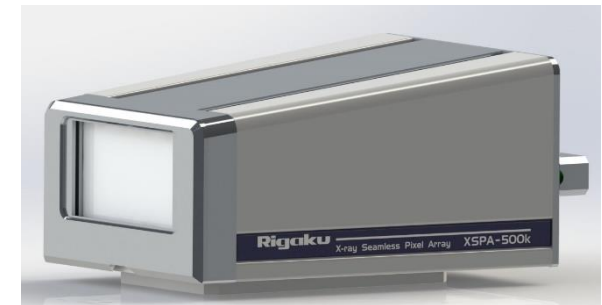


# Characterization of the XSPA-500k photon counting detector at Synchrotron SOLEIL

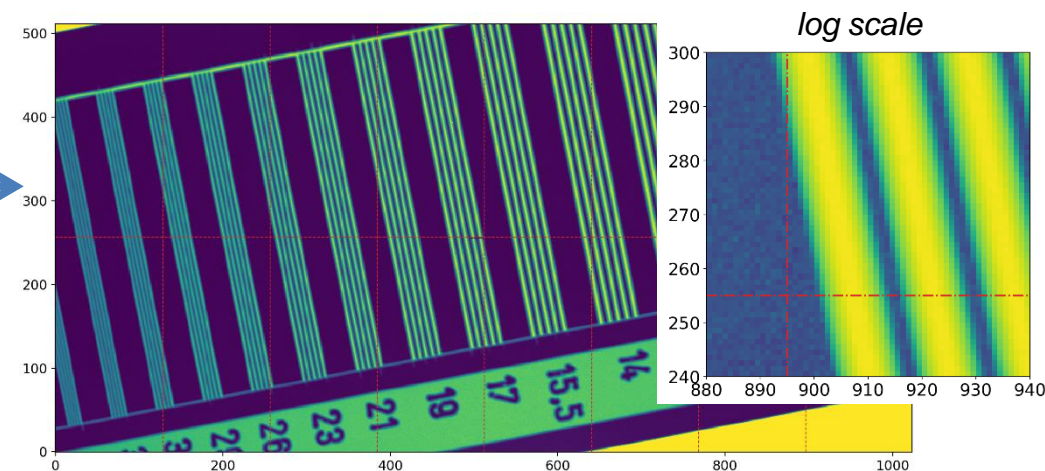
Arkadiusz Dawiec, Synchrotron SOLEIL  
*on behalf of RIGAKU, AGH and SOLEIL colleagues*

*01.04.2021, IFDEPS Virtual Thursdays*



## Detector main characteristics:

- Pixel matrix : 1024 × 512 pixels (77.8 × 38.9 mm<sup>2</sup>)  
**seamless pixel array**  
**(equal-size pixels over the entire detection area)** →
- Pixel size : 76 × 76 μm<sup>2</sup>
- Number of UFXC chips : 16
- Framerate (in ZeroDead) : 8.6 kfps @ 16 bit  
: 56 kfps @ 2 bit
- Gating capabilities : yes (down to 40 ns)



## Measurements @ SOLEIL:

*following standard internal detector acceptance protocol*

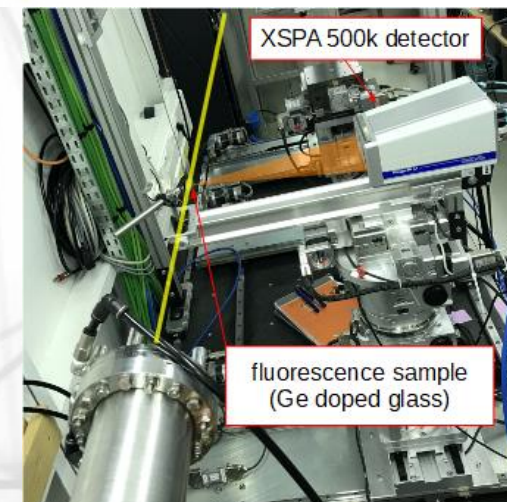
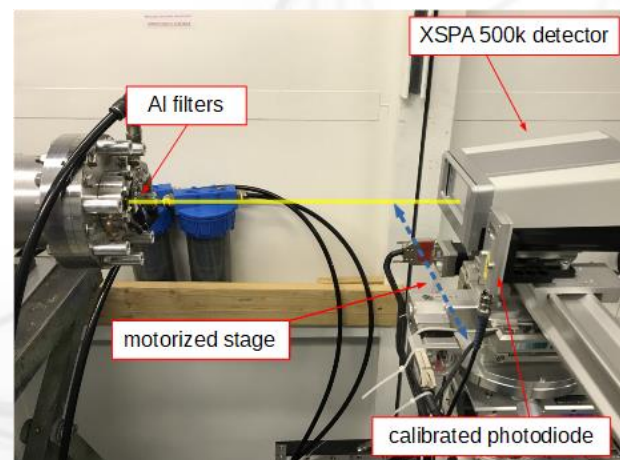
All measurements @ 10 keV (Ge fluo + direct beam)

