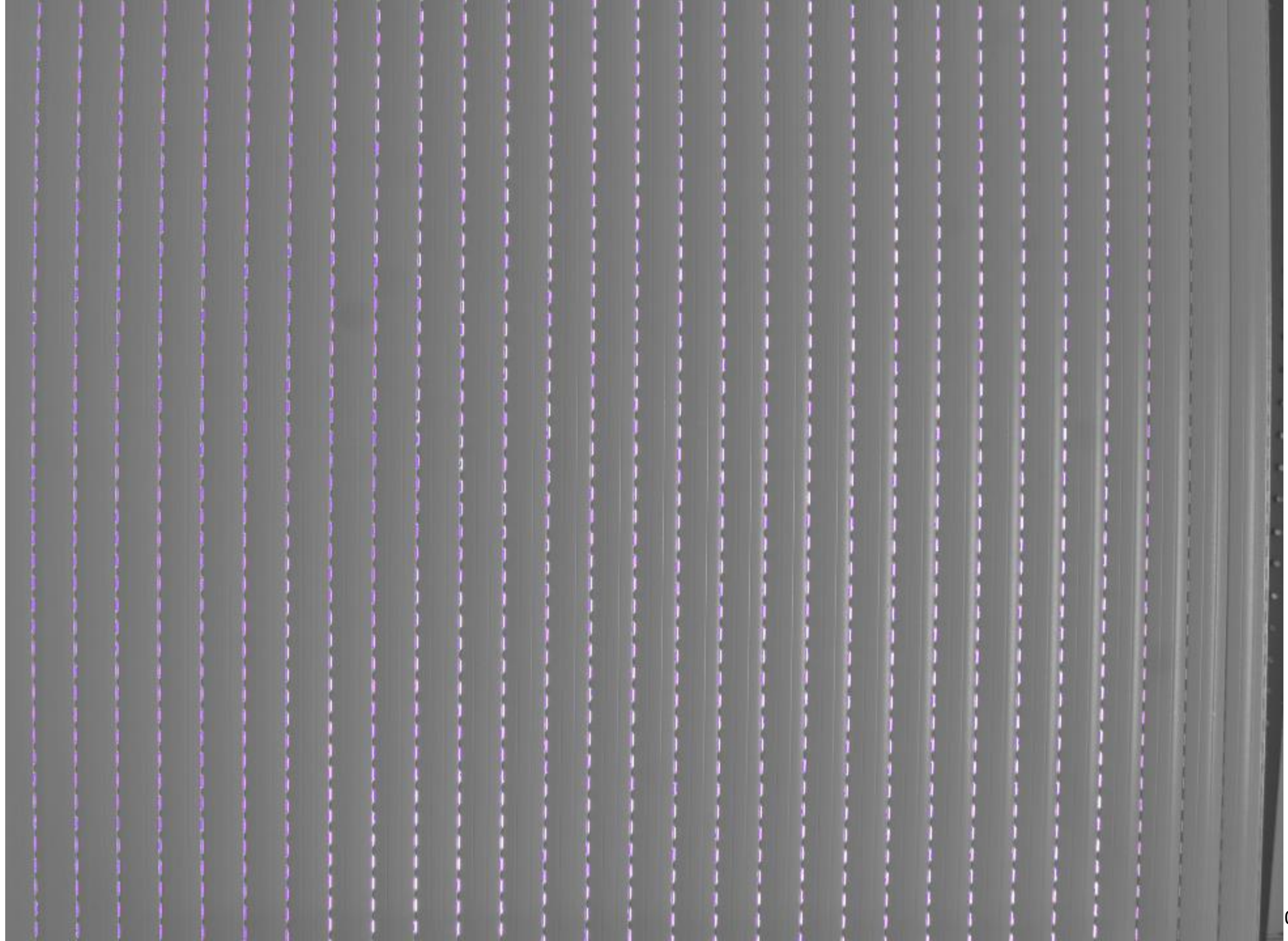


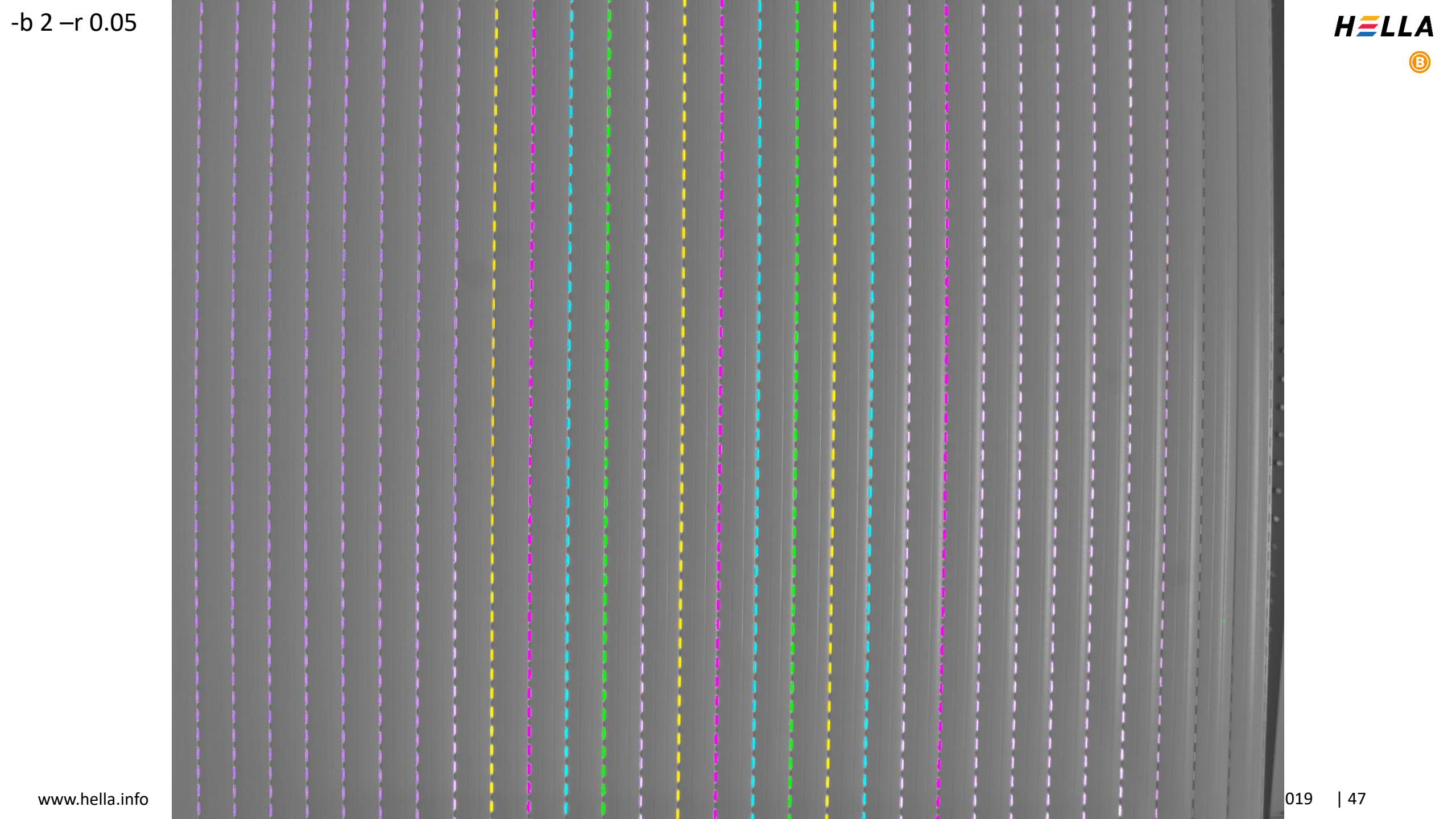
Indication:

$55\text{pixel/peak} / 3000\text{pixel}/66^\circ = \sim 0.021\text{rad/peak}$ in x-direction
 $9\text{pixel/peak} / 2000\text{pixel}/47^\circ = \sim 0.004\text{rad/peak}$ in y-direction

