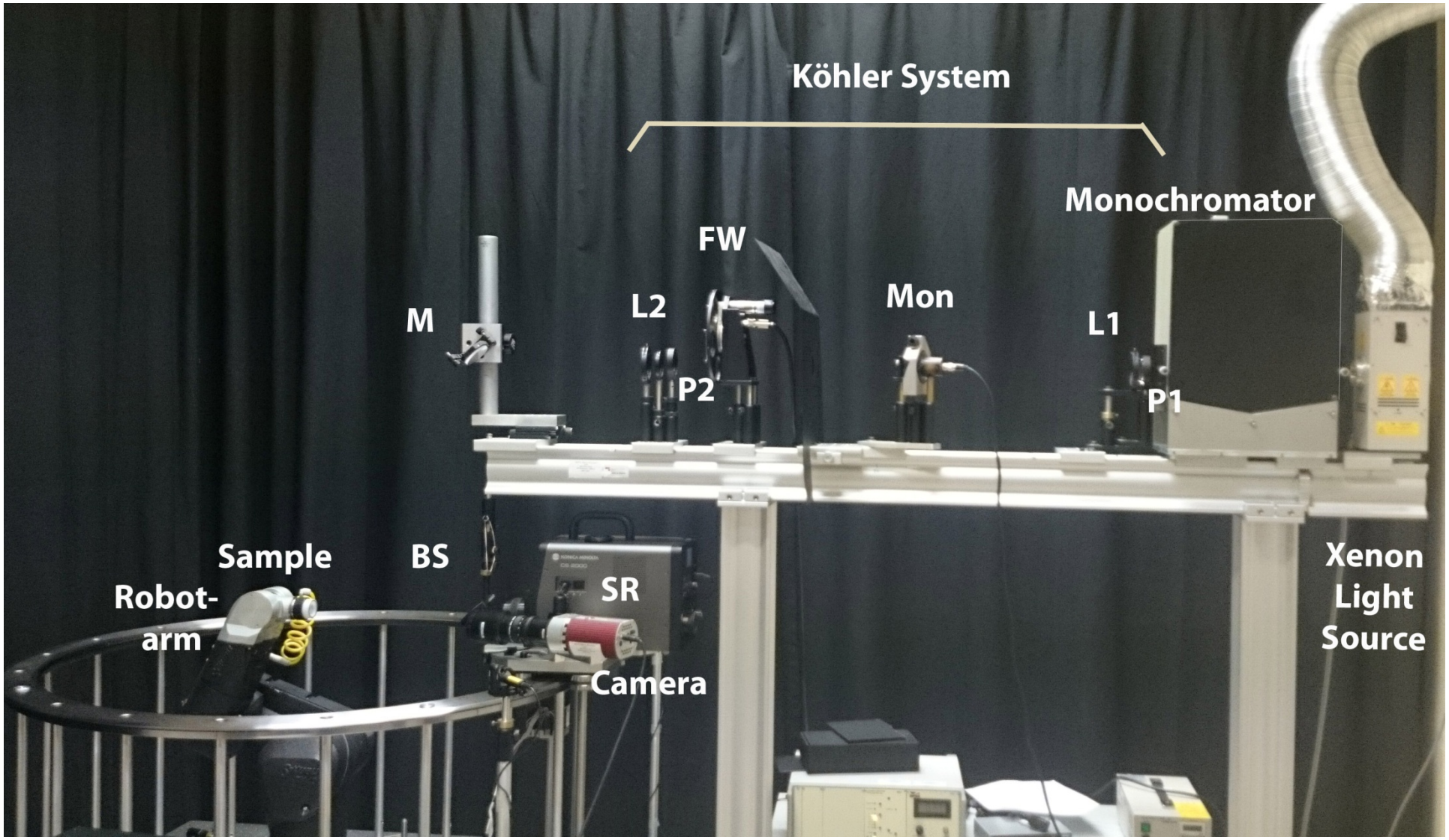
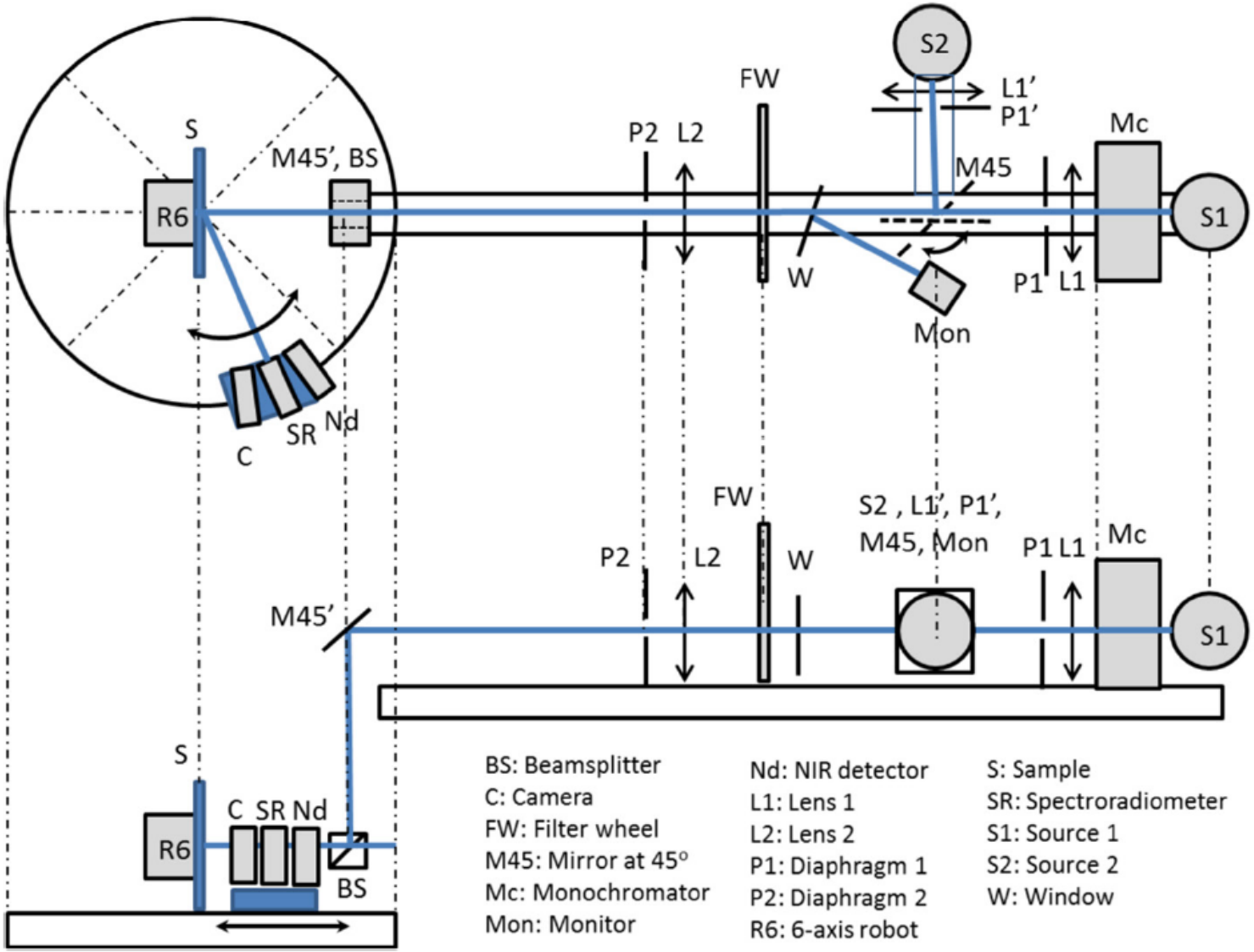
CSIC's gonispectrophotomer