- Homogeneity and bad pixels
- Signal to noise/PRNU
- Threshold dispersion, energy resolution
- NPS, MTF, DQE
- Linearity
- Short gate/single bunch

Only selected results presented here, complete characterization in:

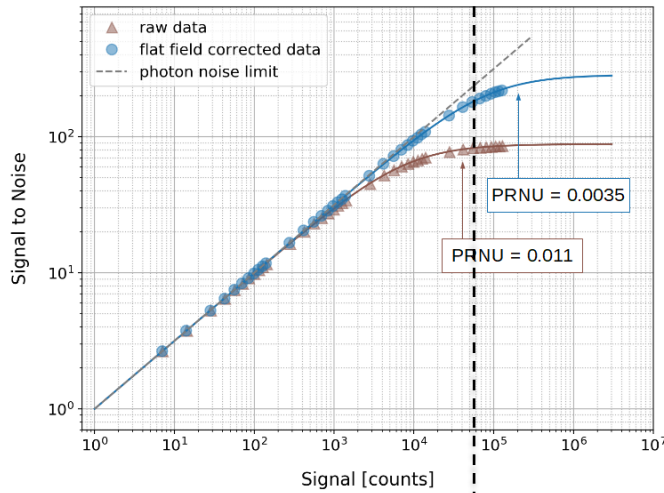
Y. Nakaye, et al., *Characterization and performance evaluation of the XSPA-500k detector using synchrotron radiation*, *J. Synchrotron Radiat.* **28**, (2021) 439.

Experimental set-ups @ beamline

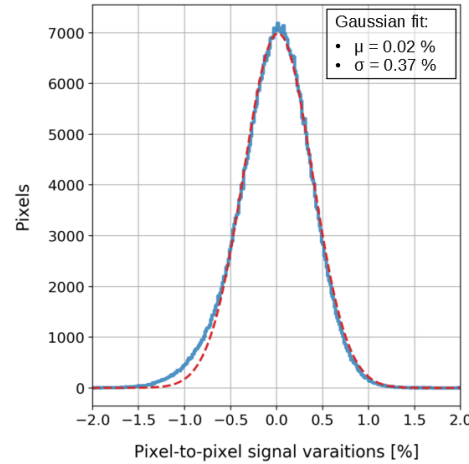


# Homogeneity, SNR, spatial properties

SNR

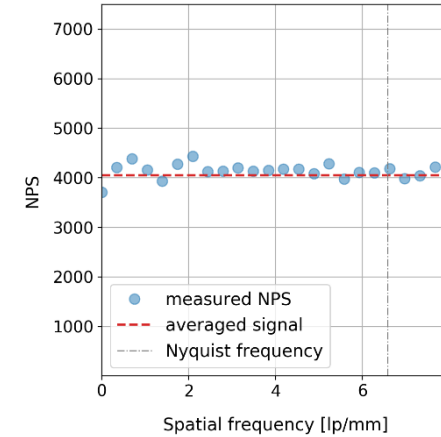


Pixel-to-pixel signal variations

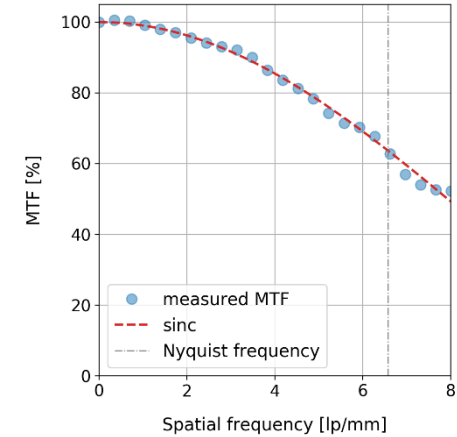


Almost all pixels within  $\pm 1\%$  range

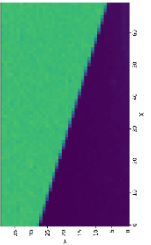
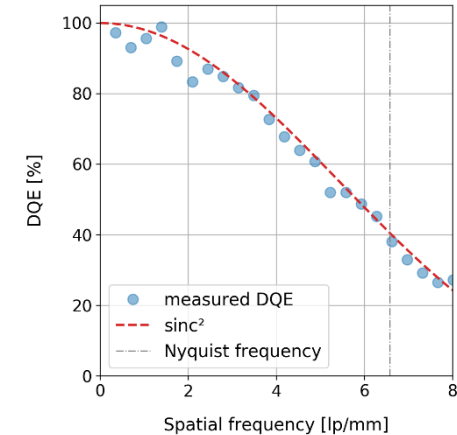
NPS