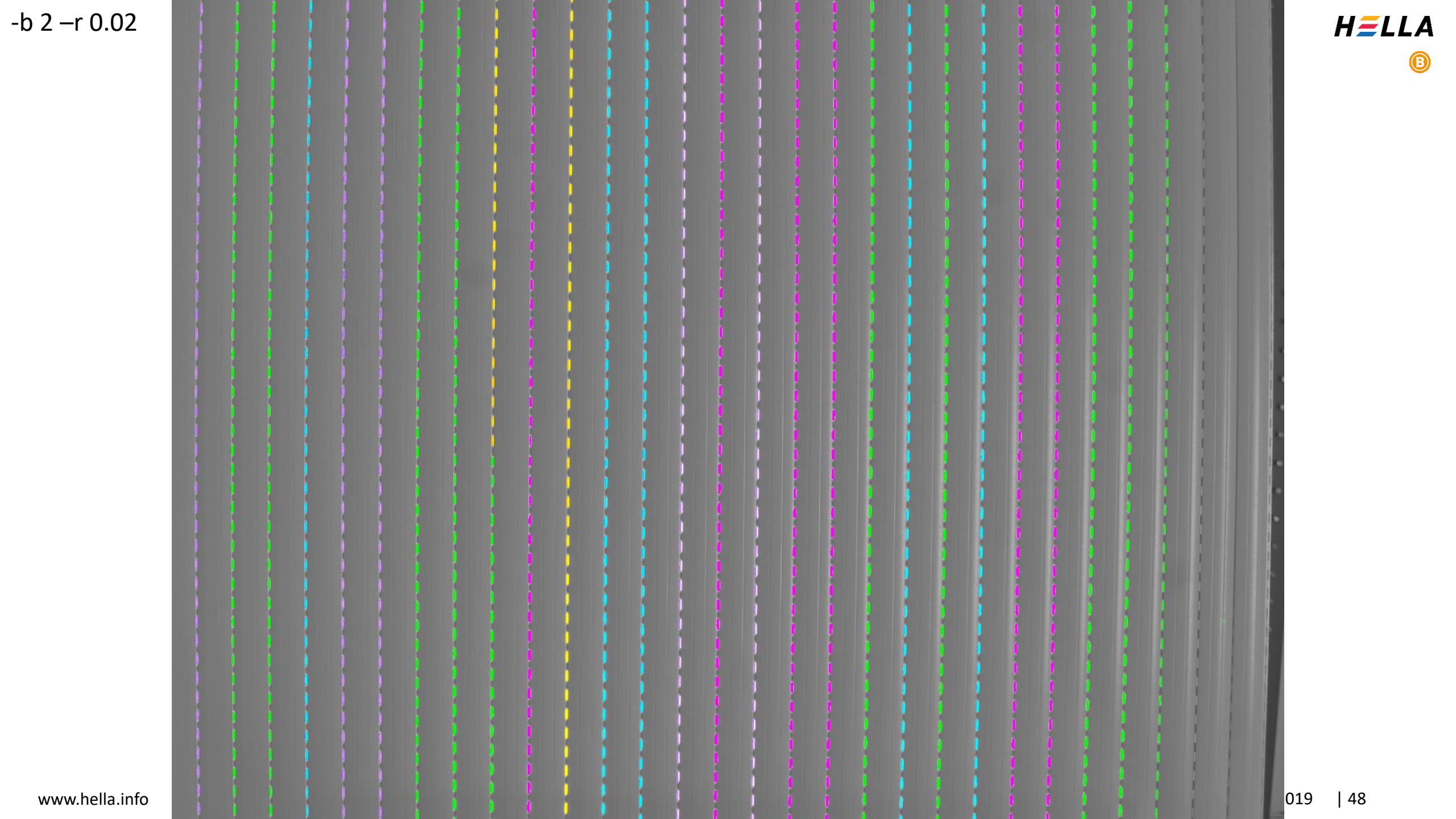
A37 slat



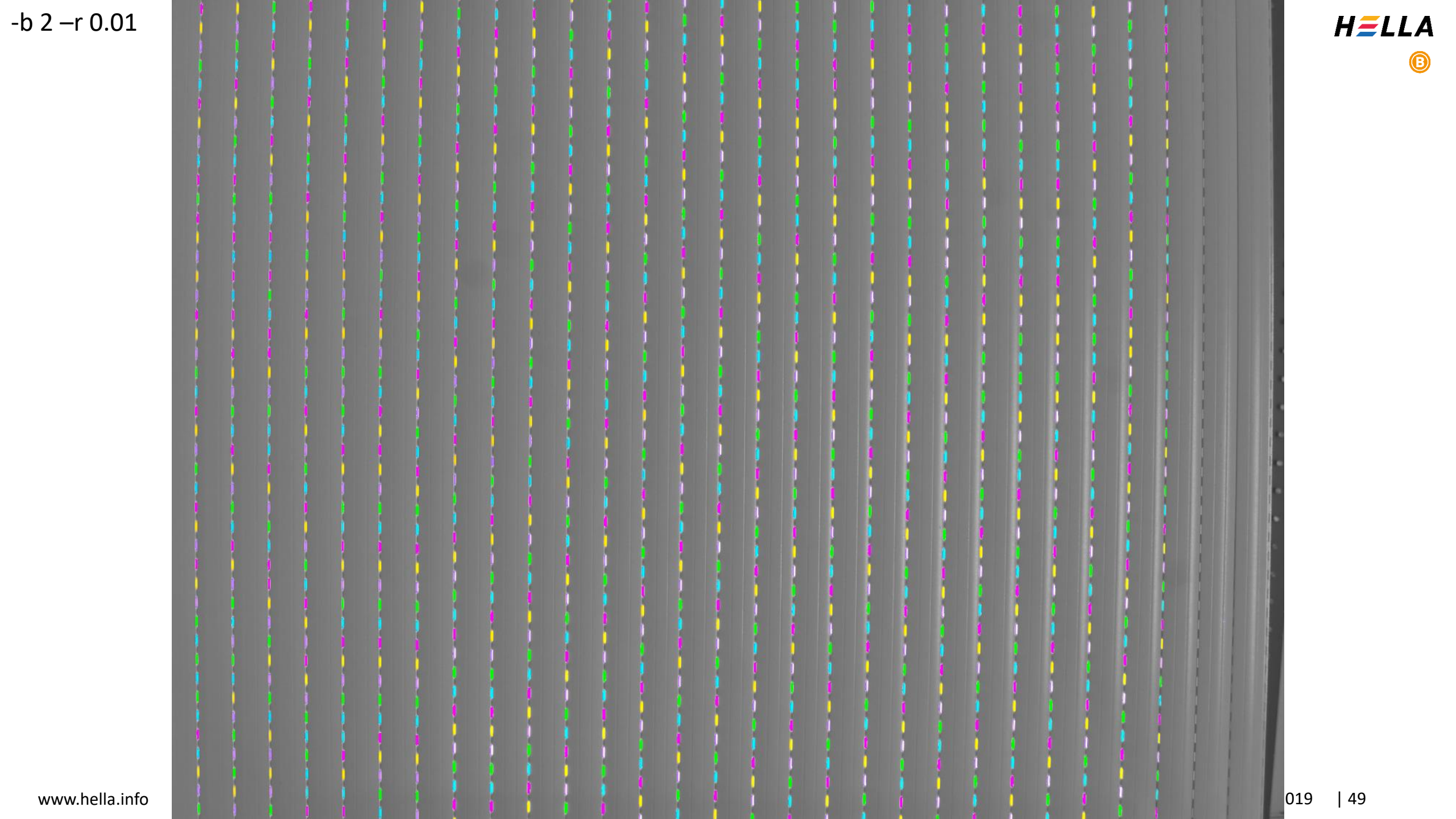




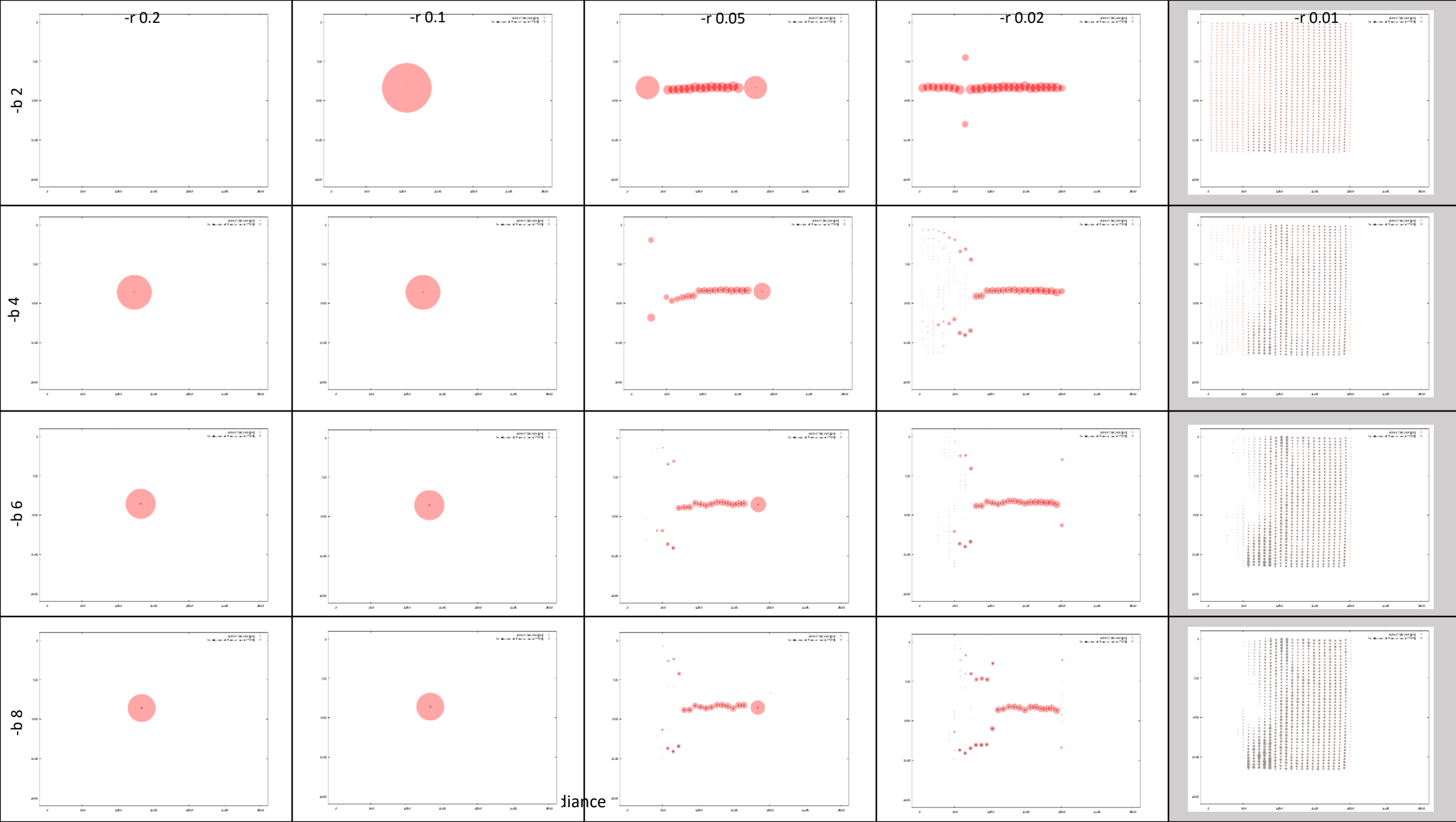
-b 2 -r 0.05



-b 2 -r 0.02



-b 2 -r 0.01



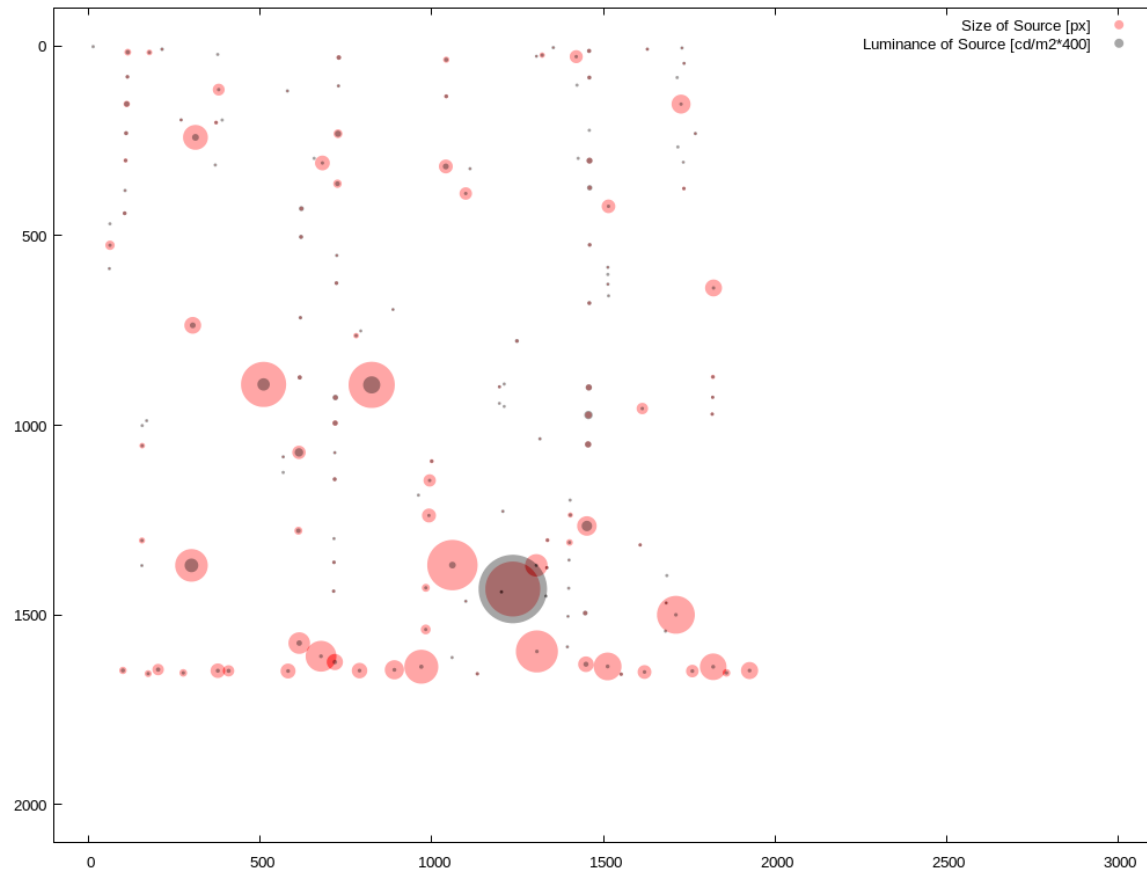
ISO setting

ISO 800 or 1600

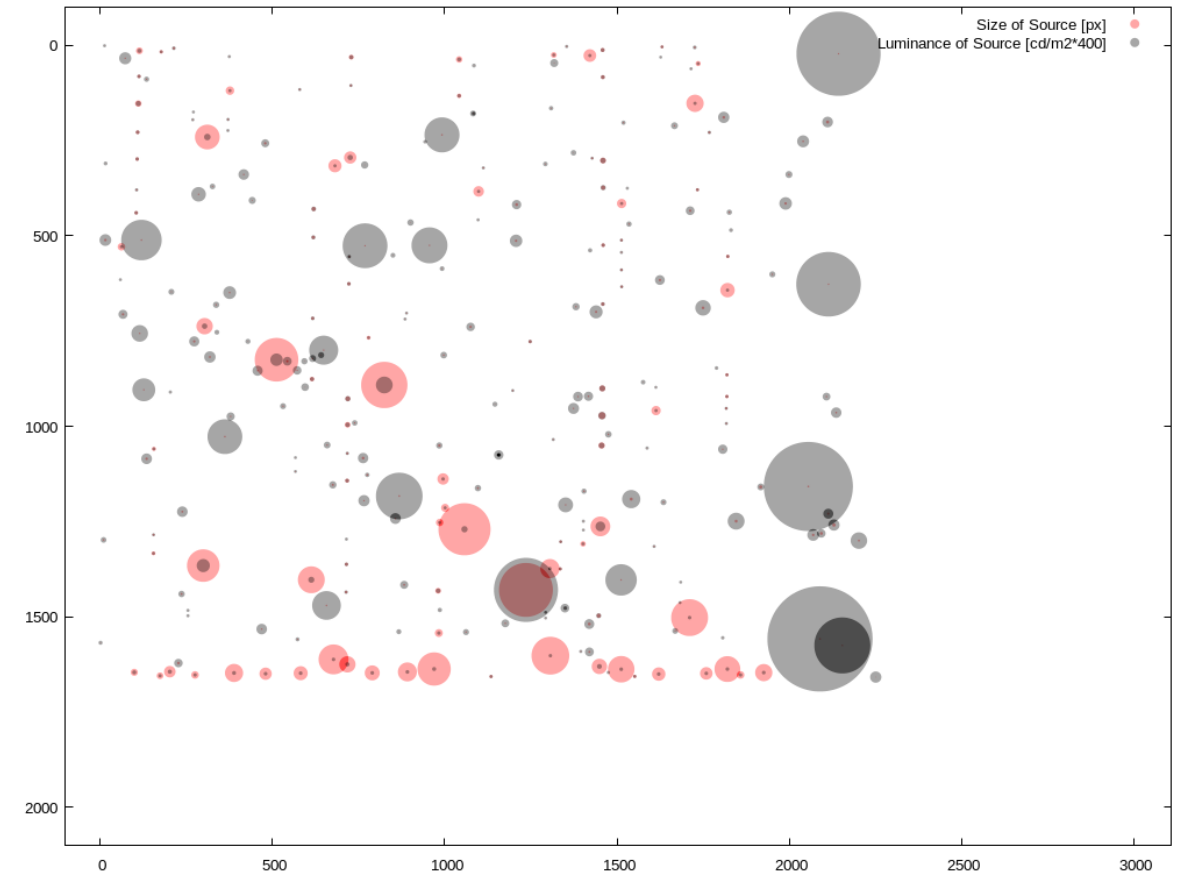