CSIC's gonispectrophotomer



Testing sparkle measurements capabilities of national metrology institutes

Ferrero, A.[1], Basic, N.[2], Campos[1], Pastuschek, M.[3], Perales, E.[4], Porrovecchio, G.[5], Šmid, M.[5], Schirmacher A.[3], Velázquez, J.L. [1], Martínez-Verdú, F.M.[4]

[1]CSIC, Madrid, SPAIN,

[2]METAS, Bern, SWITZERLAND,

[3]PTB, Braunschweig, GERMANY,

[4]Universidad de Alicante, Alicante, SPAIN,

[5]CMI, Prague, CZECH REPUBLIC

Involved national metrology institutes

Physikalisch-Technische Bundesanstalt
Nationales Metrologieinstitut

Independent measurements of
luminance factor images by CSIC,
CMI, METAS and PTB.

Definition of measurands

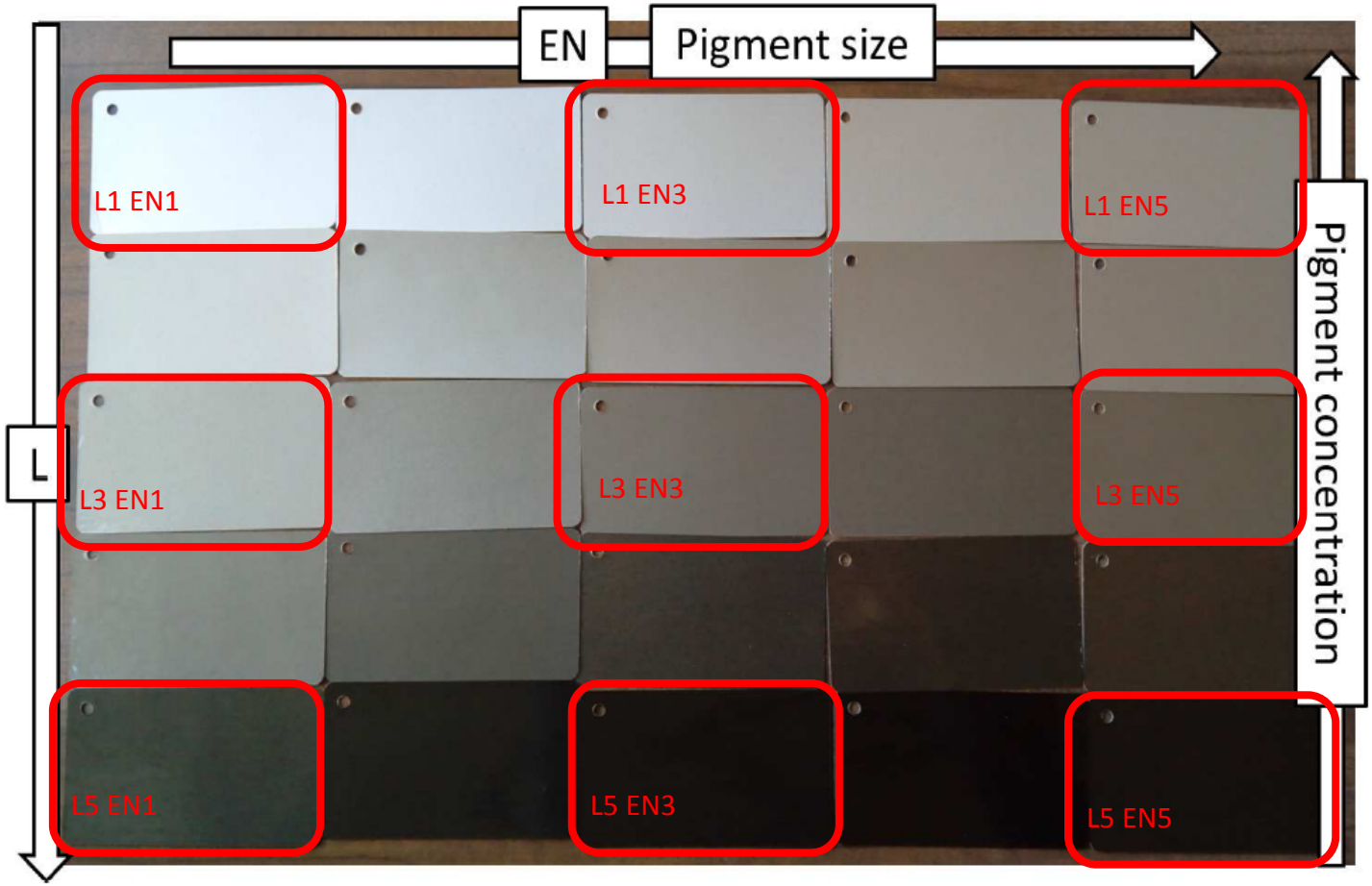
Sparkle visibility (*V*)
The relative increase of sparkle contrast with respect to the contrast threshold to be perceived .

Sparkle density (*d*)
Surface density of perceived sparkle ($V > 0$) on the sample.

Assumed observation conditions for sparkle quantities calculations
Observation distance: 500 mm
Illumination on the sample. 50000 lx

Samples

9 samples measured, with a combination of three effect pigments sizes and three effect pigments concentrations.

