Large area photon-counting X-ray or particle image sensor using pixelated scintillators

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Introduction

State of the art X-ray imaging is based on charge integration and indirect detection. Conceptually , photon counting X-ray imaging is superior in many respects.

Hurdles:

Circuit:

→ counting pixels are complex and yield sensitive

→ counting pixel power and paralysis.

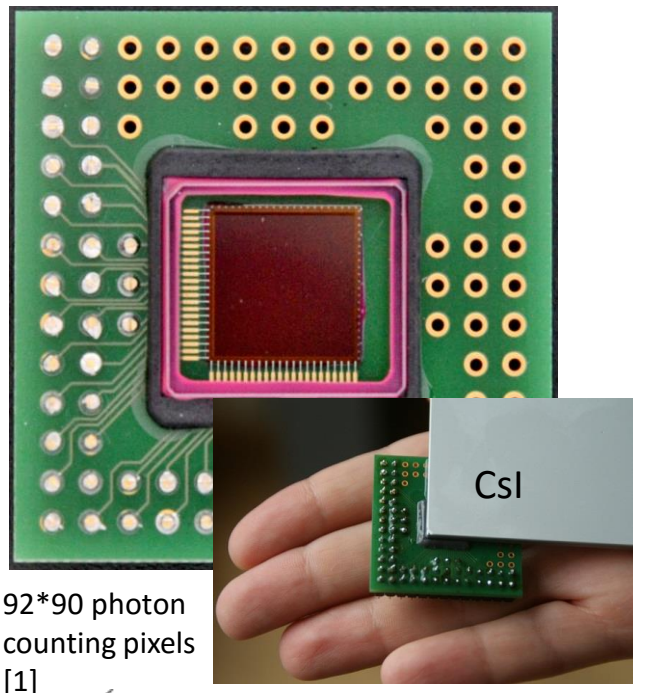
→ Energy discrimination

Detector:

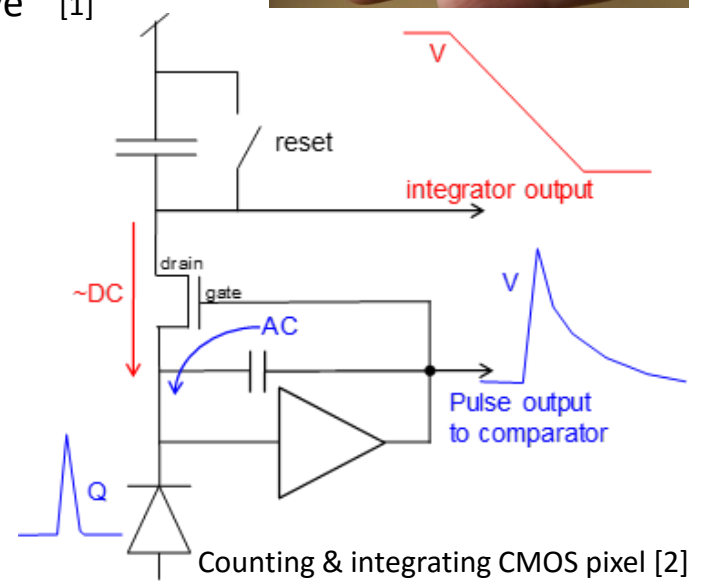
→ "indirect detecting" scintillators are inferior to "direct" detectors.

→ Lubbert's effect.

→ Scintillation time constant



92*90 photon counting pixels [1]



Counting & integrating CMOS pixel [2]

The Idea/Concept

large 2D array of counting pixels. CMOS ROIC + pixelated scintillator.

Potential partner Philips Medical, see abstract #75

Project goals:

Lubbert's effect

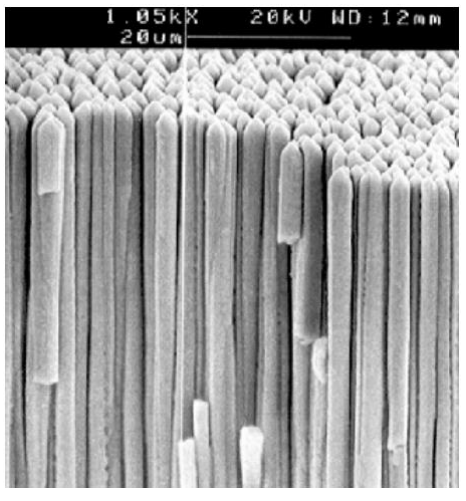
- fabrication of pixelated scintillator. *Prior art see figures↓*
- The hybridization and packaging of devices (ROIC + Scintillator)

circuit

- aiming to wafer size, depending of budget, concepts working further on the prior experience.

Also part of the project:

- Experimental verification under the X-ray beam
- interested partners in particle physics, NDT, etc.



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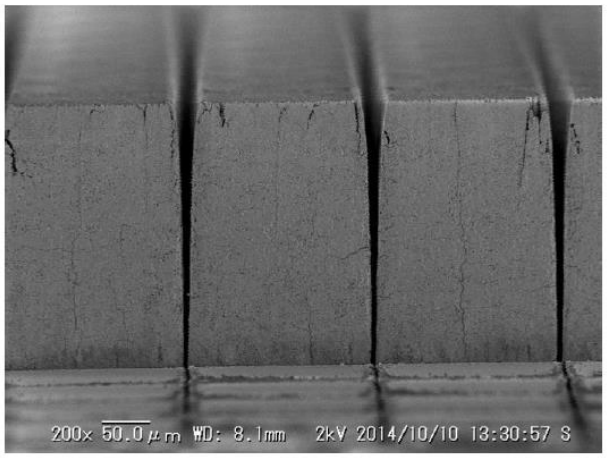

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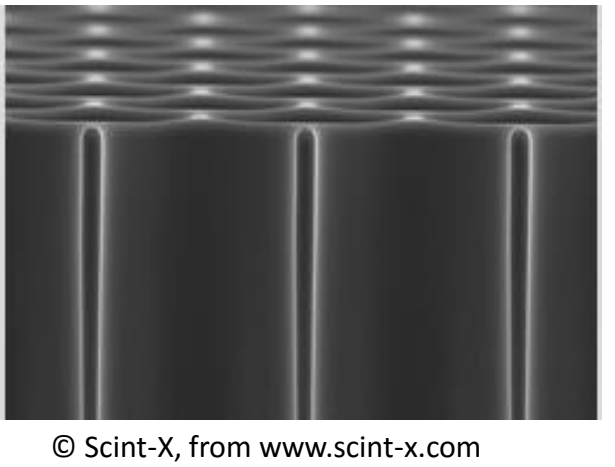

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Potential Impact

The substitution of direct X-ray, gamma, and eventually and particle detector arrays by scintillators. When scintillators replace non-Silicon semiconductor detectors, one can expect a large cost reduction. Also scaling and hybridization to wafer scale becomes straightforward.

1. B.Dierickx, S. Vandewiele, B. Dupont, A. Defernez, N. Witvrouwen, D.Uwaerts, "Scintillator based color X-ray photon counting imager", Workshop on medical applications of spectroscopic X-ray detectors, CERN 22-25 April 2013 (slides available at www.caeleste.be)
2. B. Dierickx, Q. Yao, N. Witvrouwen, D. Uwaerts, S. Vandewiele and P. Gao, «X-ray Photon Counting and Two-Color X-ray Imaging Using Indirect Detection", Sensors, accepted for publication 2016