-b 2 -r 0.02

Session K52 7

ISO 800



ISO 1600



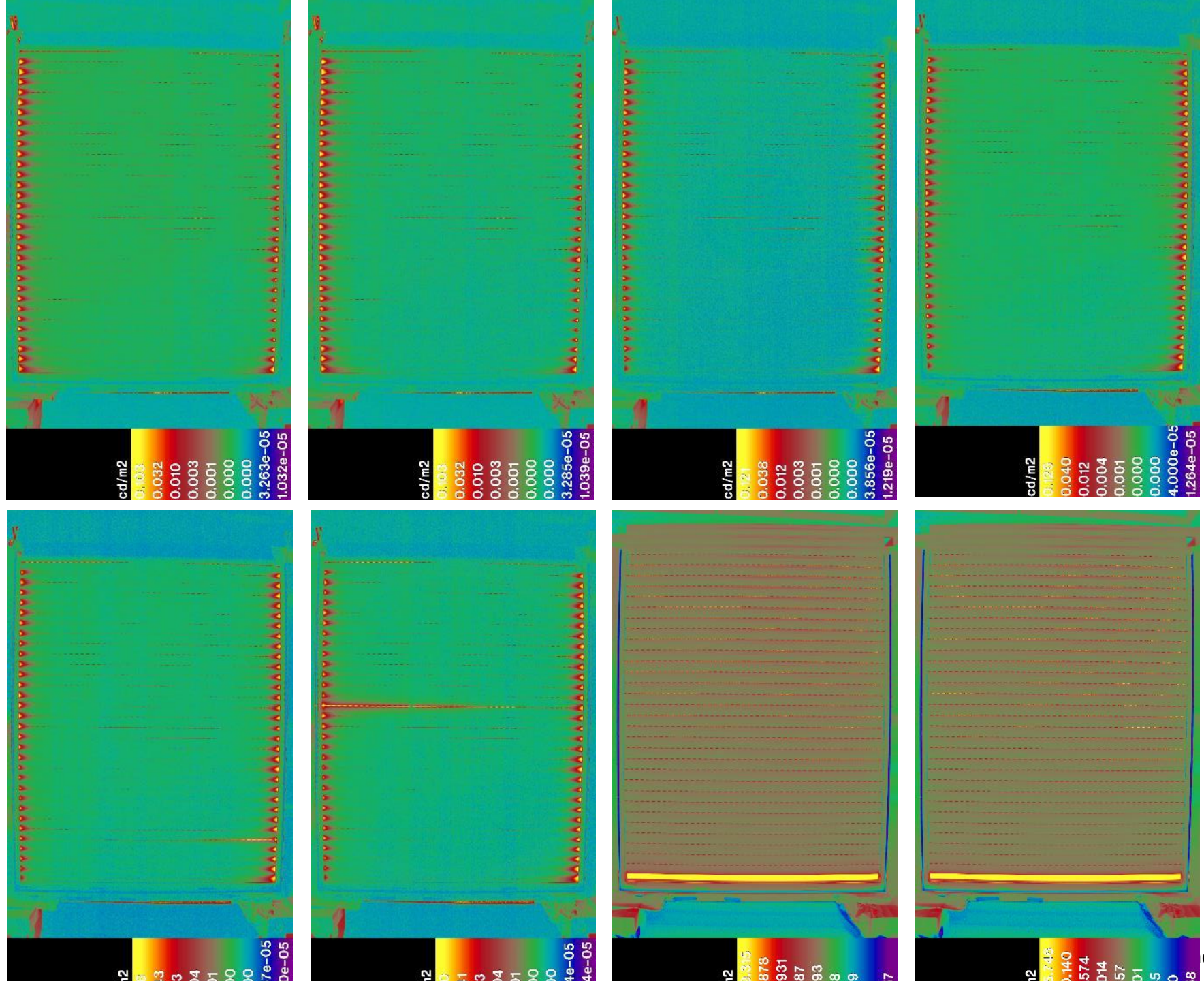
Test series



A37

series of 8

A37 1 – 8
800



A37 – mask result

Output of evalglare mask algorithm

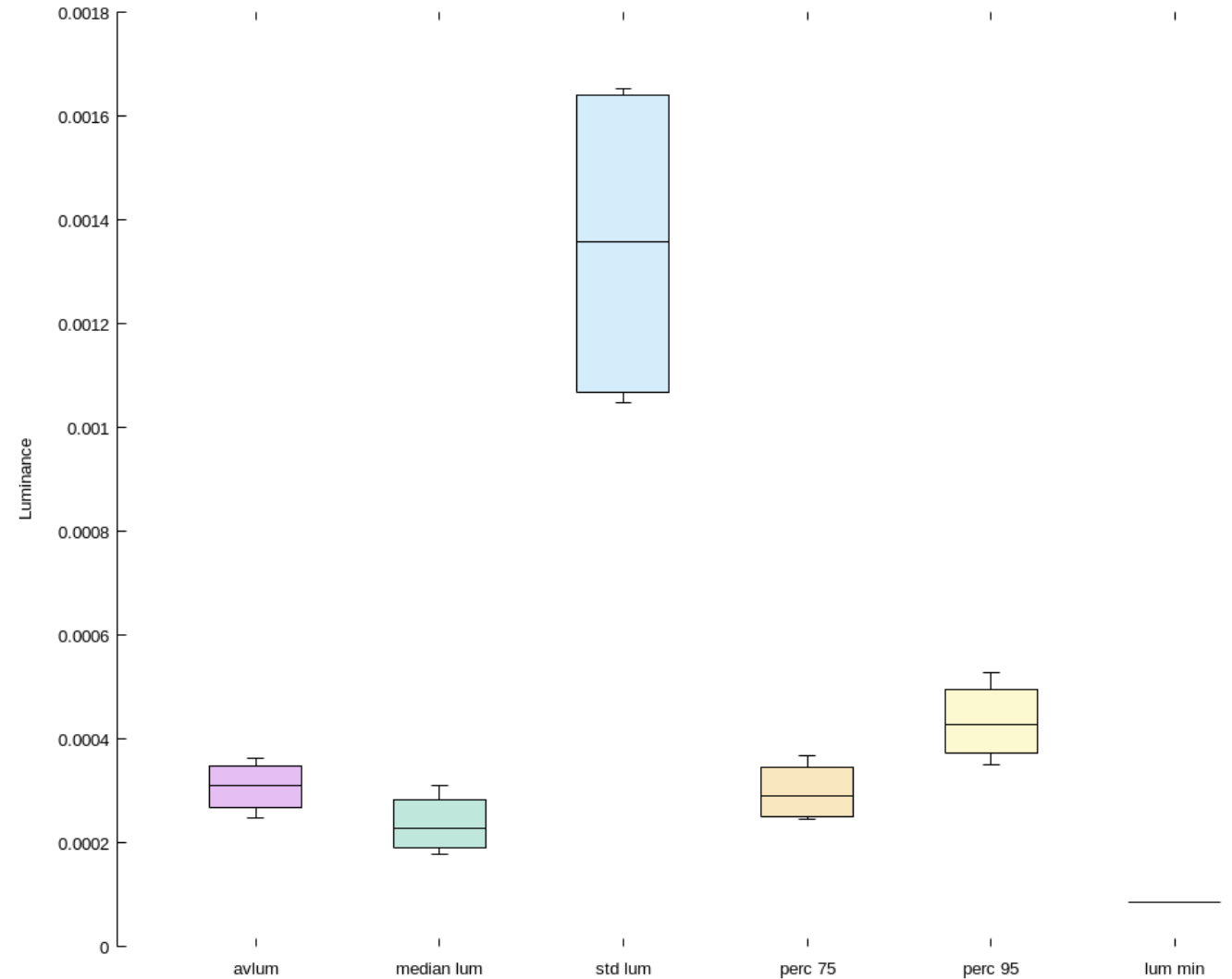
mask = full image, which was cropped beforehand