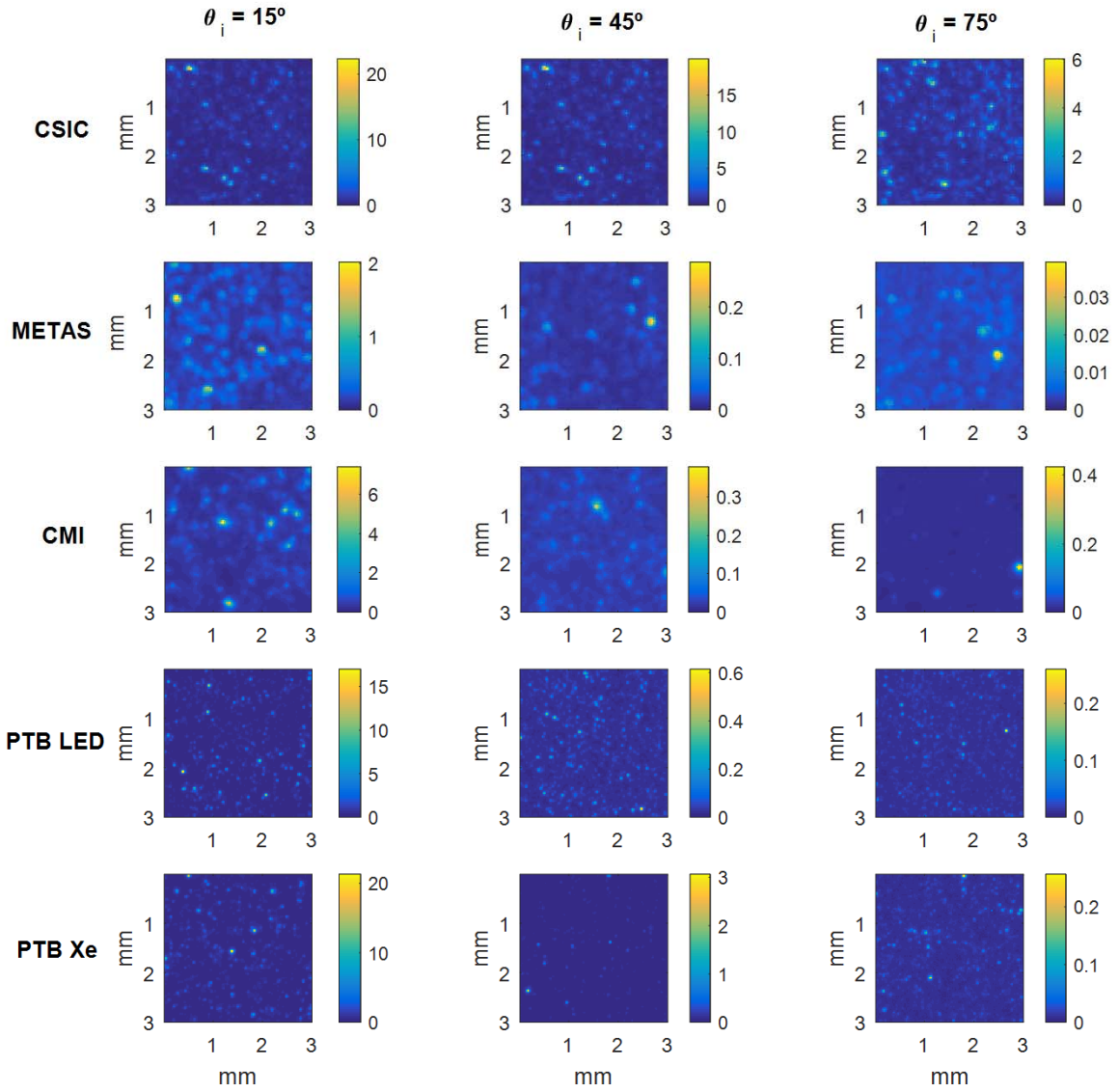


Standox Effect Navigator samples. In red squares, the 9 samples used in this work. No sparkle impression is observed, since picture was acquired under quasidiffuse illumination.

Measuring systems

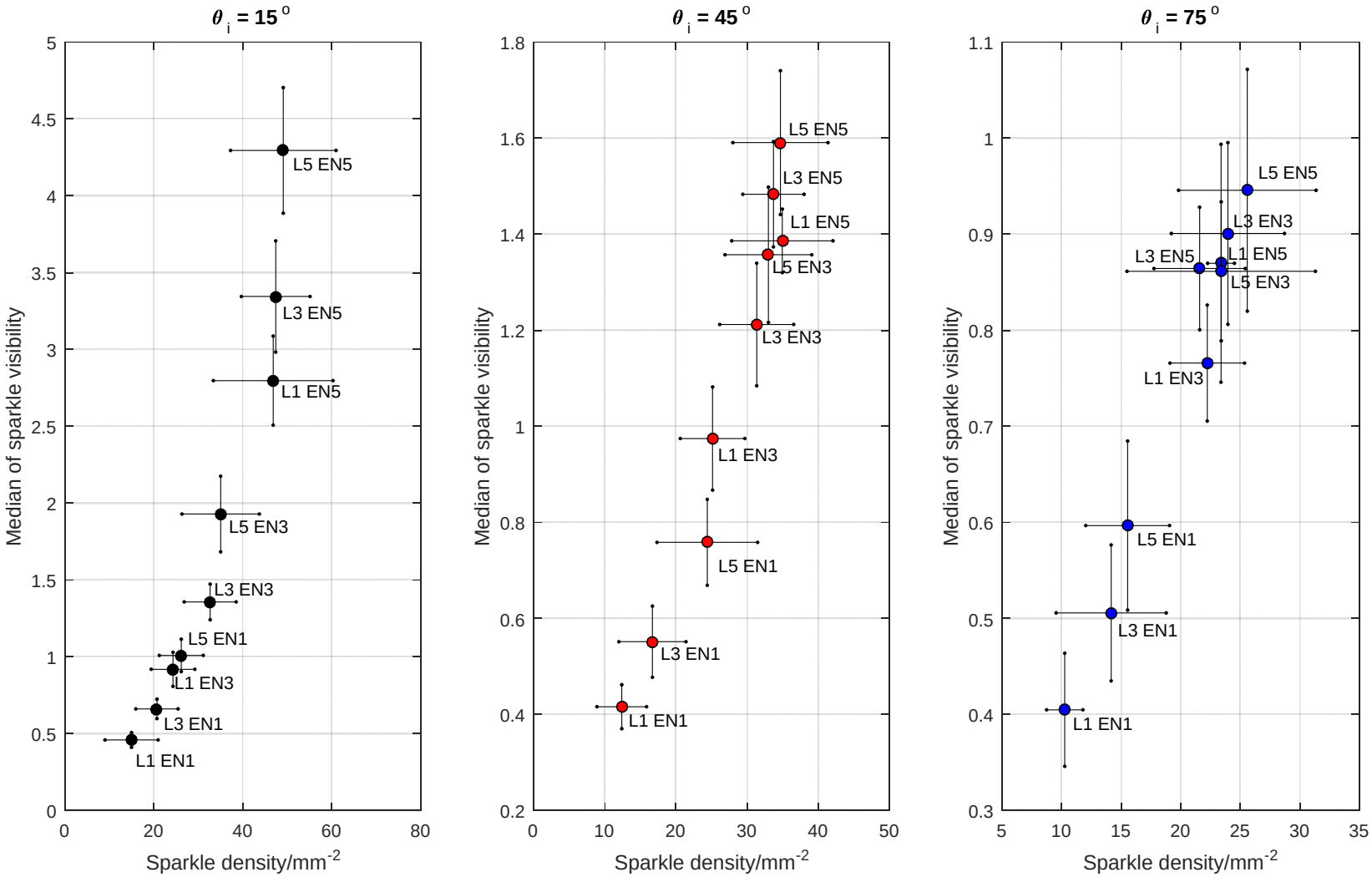
Some relevant descriptors of the measuring systems.	Spatial resolution of imaging system (μm)	Light source's full-divergence (º)	Collection full-angle (º)	Side size of squared virtual aperture (μm)
CSIC	45	0,8	2,5	135
CMI	31	2,0	4,2	155,5
METAS	42	1,4	1,0	126
PTB (Xenon)	24	1,8	2,3	120,5
PTB (LED)	24	2,6	2,3	120,5

