

# Images & turbulence — 27

-> Detection noises:

- At first: *photon noise* (or *shot noise*), poissonian, actually a transformation of the image.

$$p(n) = \frac{N^n e^{-N}}{n!}, \text{ with : } N = \frac{L\Delta t}{h\nu}, L = \text{luminosity}, \Delta t = \text{time exp.}$$

$p(n)$  = probability to detect  $n$  photons when  $N$  are expected

For large  $N$ : ~gaussian...

$$p(n) \simeq \exp \left( -\frac{(n - N)^2}{2N} \right)$$

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-> Detector noises:

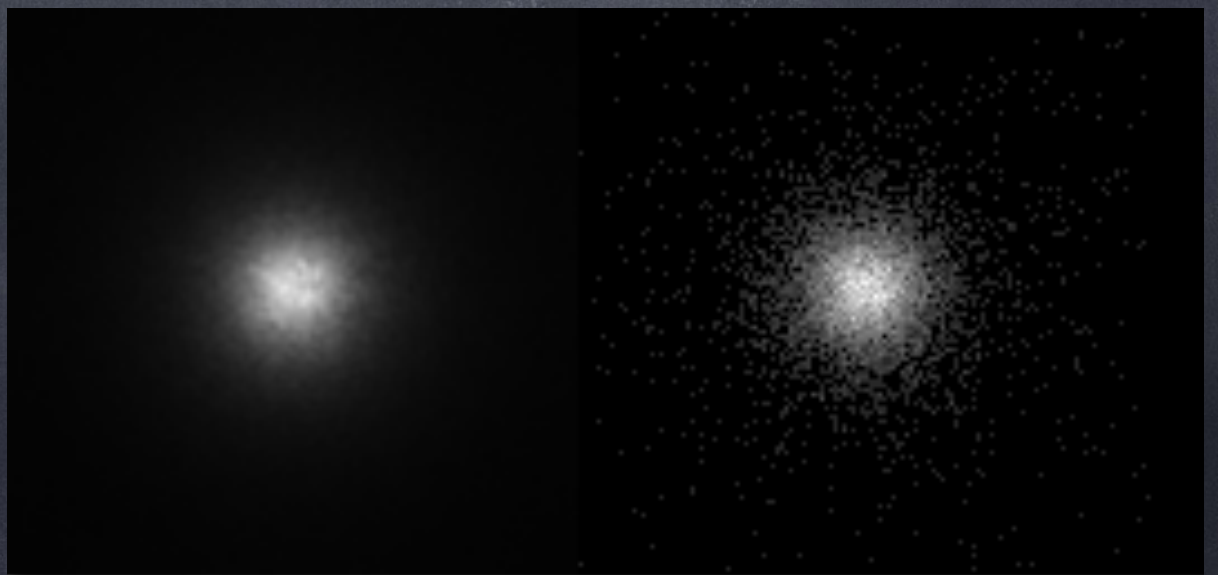
- At first: *photon noise* (or *shot noise*), poissonian, actually a transformation of the image.
- At last: *read-out noise* (*RON*), gaussian with zero mean and rms  $\sigma_e$  [e-/px], additive noise.
- In between: *dark current noise*, *amplification noise* & *exotic dark current noise* in the case of EMCCDs, noise due to the *calibration* of the *flat field*, '*salt & pepper*' noise ('hot' and 'cold' pixels), etc.

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```
;; Photon noise (Poisson)
if keyword_set(PHOT_NOISE) then begin
    idx=where((image GT 0.) AND (image LT 1E8),c)
                                ; For values higher than 1E8, should one
    if (c NE 0) then for i=0l,c-1l do $    ; really has to worry about photon noise ?
        noisy_image[idx[i]]=randomn(seed_pn,POISSON=image[idx[i]],/DOUBLE)
endif
```

image formation with noise:

- 1- 'add' photon noise on one short-exp. PSF (in function of N...),
- 2- long-exp. PSF (100N photons!),
- 3- 'add' photon noise on the long-exp. PSF,
- 4- compare long-exp. & short-exp. noisy images (and 'clean' images),
- 5- compare also with the sum of the (100) short-exp. noisy images...



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Logbook "Adaptive Optics"
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+ PSD( $r_0$ ,  $L_0$ )
+ => influence of  $r_0$  and  $L_0$ 
-
+ rms( $r_0$ ,  $L_0$ )
+ => influence of  $r_0$  and  $L_0$ 
-
+ FWHM( $r_0$  or  $\lambda \Rightarrow r_0$ ,  $L_0$ )
+ => influence of  $r_0$  and  $L_0$ 
+ => comparison with the "seeing"  $\lambda/r_0$ 
+ noisy images
=> comparison sum(noisy img) vs. noisy sum
```

(à suivre...)