4 Series

Identical shutter

Moving between measurements

Too early too show real statistic

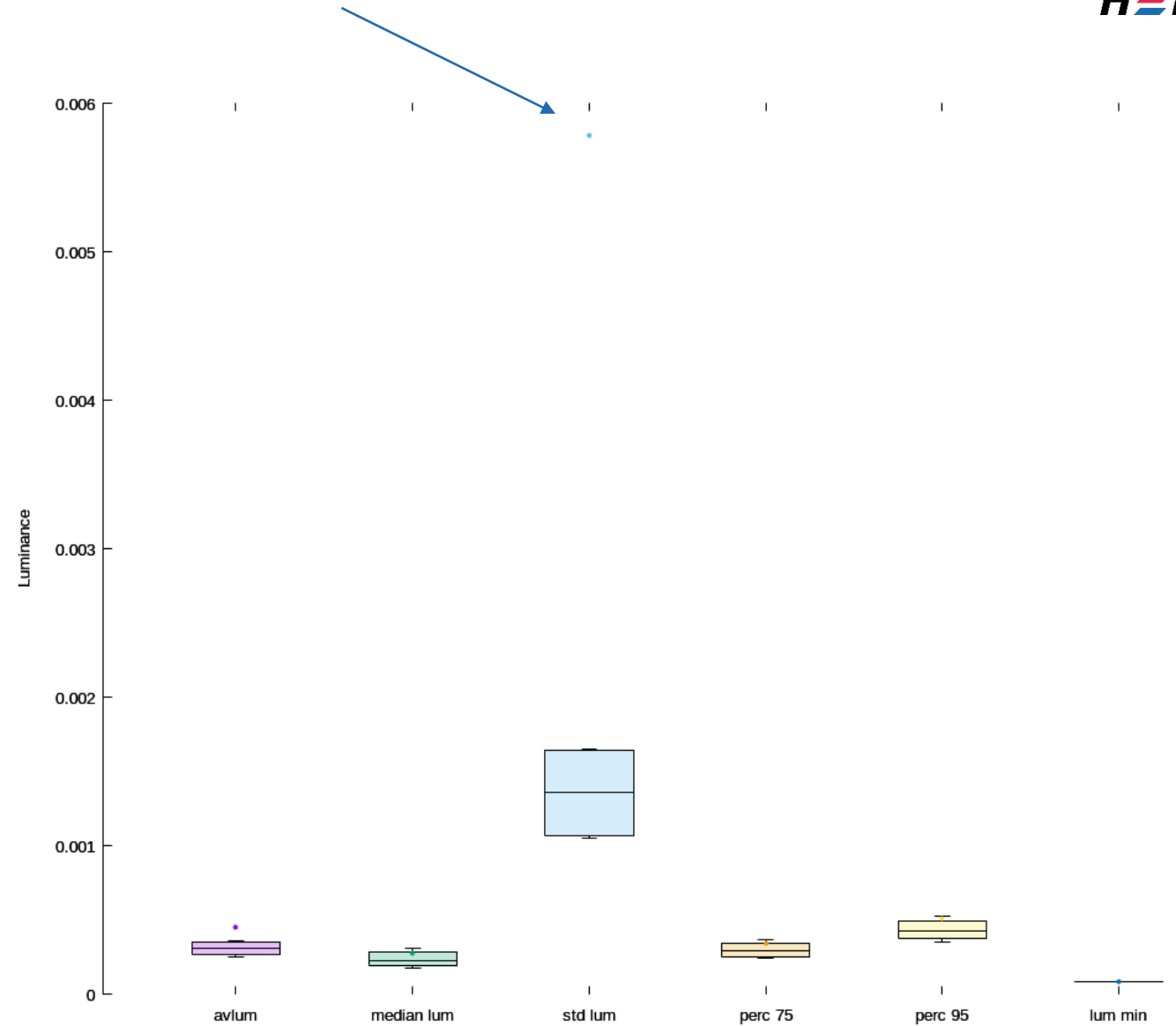


A37 – manipulated

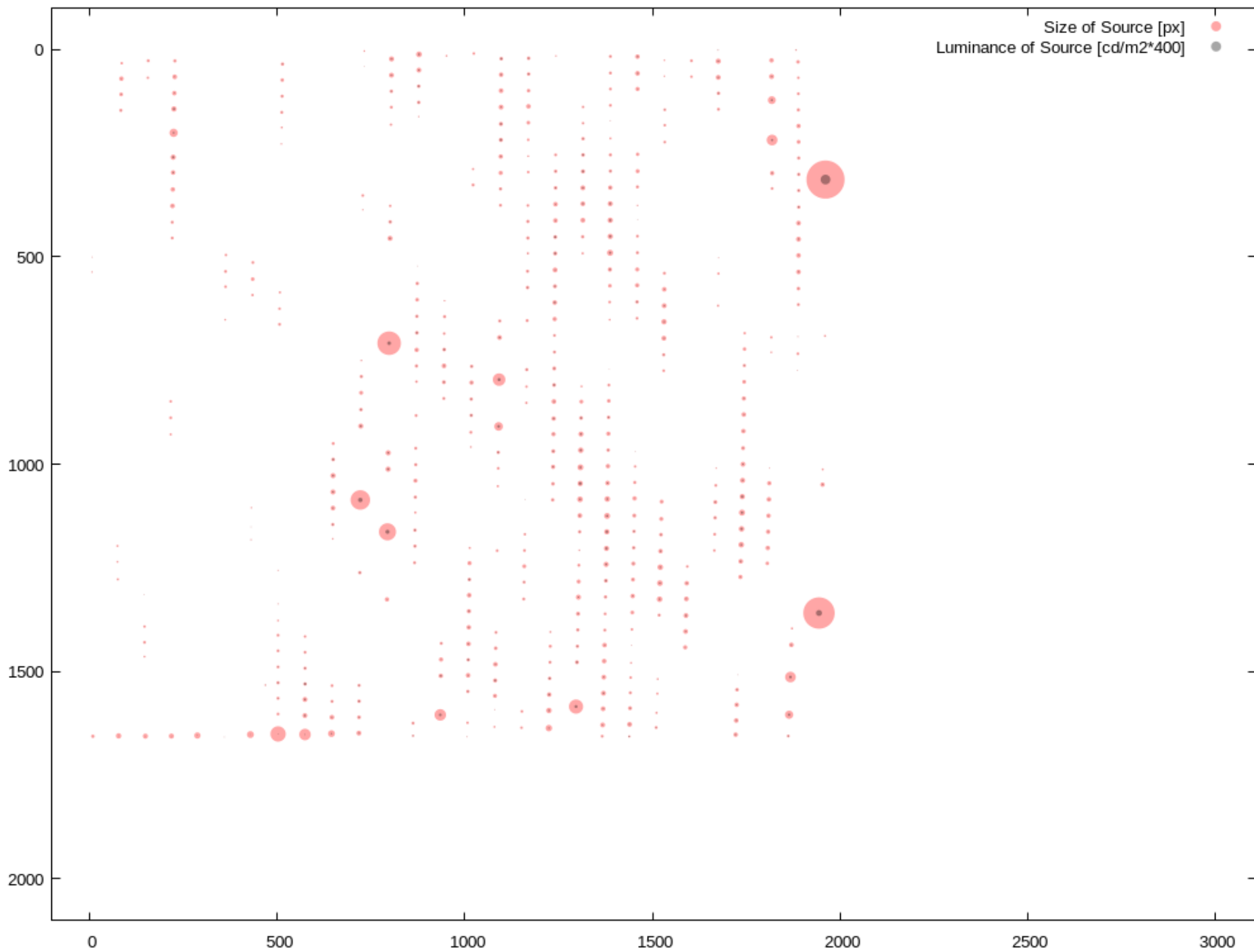
Output of evalglare mask algorithm

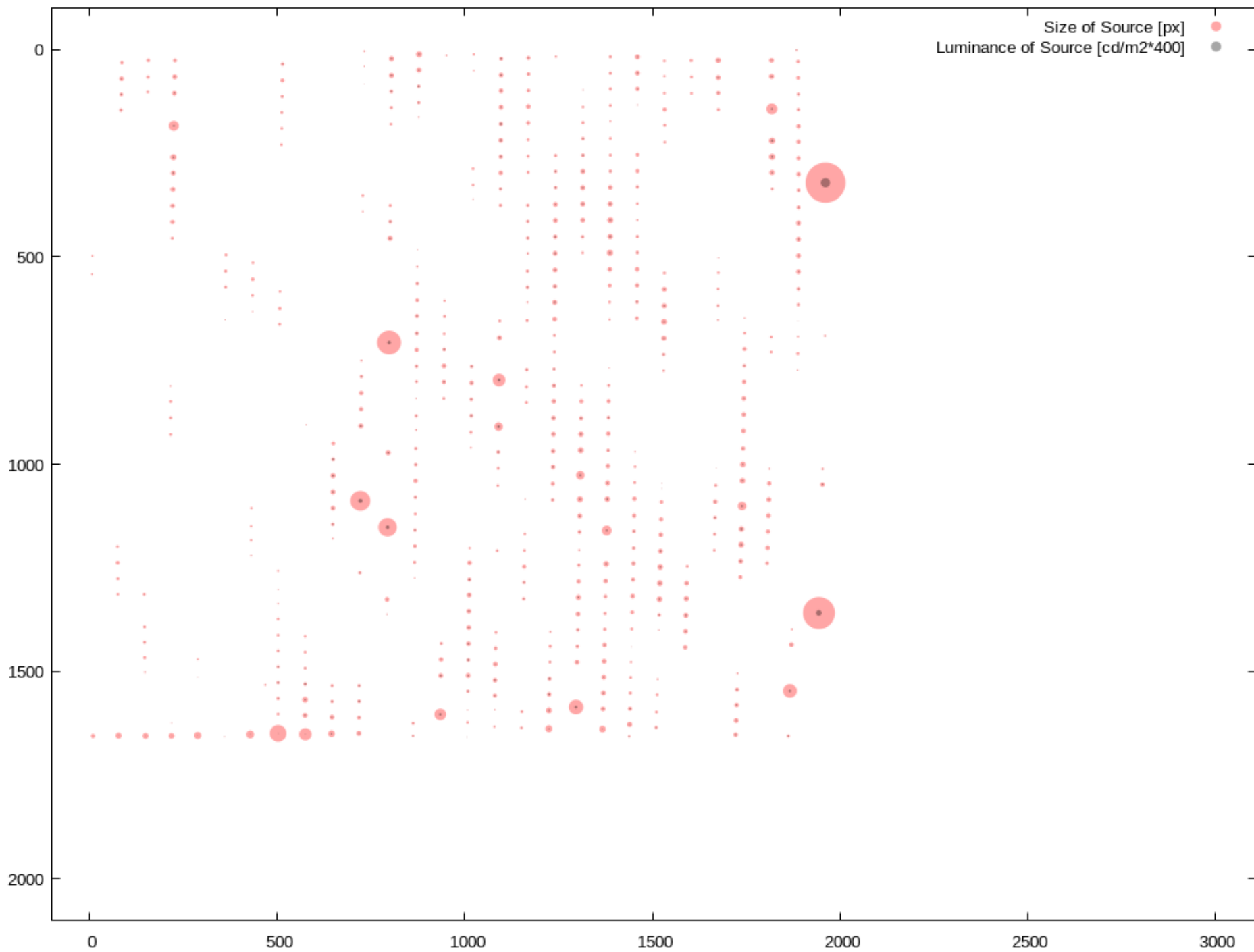
mask = full image, which was cropped beforehand