Luminance factor images



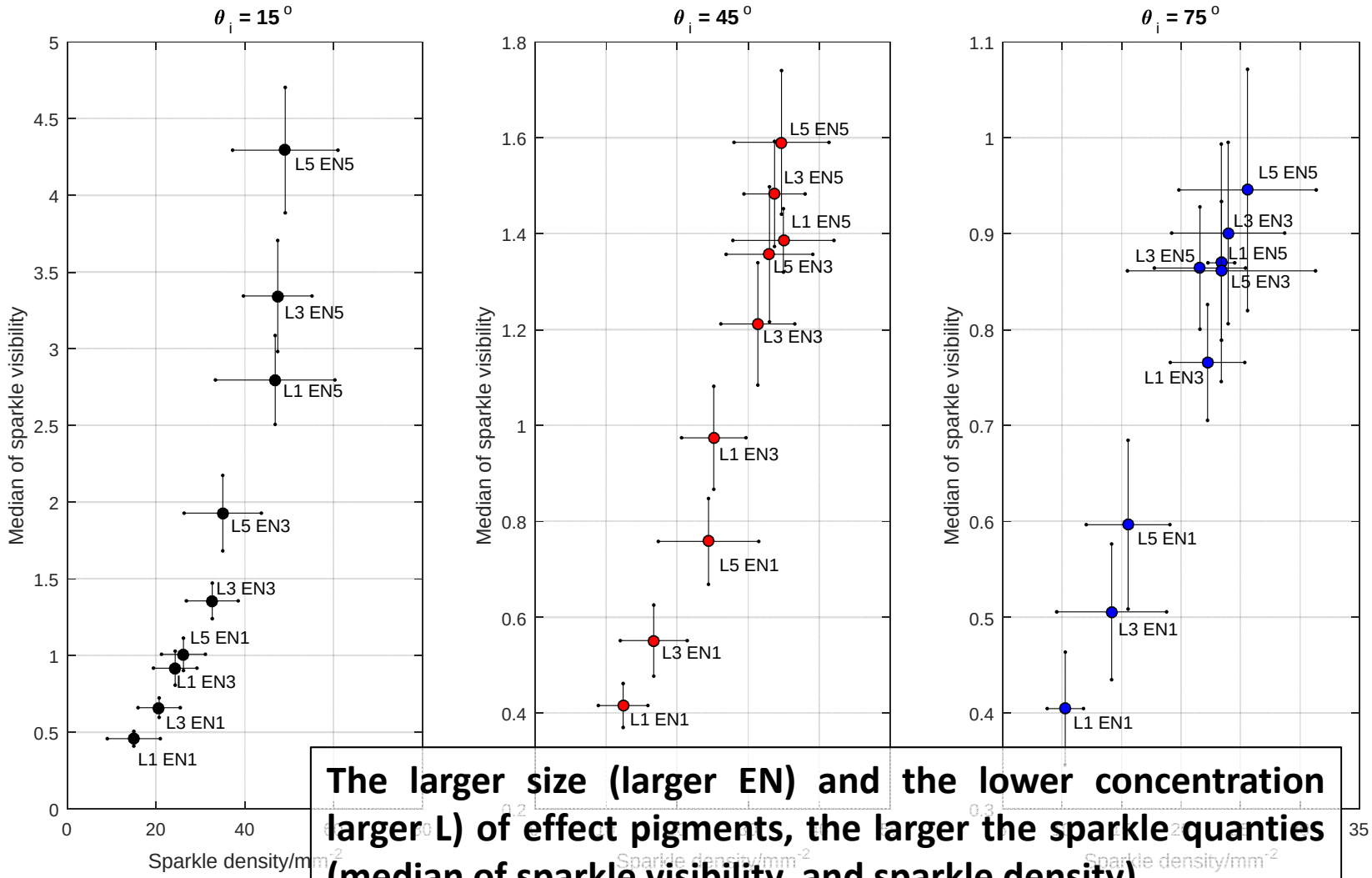
Examples of measured luminance factor images for sample L5 EN5. All images are from the central area of the sample, however the position was not controlled.

Results


θ i = 15 o
Median of sparkle visibility
Sparkle density/mm-2
L5 EN5
L3 EN5
L1 EN5
L5 EN3
L3 EN3
L5 EN1
L1 EN3
L3 EN1
L1 EN1
θ i = 45 o
Median of sparkle visibility
Sparkle density/mm-2
L5 EN5
L3 EN5
L1 EN5
L5 EN3
L3 EN3
L1 EN3
L5 EN1
L3 EN1
L1 EN1
θ i = 75 o
Median of sparkle visibility
Sparkle density/mm-2
L5 EN5
L3 EN3
L3 EN5
L1 EN5
L5 EN3
L1 EN3
L5 EN1
L3 EN1
L1 EN1