MTF



DQE

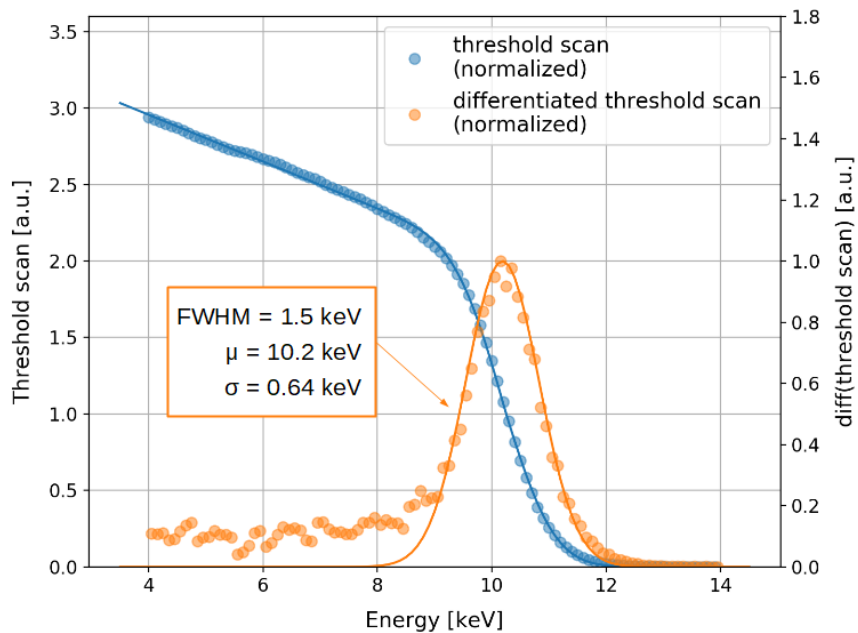


Results very much as expected for this type of the detector

$1/PRNU^2$   
 ← Poisson limited dynamics | FPN regime →

- Excellent SNR and pixel-to-pixel signals variations
- Very low number of bad pixels (<0,02% of all pixels)
- Spatial properties very much as expected for photon counting detector

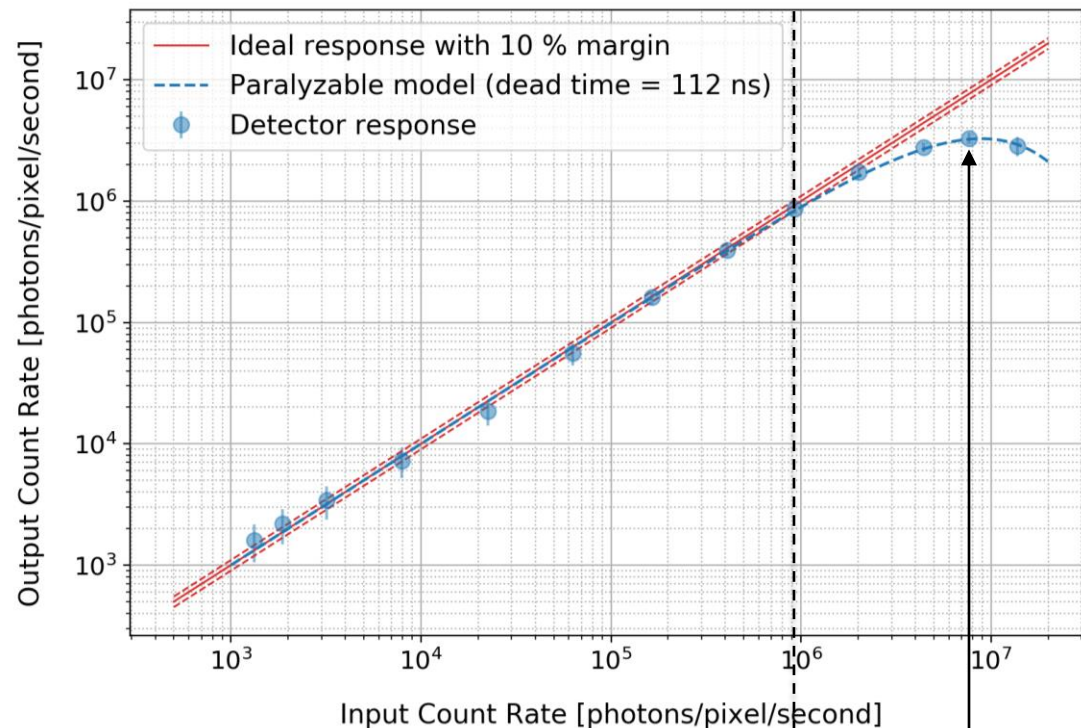
## Energy resolution



Measured for the **entire** detector.