std_lum changes most



A37 1
- b 6 - r 0.01

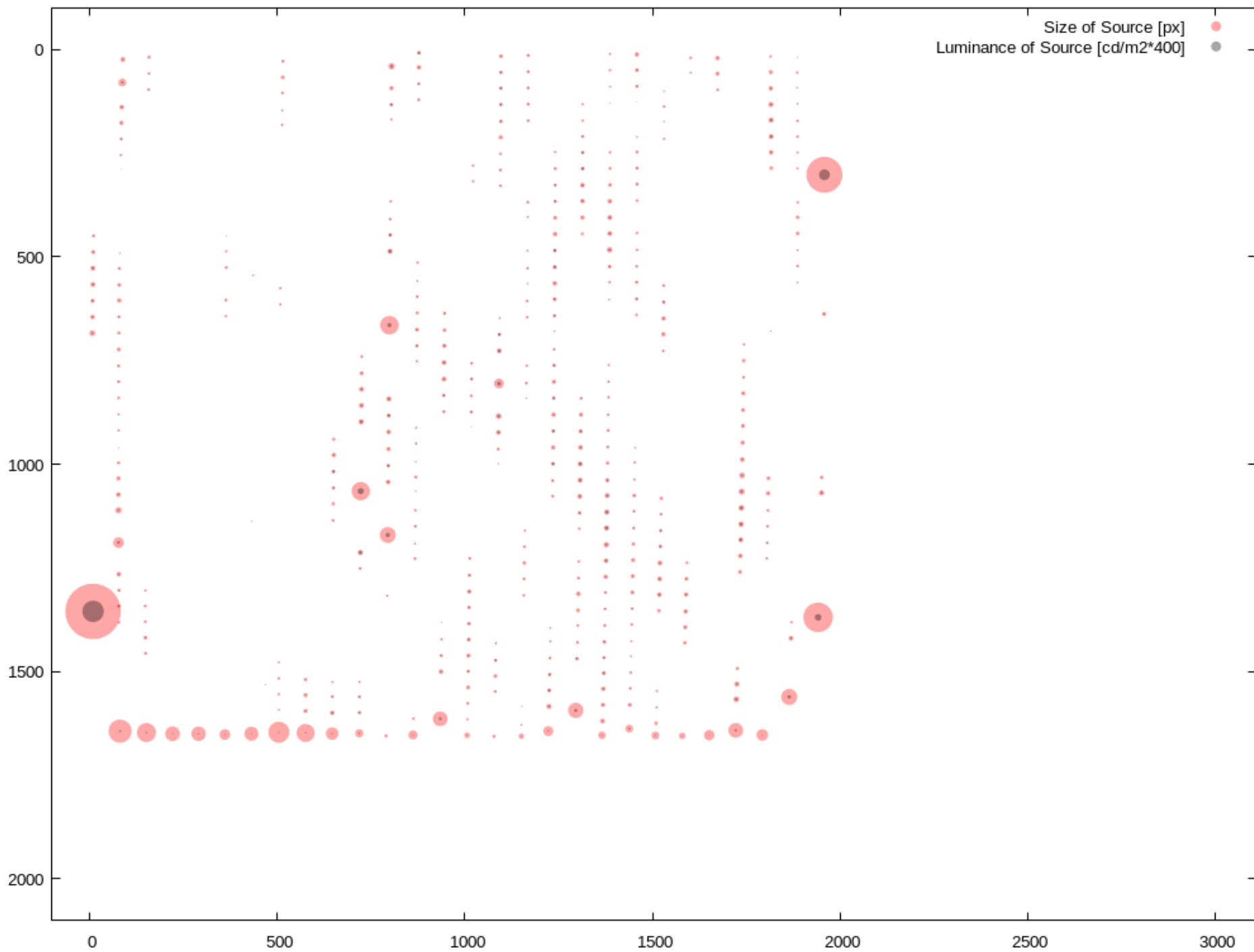




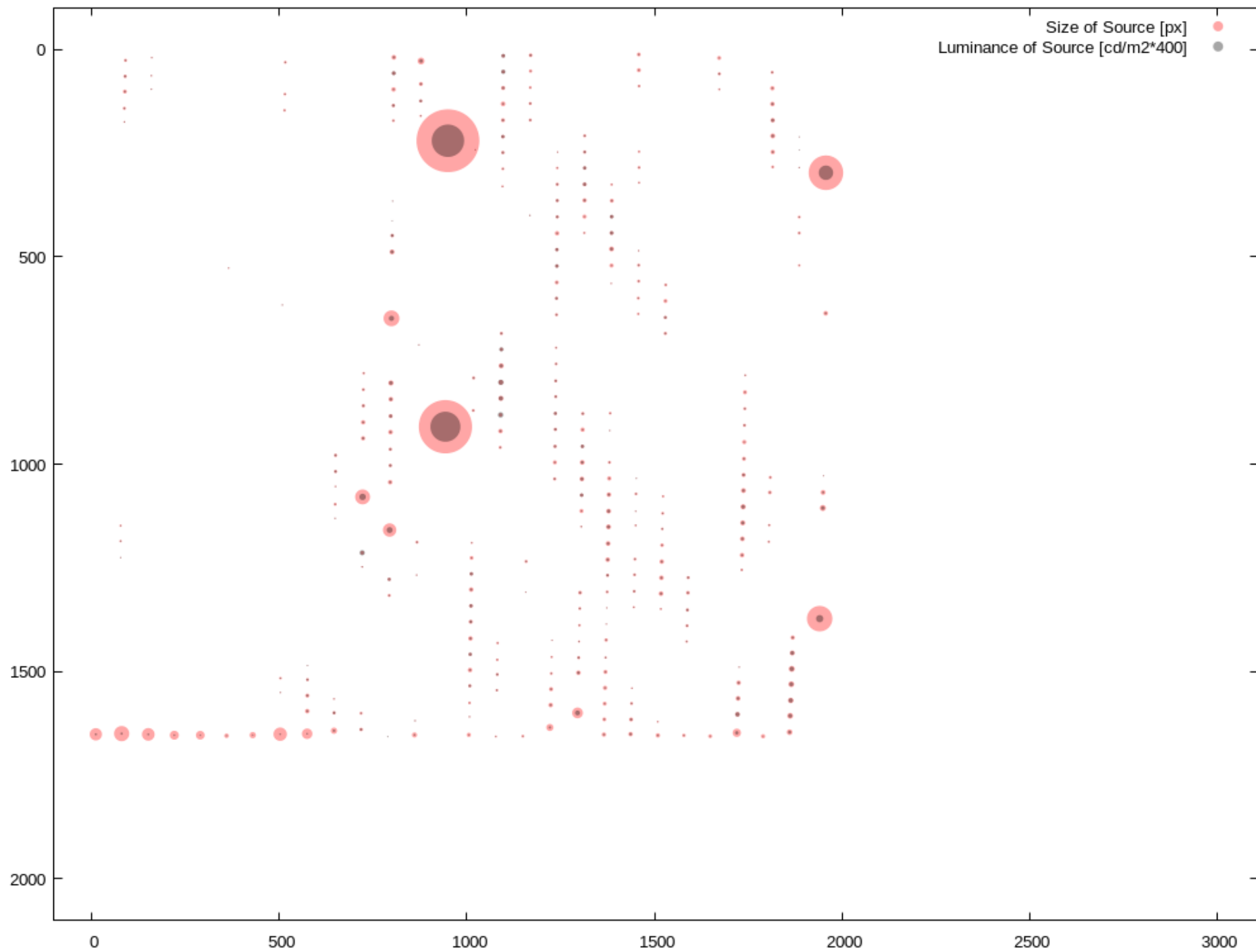
A37 3
- b 6 -r 0.01

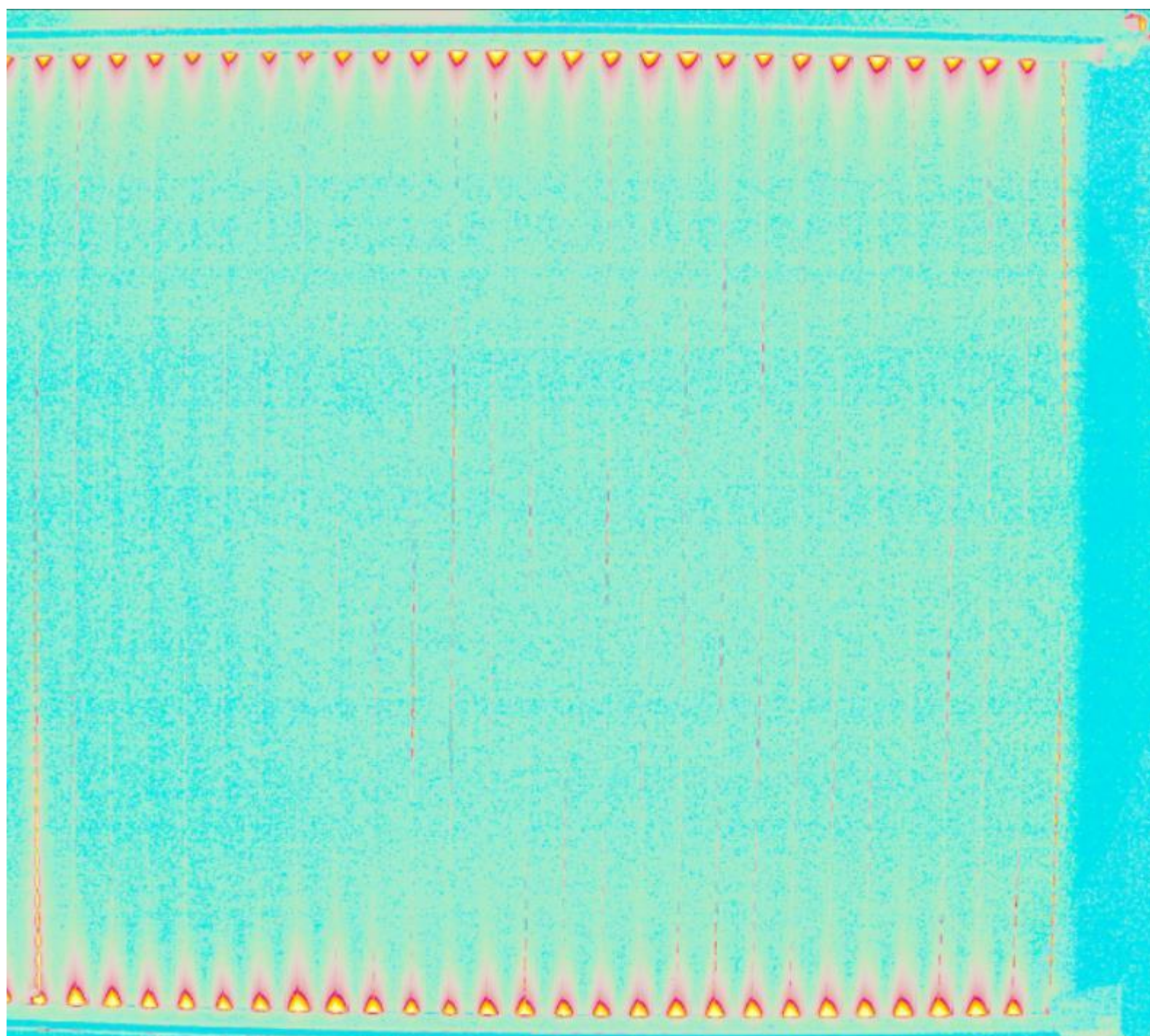