Sparkle measurements

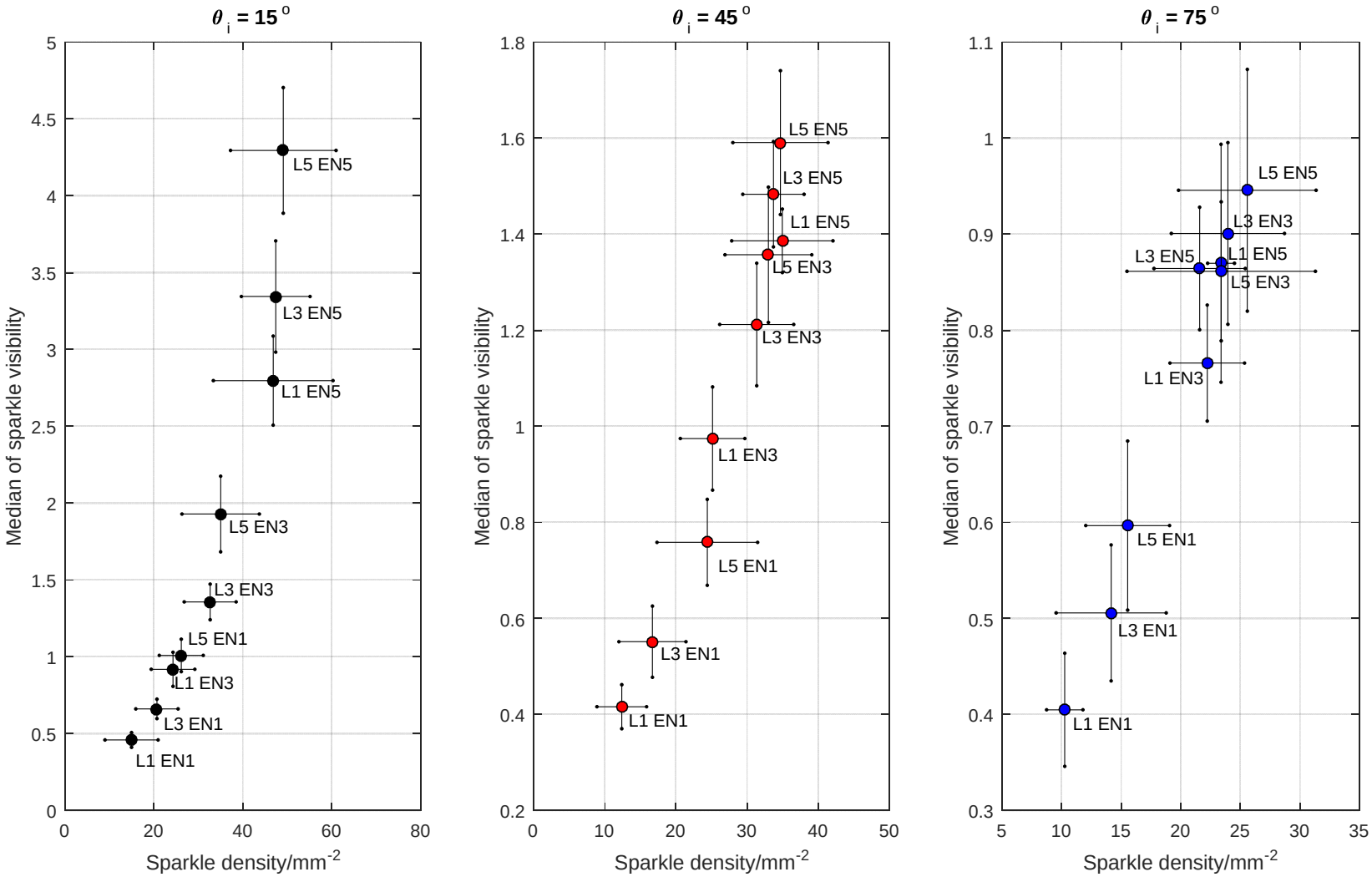
The value of the average of the measurements of the five data set (CSIC, CMI, METAS, PTB Xe and PTB LED). Error bars represent the standard deviation of the sparkle quantities.



The larger size (larger EN) and the lower concentration larger L) of effect pigments, the larger the sparkle quanties (median of sparkle visibility and sparkle density).