- Very good energy resolution (comparable to other photon counting detectors)
- Excellent count rate measurement (taking into account rather slow pixel front-end settings)

## Counting linearity

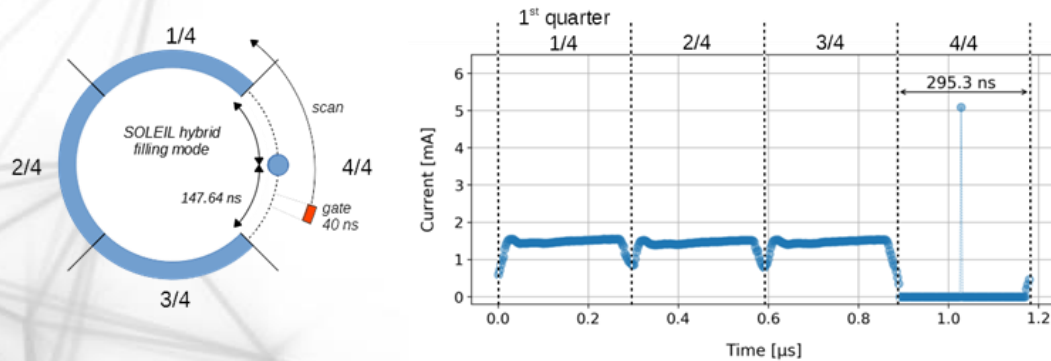


Linear range up to  **$9.4 \times 10^5$  ph/pix/sec**

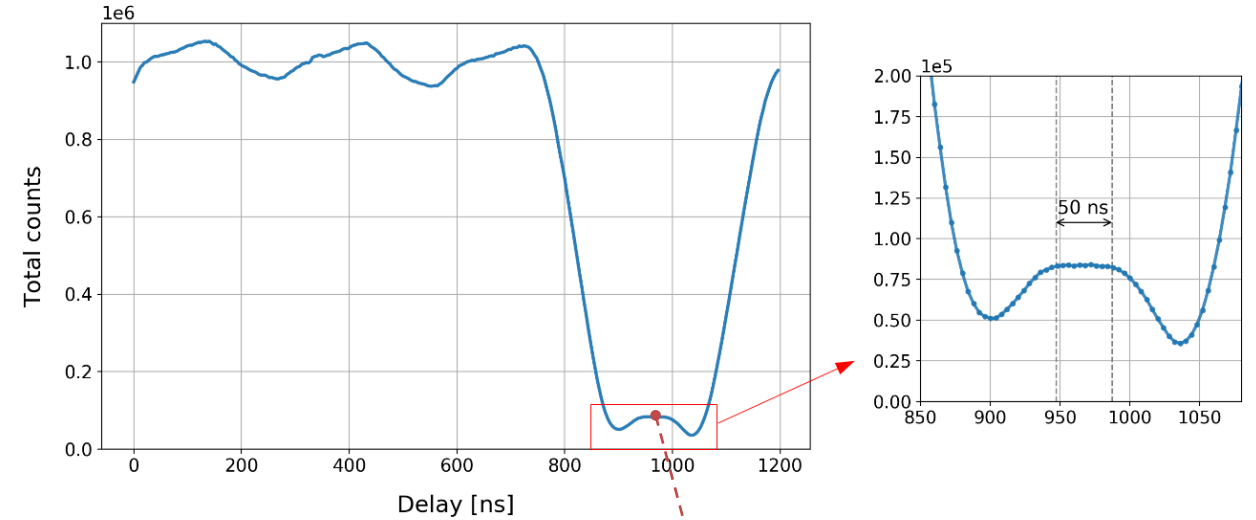
Max count rate @  **$9 \times 10^6$  ph/pix/sec**

Only a fraction of the count rate capabilities are demonstrated due to a rather slow pixel front-end settings

## Experimental setup – mapping the storage ring filling mode



## Response of a complete detector - fluorescence measurements



### Excellent short gate performance (40 ns):

- single bunch isolation on the entire detector surface (within 50 ns time window)
- single bunch isolation over complete linear range (measurements done with a direct beam)