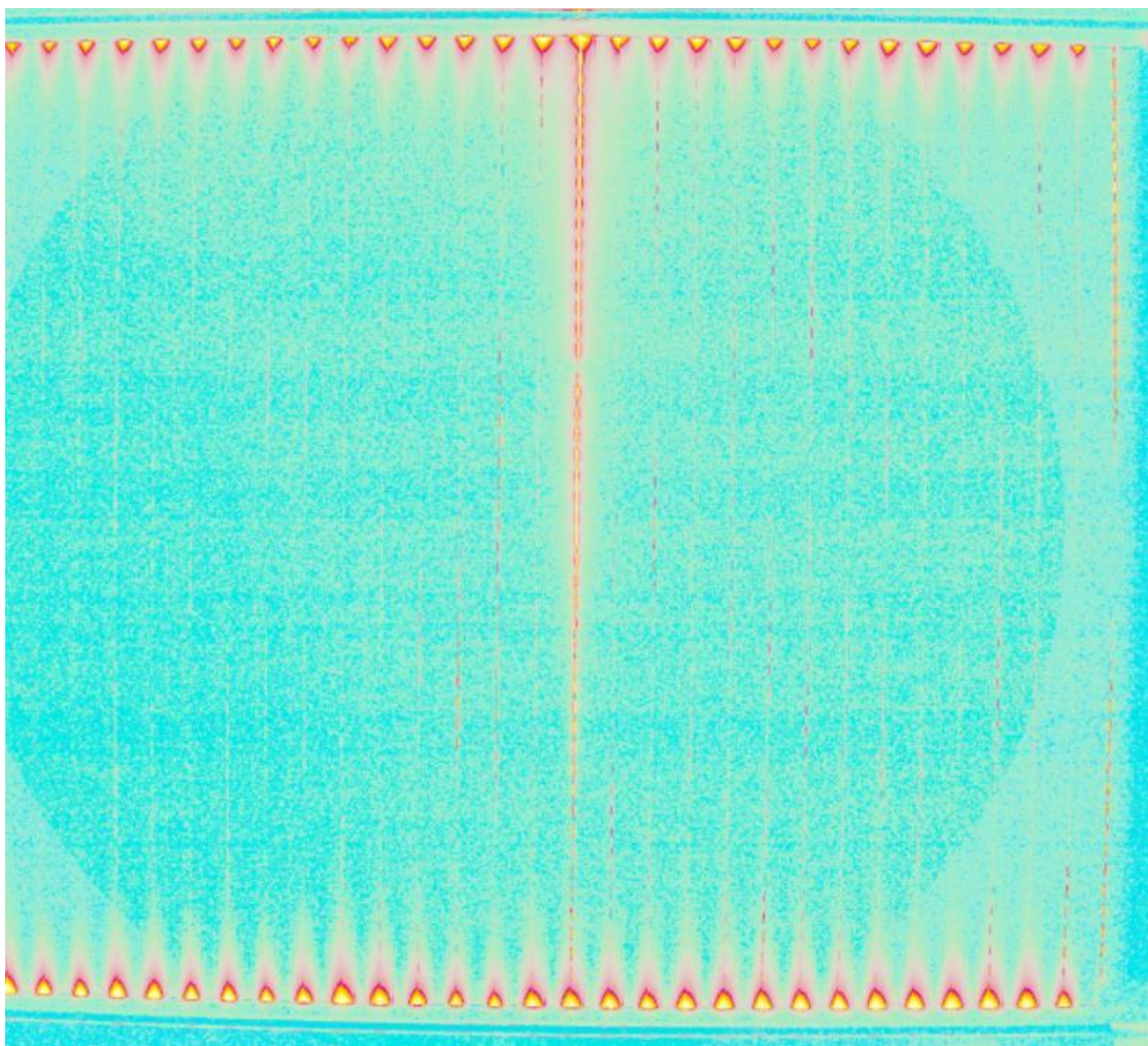
A37 5
- b 6 - r 0.01



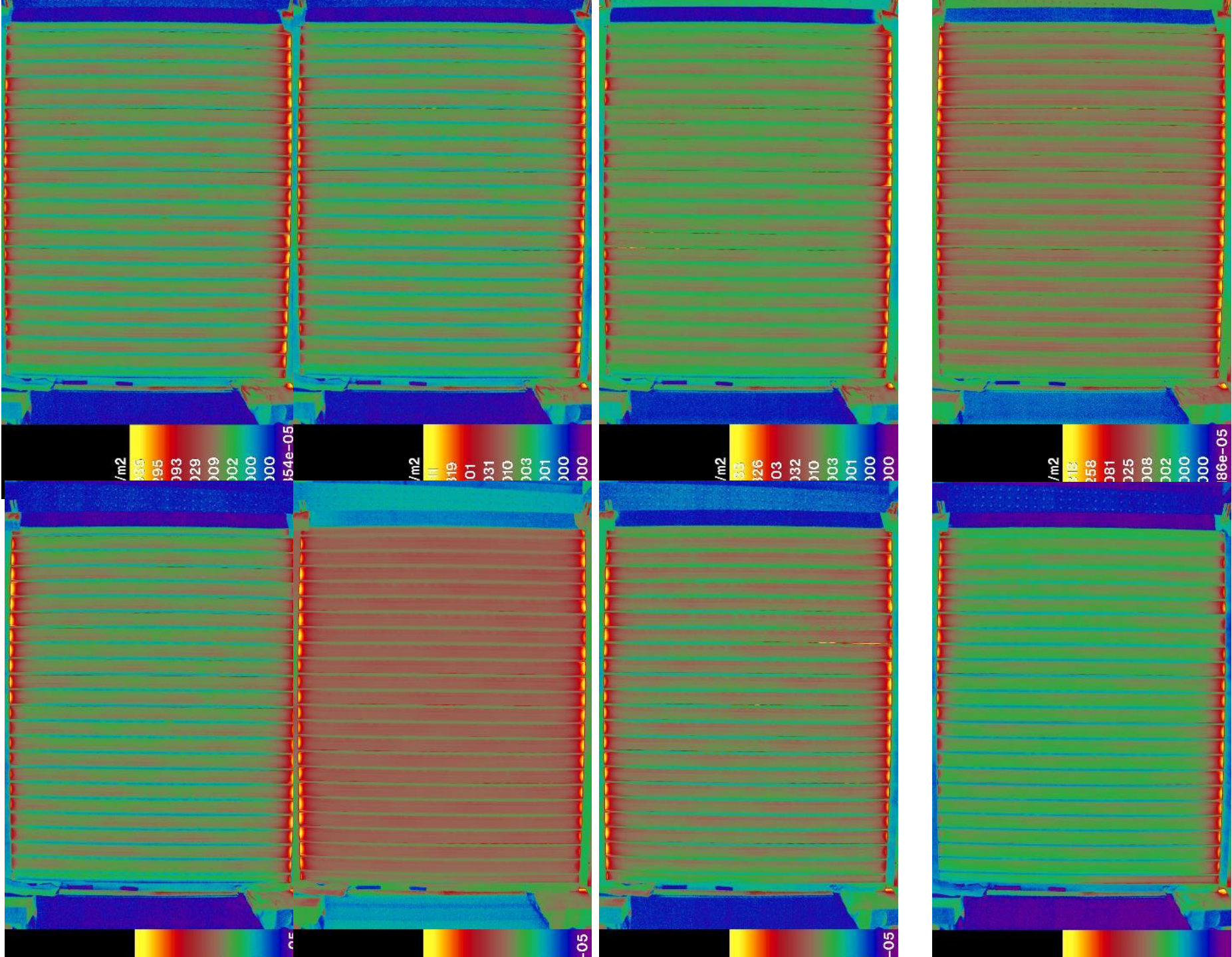
A37 6
- b 6 - r 0.01

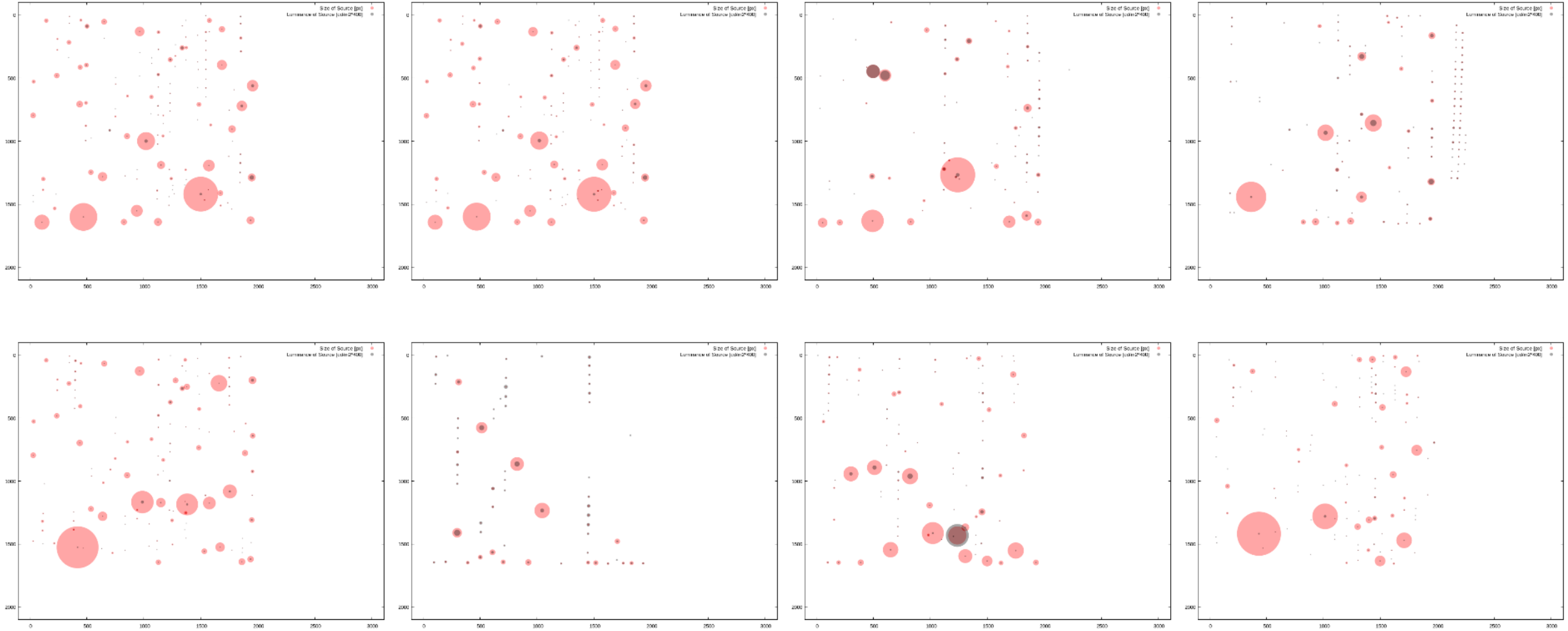




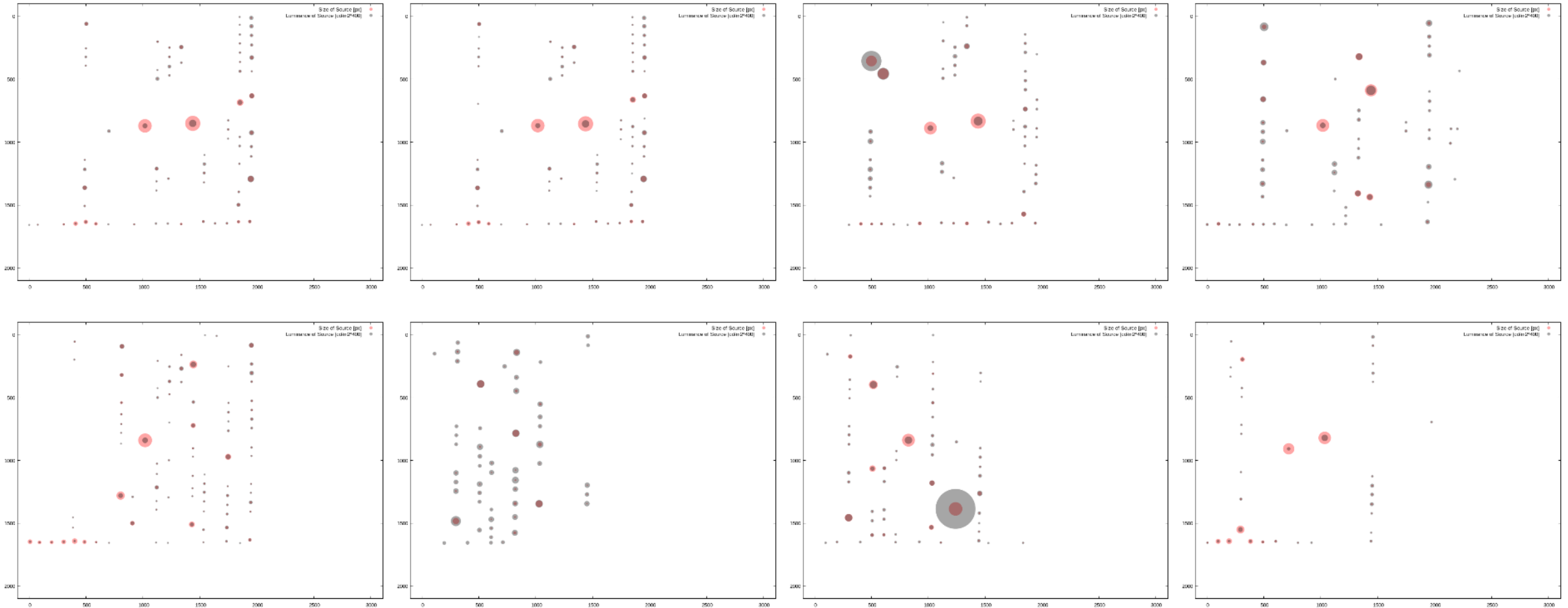


K52