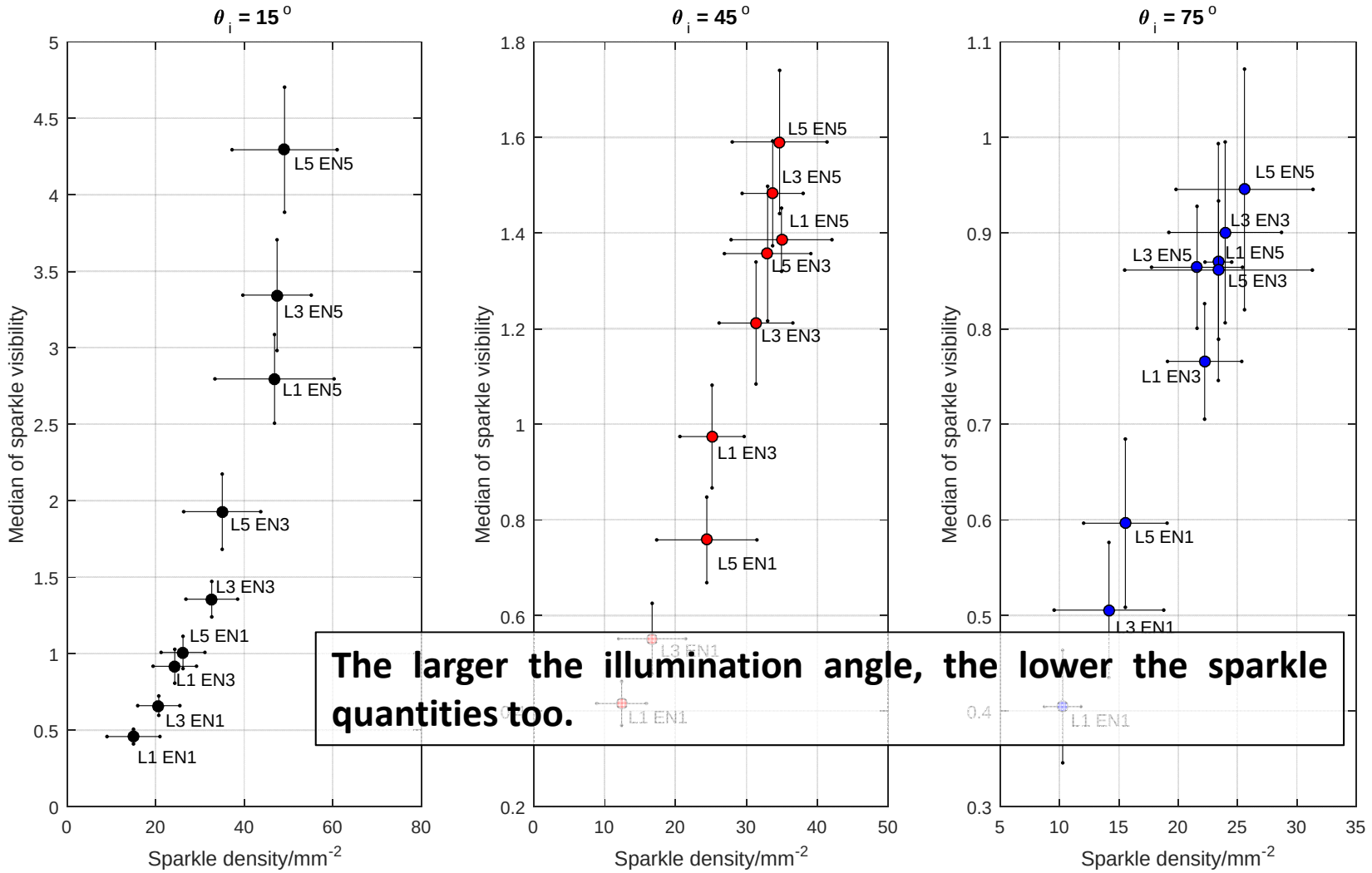
Sparkle measurements

The value of the average of the measurements of the five data set (CSIC, CMI, METAS, PTB Xe and PTB LED). Error bars represent the standard deviation of the sparkle quantities.



Sparkle measurements

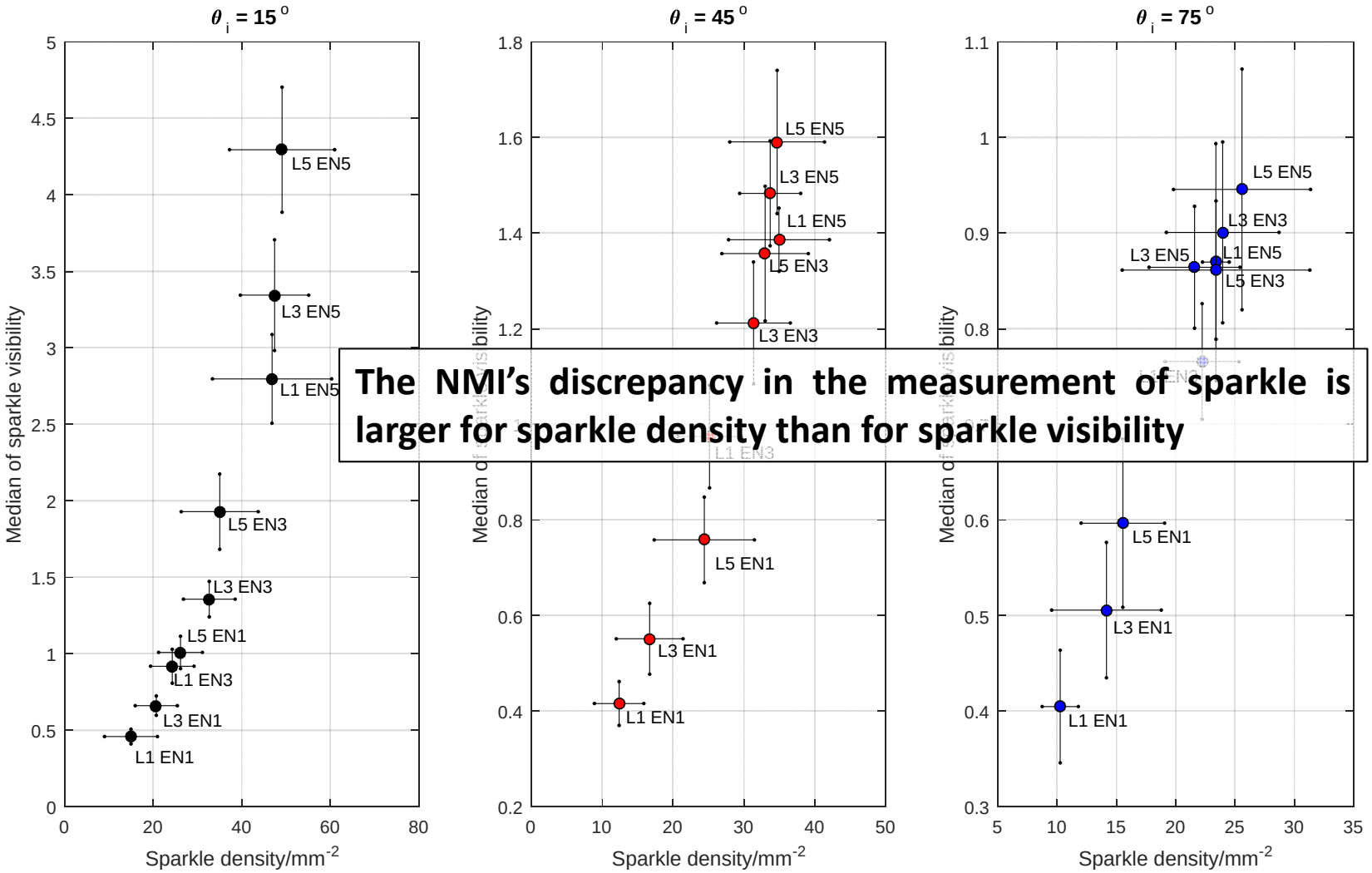
The value of the average of the measurements of the five data set (CSIC, CMI, METAS, PTB Xe and PTB LED). Error bars represent the standard deviation of the sparkle quantities.



The larger the illumination angle, the lower the sparkle quantities too.

