Photoluminescence imaging (PLI) is a standard characterization tool for silicon wafers and solar cells since more than a decade (Trupke APL 2006). Some artifacts have been discussed in literature, which cause a local over- or underestimation of the PLI signal. Nevertheless no comprehensive list of artifacts is given in literature and artifacts are often only mentioned at the side or completely ignored. In this contribution we give an overview on the possible artifacts that can occur during PLI, we point out the origin of the artifacts and derive possible correction methods. The following artifacts can occur during a PLI measurement:

1. Inhomogeneous sample illumination,
2. Varying light capture due to varying sample optics,
3. Lateral balancing currents,
4. Variations of carrier depth profiles,
5. Temperature variation,
6. Wafer thickness variation,
7. Photon scattering within the sample,
8. Photon reabsorption,
9. Varying light emission due to varying rear and front side optics,
10. Parasitic light from excitation source,
11. Parasitic light from luminescing objects,
12. Ghost reflexes,
13. Vignetting,
14. Photon scattering within the detector chip,
15. Camera noise.

It has to mentioned, that some of the artifacts named above are only to be considered as artifacts from a certain point of view. Lateral balancing currents for example, is an effect, which leads to misinterpretations if the local lifetime shall be derived from PL-image, but it does not lead to misinterpretation if the carrier distribution in the sample shall be determined.

We exemplarily give a short explanation of artifacts 1, 3, 9 and 13 in this abstract.

**Fig 1:**

a) measured relative illumination intensity of the investigated PLI-setup across the wafer plane; b) PL-image with a thin scratch on the front side illustrating lateral balancing currents; c) PL-images of wafer partially covered with ink on the rear side illustrating the impact of varying rear side optics (left: without SPF, right: with SPF); d) PL-images of a diffuse homogeneous light source with different f-numbers illustrating vignetting.

### Inhomogeneous sample illumination:

Ideally the wafer is illuminated in a completely homogeneous way during the measurement. Nevertheless a homogeneous illumination is technically difficult to realize at reasonable costs. Fig 1a shows the measured relative interpolated distribution of illumination intensity across the wafer plane for the investigated PLI-setup. The easiest way of correcting PL-images with respect to inhomogeneous illumination, which is strictly only valid for low level injection, is dividing each image by the shown relative distribution. A more sophisticated correction accounts for the fact that the charge carrier product is not proportional to illumination for high level injection (Höffler PhD-thesis 2015).

### Lateral balancing currents:

If the local lifetime, which e.g. is needed as a local input parameter in device simulation, needs to be determined, one has to be aware of lateral balancing currents. Fig 1b shows the PL image of an $iV_{oc}$-sample with a thin scratch on the front side. The fact that the scratch appears “blurred” is caused by potential differences between “good” and “bad” regions. Correction methods have been proposed in literature (Phang APL 103, 2013; Schindler PiP 2016).

### Varying light emission due to varying rear- and front-side optics:

Varying optics of the wafer’s rear side can have a measurable impact on the PL signal (Schinke IEEE JPV 2013). Fig 1c shows the image of a wafer which features ink on the rear side on the positions of the dark fields. While the ink has no impact on the local electrical properties there is still a significant difference in PL signal which is only caused by differences in the rear side optics. A short pass filter (SPF) in front of the camera can decrease the effect making use of the reabsorption of long wavelength light in the silicon wafer.

### Vignetting:

Vignetting describes the decrease of the signal to the edges of the image. It can be divided into four effects: optical-, mechanical-, natural- and pixel-vignetting. Vignetting properties can be measured by recording an image of a homogenous light source. Such images should ideally have no lateral variation in signal. With our PLI-setup we measured a sequence of such images using different f-numbers (Fig 1d). A clear decrease in vignetting can be seen and quantified via the relative signal standard deviation.