$-b \ 2 - r \ 0.02$ 

$-b\ 4 - r\ 0.02$



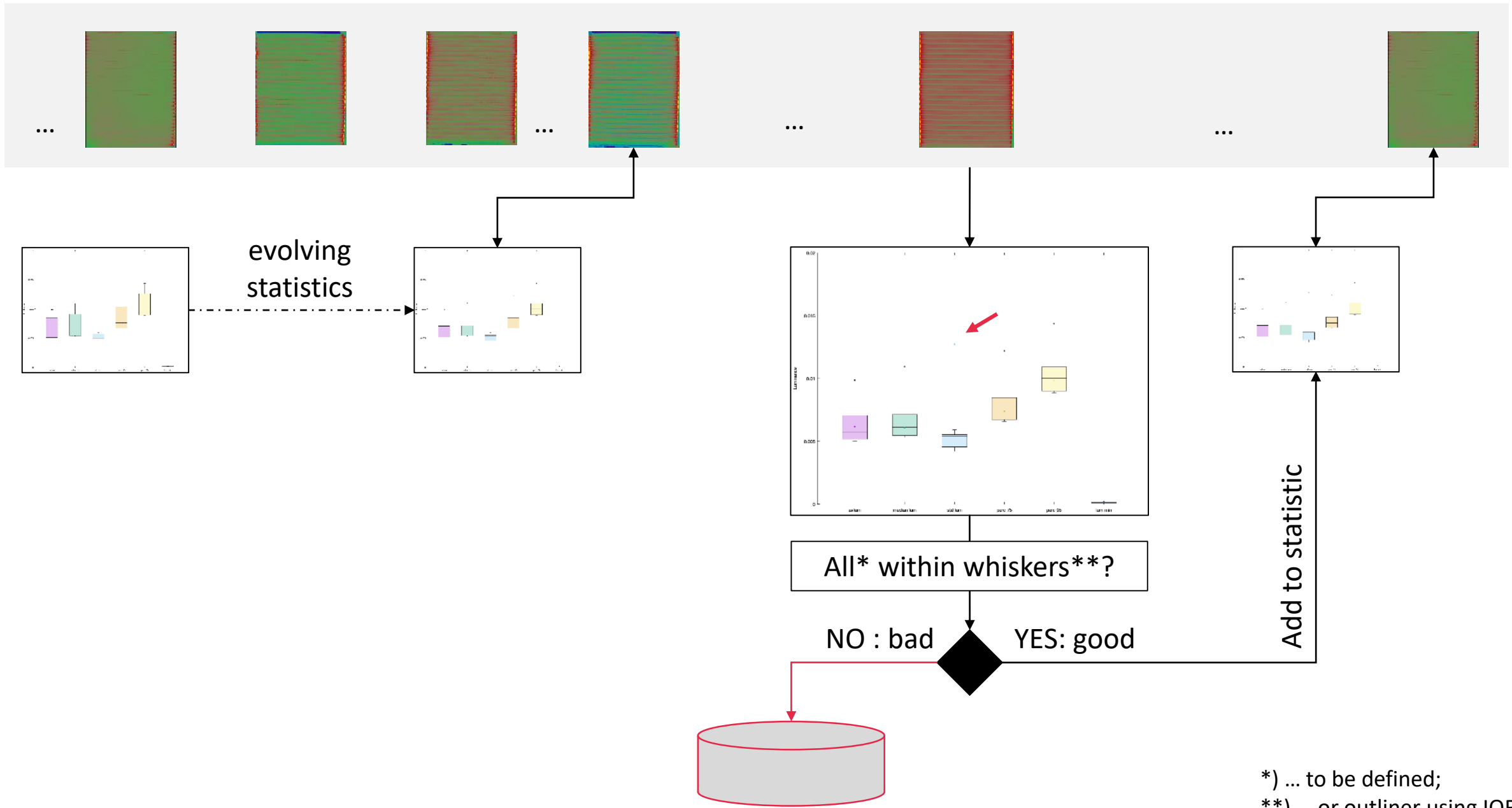
Result

Assessment Result

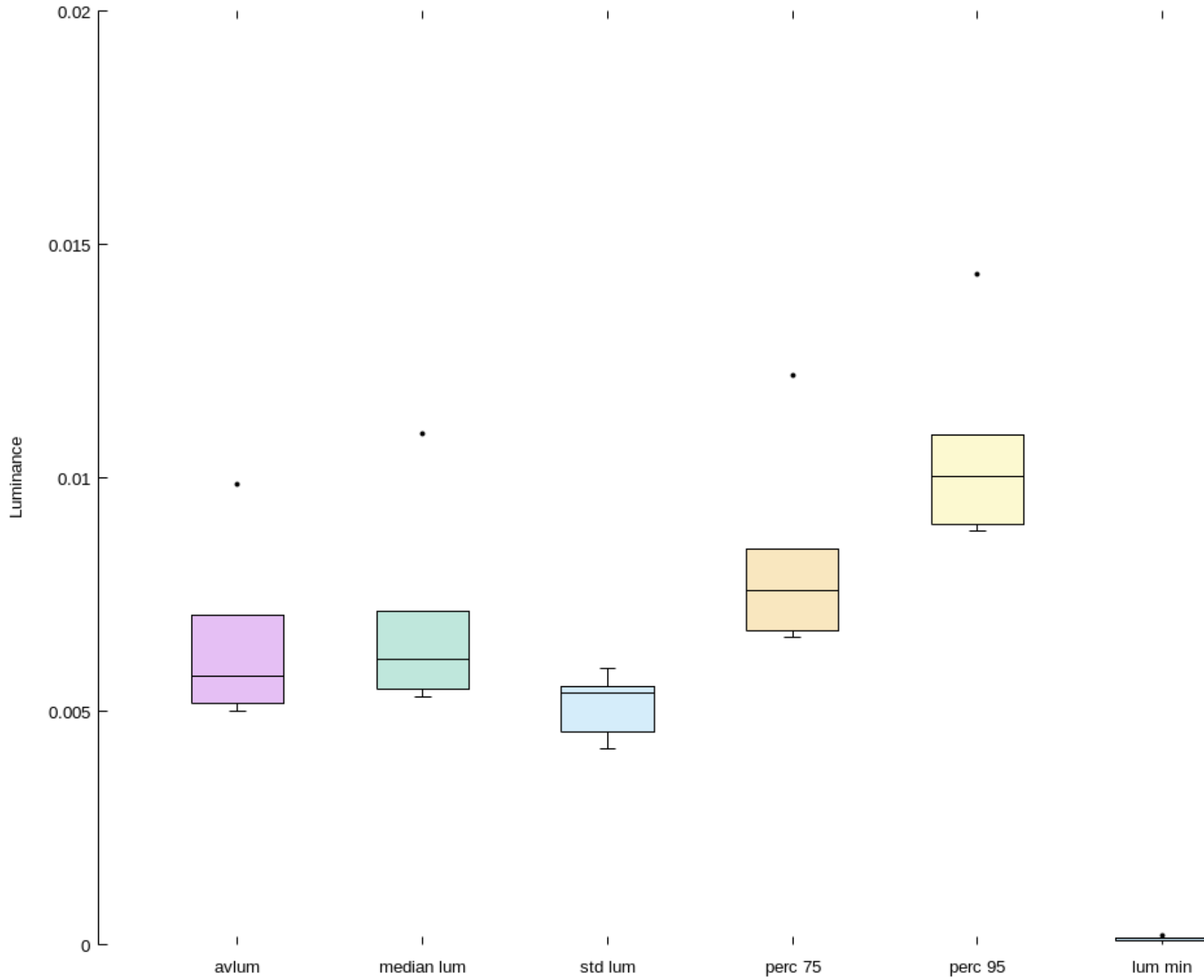
A) Quantified: Evolving Statistic of evalglare maskdata