Sparkle measurements

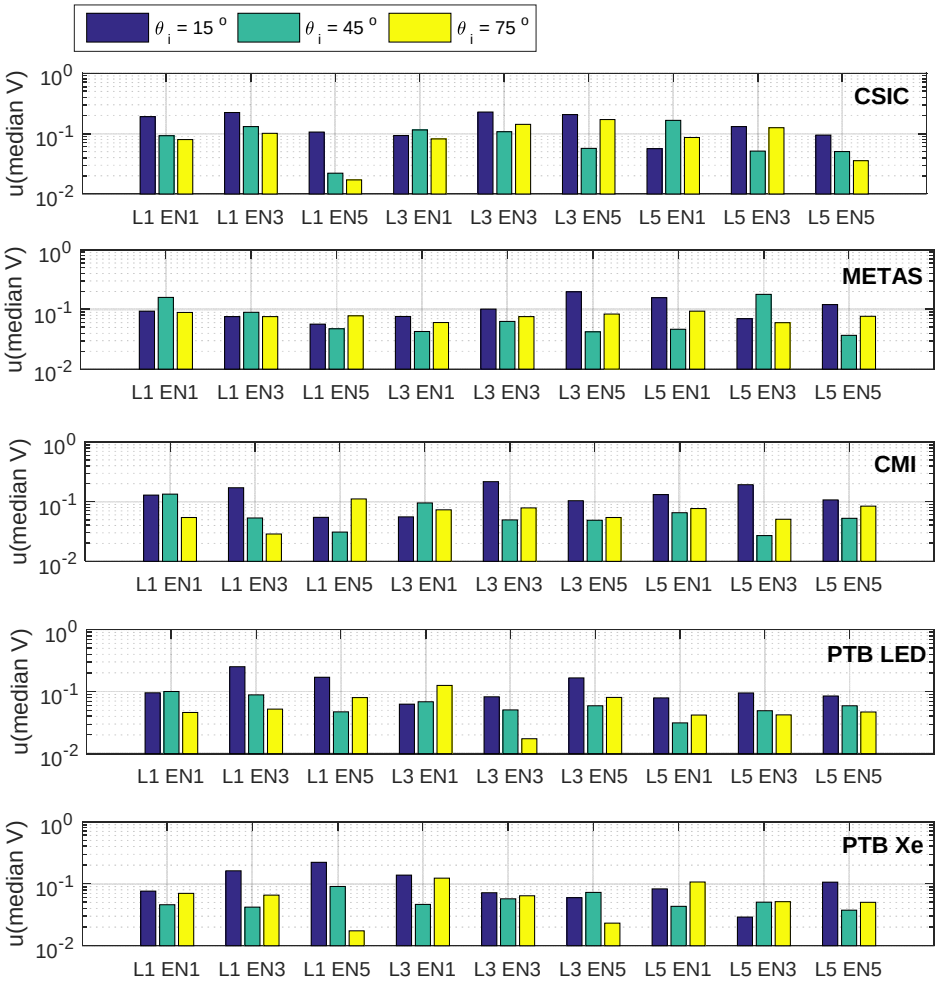
The value of the average of the measurements of the five data set (CSIC, CMI, METAS, PTB Xe and PTB LED). Error bars represent the standard deviation of the sparkle quantities.

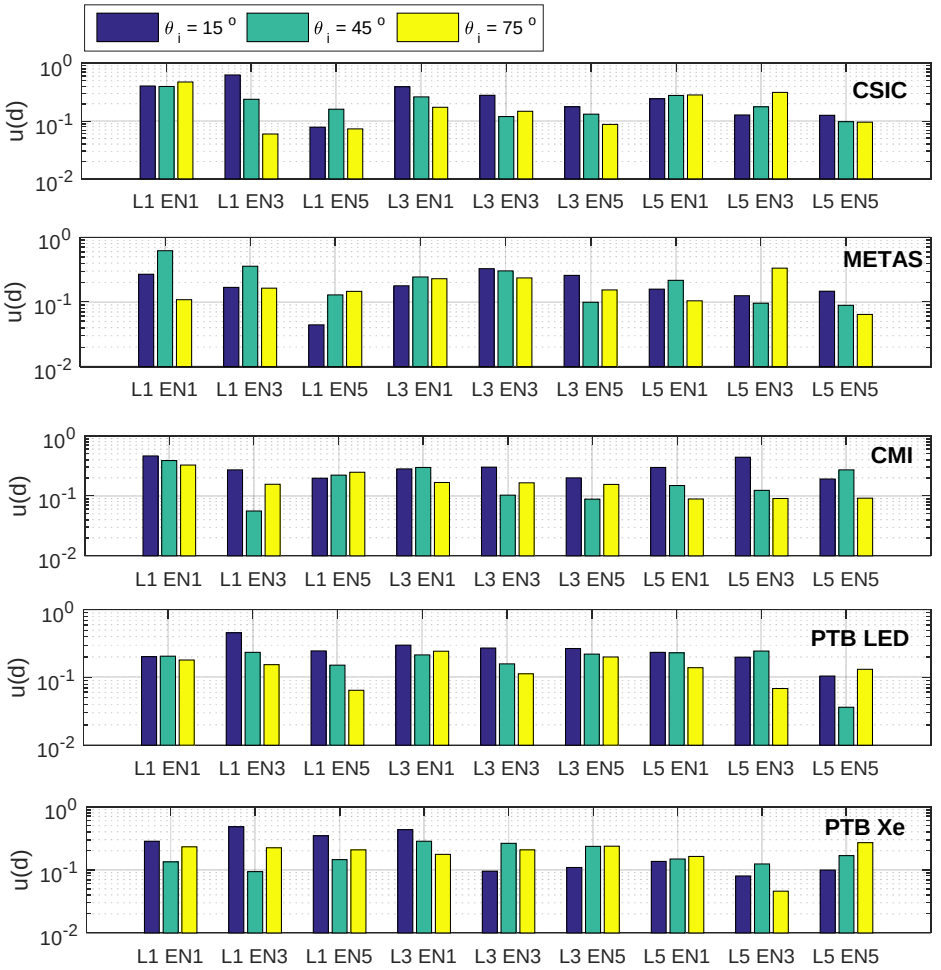


The NMI's discrepancy in the measurement of sparkle is larger for sparkle density than for sparkle visibility

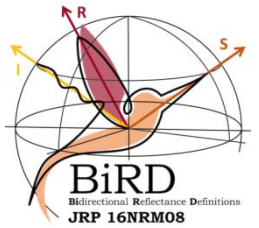
Sparkle measurements

Relative non-uniformity (mean standard deviation) for 9 subareas





Sparkle measurements



Compatibility study

Compatibility is considered in relation to the inhomogenity of sparkle quanties on the sample, which is considered the limiting uncertainty source.

Compatibility index:

$$C = \frac{NMIs - Mean\ NMI}{\sqrt{U(NMI)^2 + U(Mean\ NMI)^2}}$$

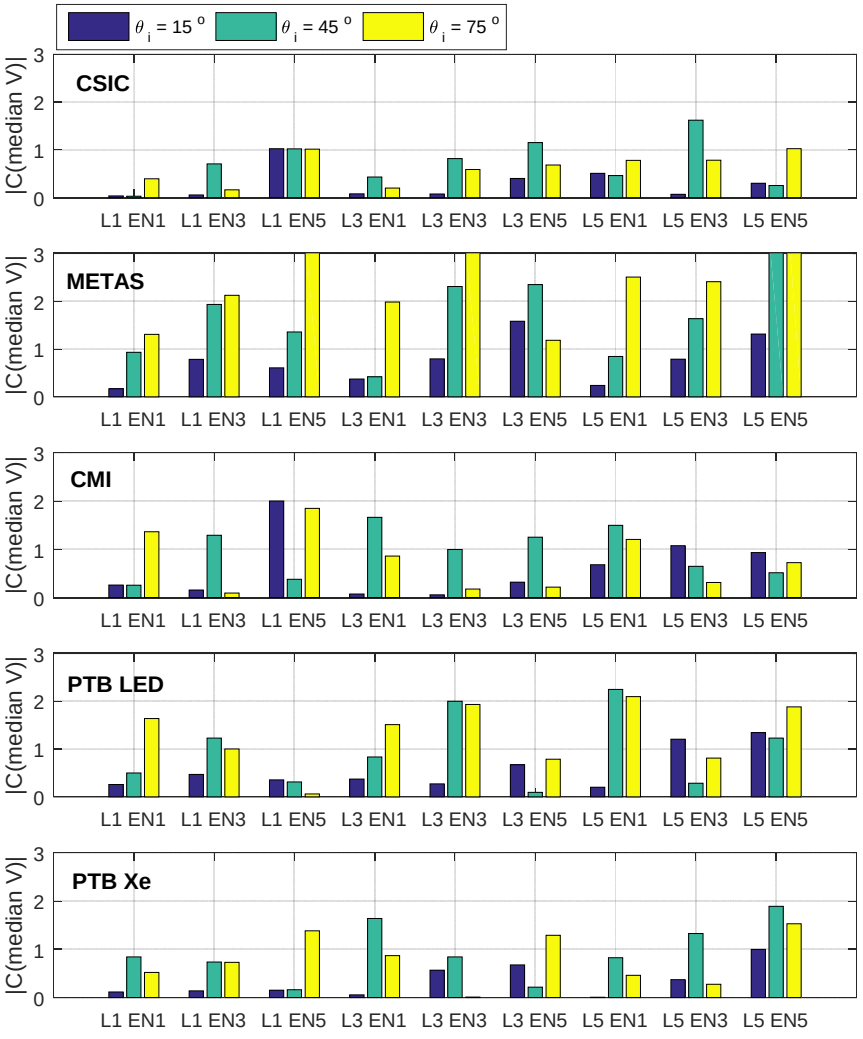
Results are compatible if $|C|<1$

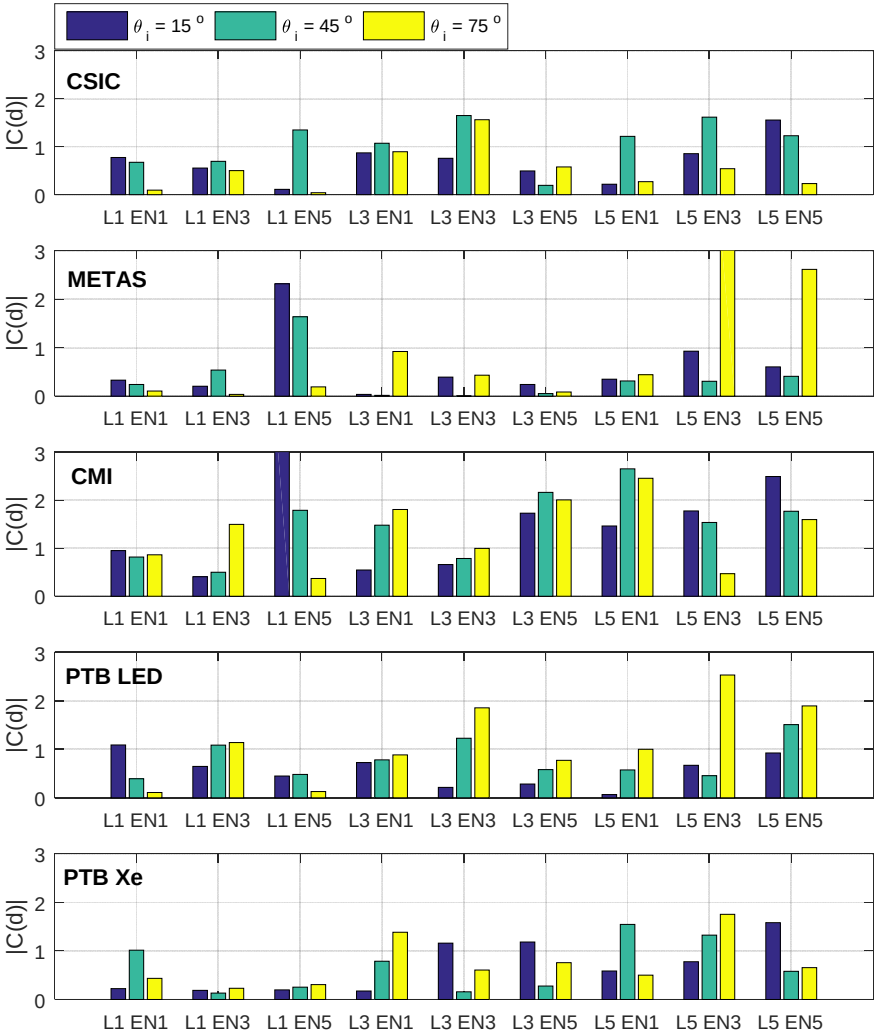
Sparkle measurements

Compatibility index

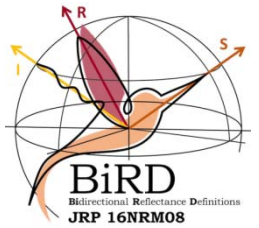
$$C = \frac{NMIs - Mean\ NMI}{\sqrt{U(NMI)^2 + U(Mean\ NMI)^2}}$$

Results are compatible if |C|<1





Sparkle measurements



Compatibility index $C = \frac{NMIs - Mean\ NMI}{\sqrt{U(NMI)^2 + U(Mean\ NMI)^2}}$

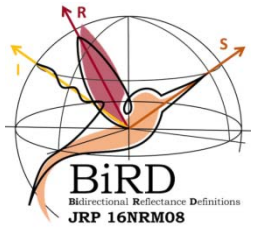
Results are compatible if $|C| < 1$

67% of compatible measures for sparkle density

63% of compatible measures for median of sparkle visibility

Around 2/3 of the individual measures are compatible with the average accross measuring systems, in almost the same extent for both sparkle quantities.

Sparkle measurements



Future work:

Determine main sources of deviation and propose solutions. Should it be…

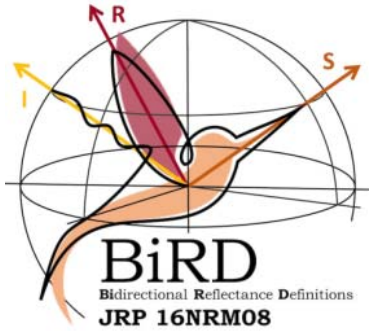
a) … improved the algorithm applied to obtain sparkle visibility and density from luminance images?

AND/OR

b) … imposed a more restrictive limitation to the measuring system regarding imaging or bidirectionality?

Thank you for your attention

EMPIR
EURAMET
The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States



Alejandro FERRERO
Instituto de Óptica, Consejo Superior de Investigaciones Científicas (CSIC), Spain
alejandro.ferrero@csic.es