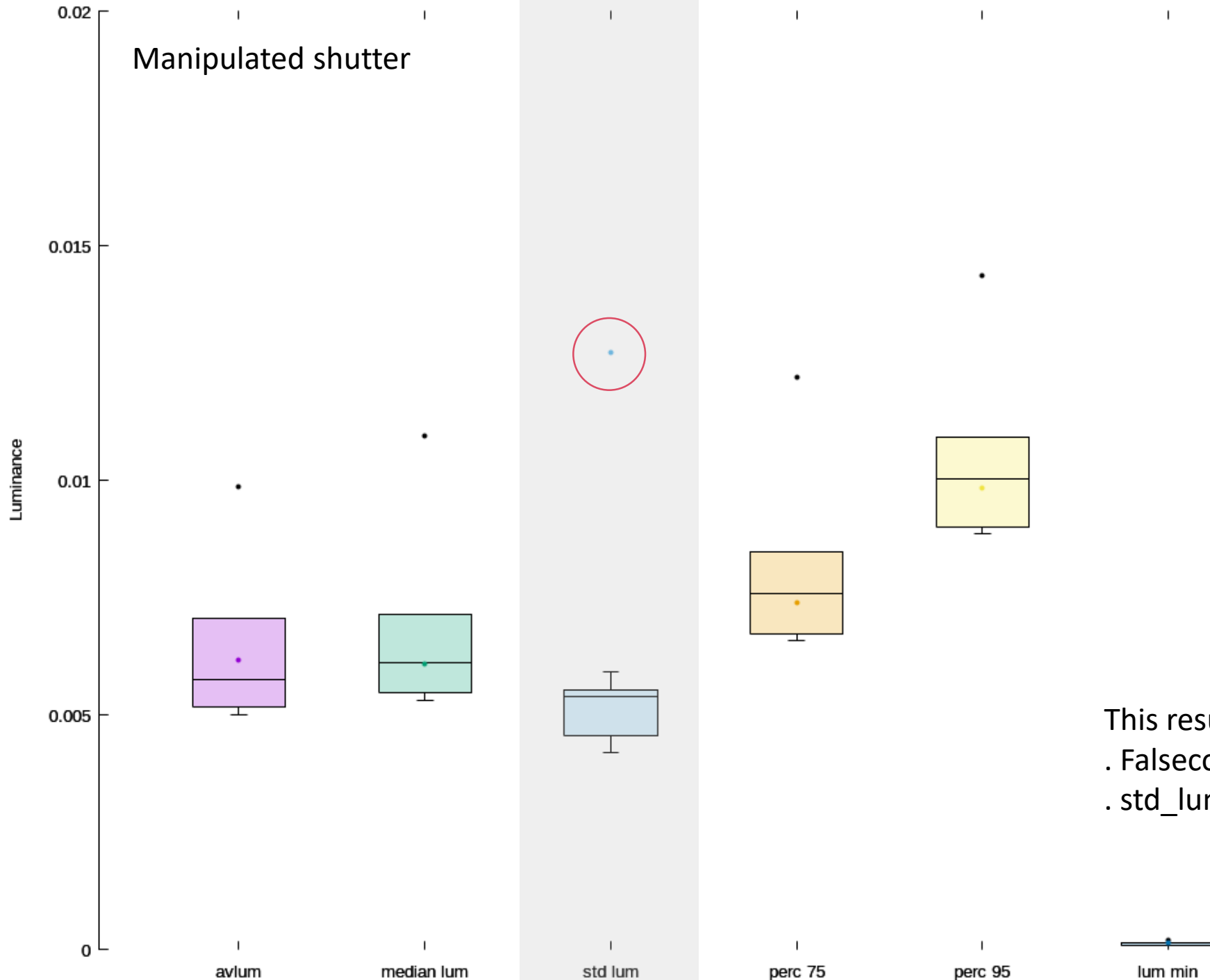
- no_pixels
- Omega
- av_lum
- median_lum
- std_lum
- perc_75
- perc_95
- lum_min
- lum_max

B) Qualitative: Evolving x,y,circle plots

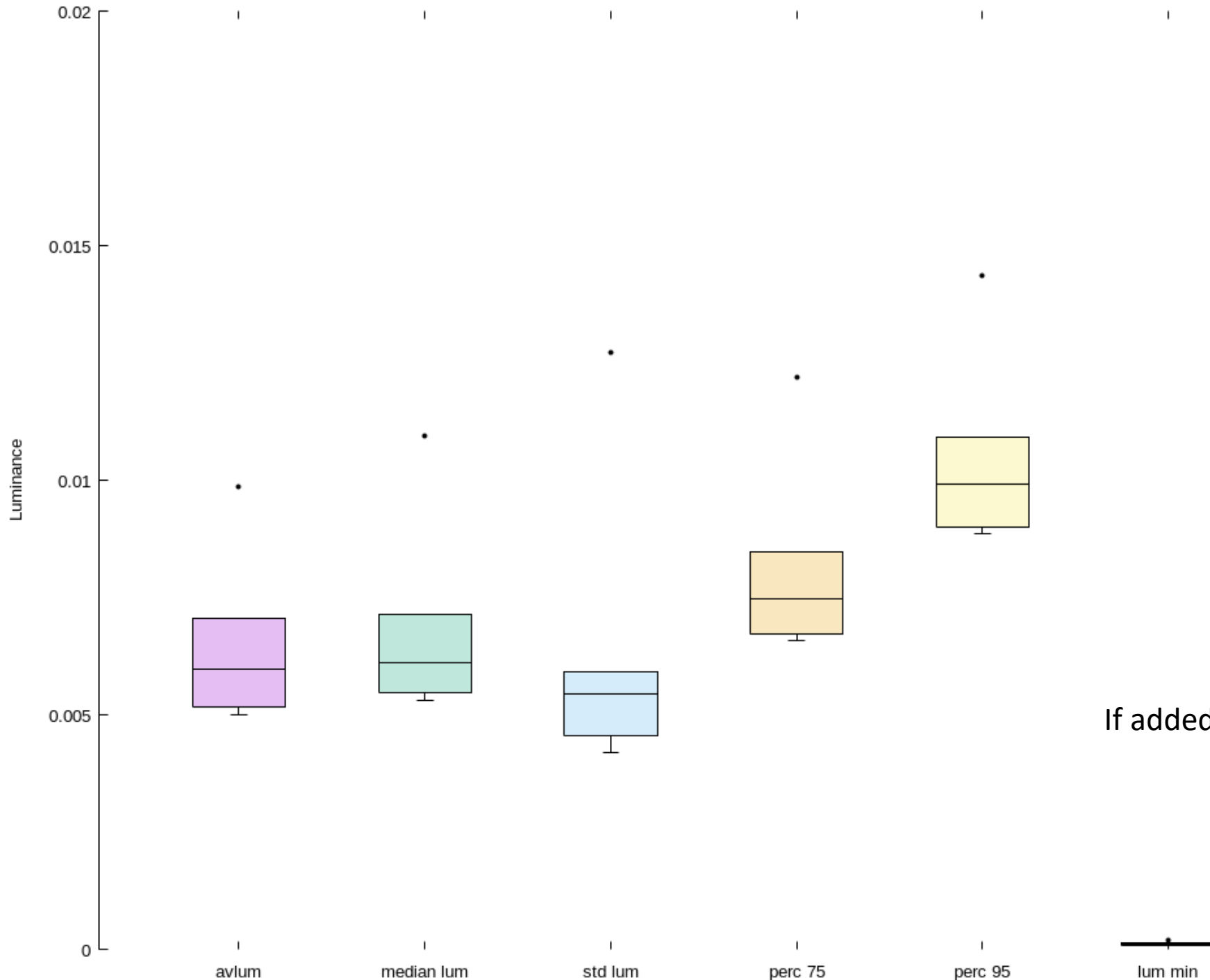


*) ... to be defined;
 **) ... or outlier using IQR



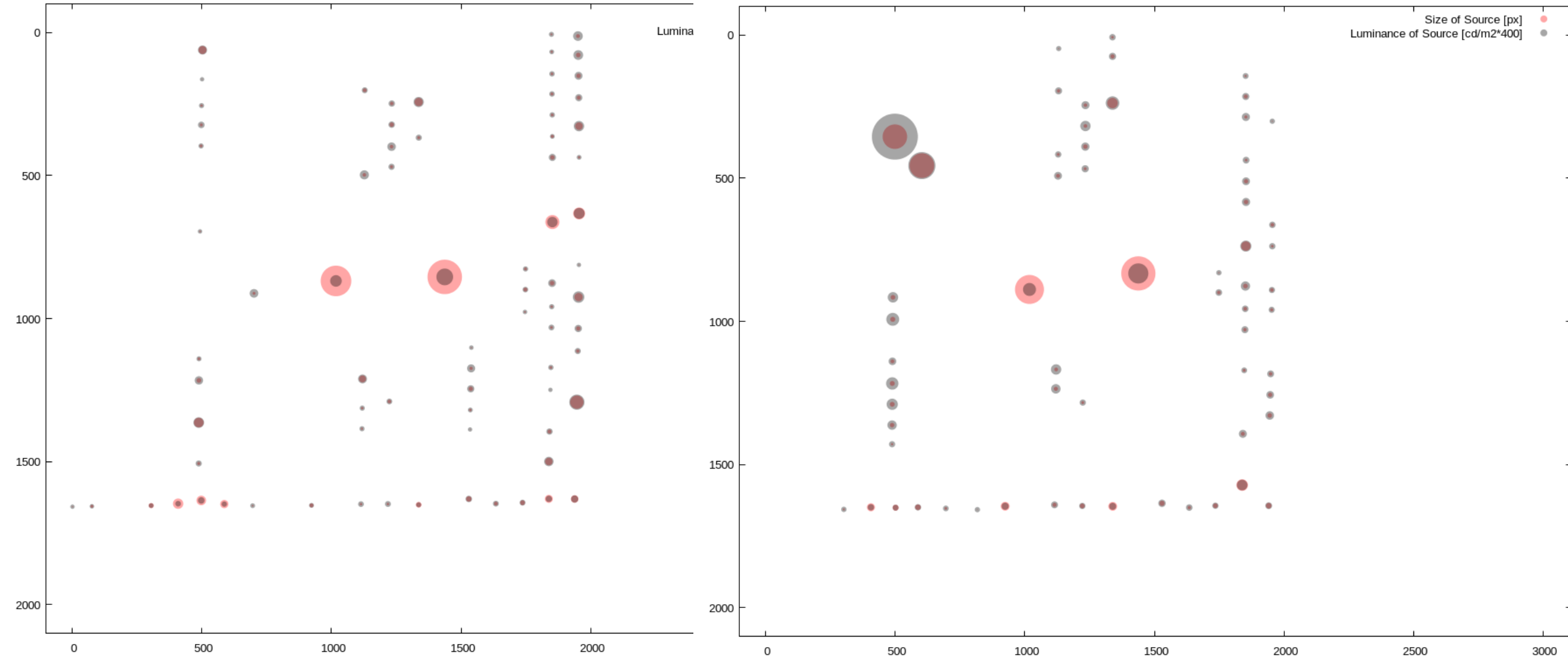


This result is detectable in:
 . Falsecolour image
 . std_lum



If added – new outlier

B) x,y,circle



Acknowledgement



References

- Wienold J., Hansen P., LIPID – EPFL, 2017, Workshop – Measurement of luminance distributions in the field of view for glare evaluations
https://infoscience.epfl.ch/record/234290/files/Workshop_presentation_PH_23_10_17.pdf
- Geisler-Moroder D., Lee E., Ward G., 15th Radiance Workshop 2016, Padova, Validation of the Radiance 5-Phase-Method against field measurements
https://www.radiance-online.org/community/workshops/2016-padua/presentations/106-GeislerMoroder-Validation_5PM.pdf
- Pierson C., Wienold J., Jacobs A., Lux Europa 2017, Luminance maps from high dynamic range imaging: calibrations and adjustments for visual comfort assessment (OT8)
https://www.academia.edu/34739822/Luminance_maps_from_High_Dynamic_Range_imaging_photometric_radiometric_and_geometric_calibrations?source=swp_share
- MN Inanici, Lighting Res. Technol. 38,2, 2006, pp.123-136, Evaluation of high dynamic range photography as a luminance data acquisition system
<https://faculty.washington.edu/inanici/Publications/LRTPublished.pdf>
- Jacobs Axel, 2012 Radiance Workshop, Copenhagen, Glare Measurement with HDR Photography