

EVENTO DE NETWORKING

HEALTHCARE & PHOTONICS

TECNOLOGIAS FOTÓNICAS APLICADAS AL SECTOR HEALTHCARE

26 MARZO/14

09.45h-17.00h

**Parc Audiovisual
de Catalunya**

Carretera BV-1274,
Km. 1, 08225 Terrassa
(Barcelona)



X R A Y IMATEK

PHOTON COUNTING DETECTORS

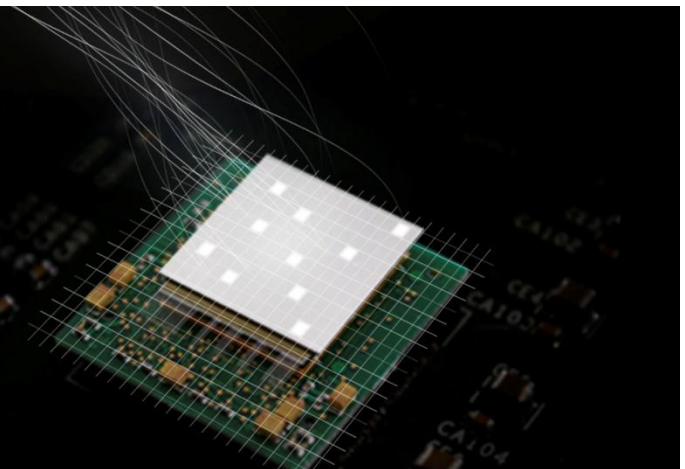
Photon Counting in Medical Imaging

Mission & Vision

- X-Ray Imatek is a company focused on research, development and marketing X/Gamma-Ray pixelated detectors based on Photon Counting technology.
- XRI delivers state-of-the-art solutions for x-ray imaging based on the Medipix2/Timepix CMOS by introducing the XRI Series, a complete family of X-Ray cameras designed to enable users to become familiar with the capabilities of Photon Counting.
- The company also offers customized equipment designs and industrialization support in every sector where x-ray imaging is needed. And provides tailored solutions that gives higher image quality at lower radiation levels as well as high speed performance with great accuracy.



Every photon counts



Business Lines / Main Markets



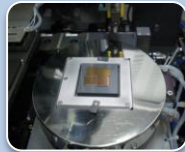
Standard Products

Focused on Research for Institutes and Universities
Ready-to-use complete solution.



OEM Products

Customized Detectors for the Industry and Research.



Services

Flip-Chip & Wire Bonding Services in-house.



High Energy Physics



Scientific
Research



Medical Imaging

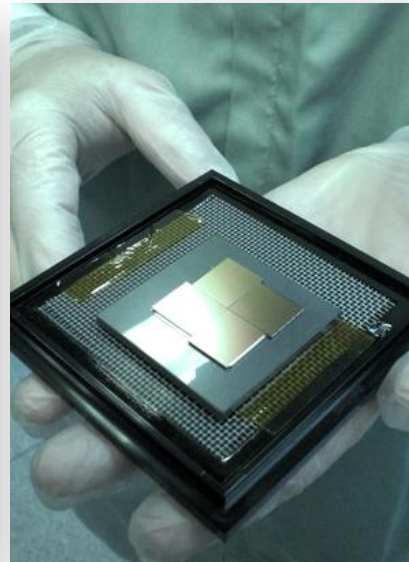


Industrial
Inspection



Security &
Defense

Services & Facilities



- Flip Chip
- Bump Deposition
- Wire Bonding
- Sensor Manufacturing
- ASIC Development
- Complete Readout Design



Detection Technologies for Medical Imaging

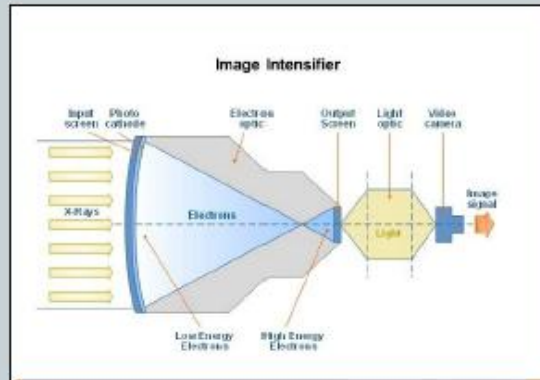


Image intensifier camera system

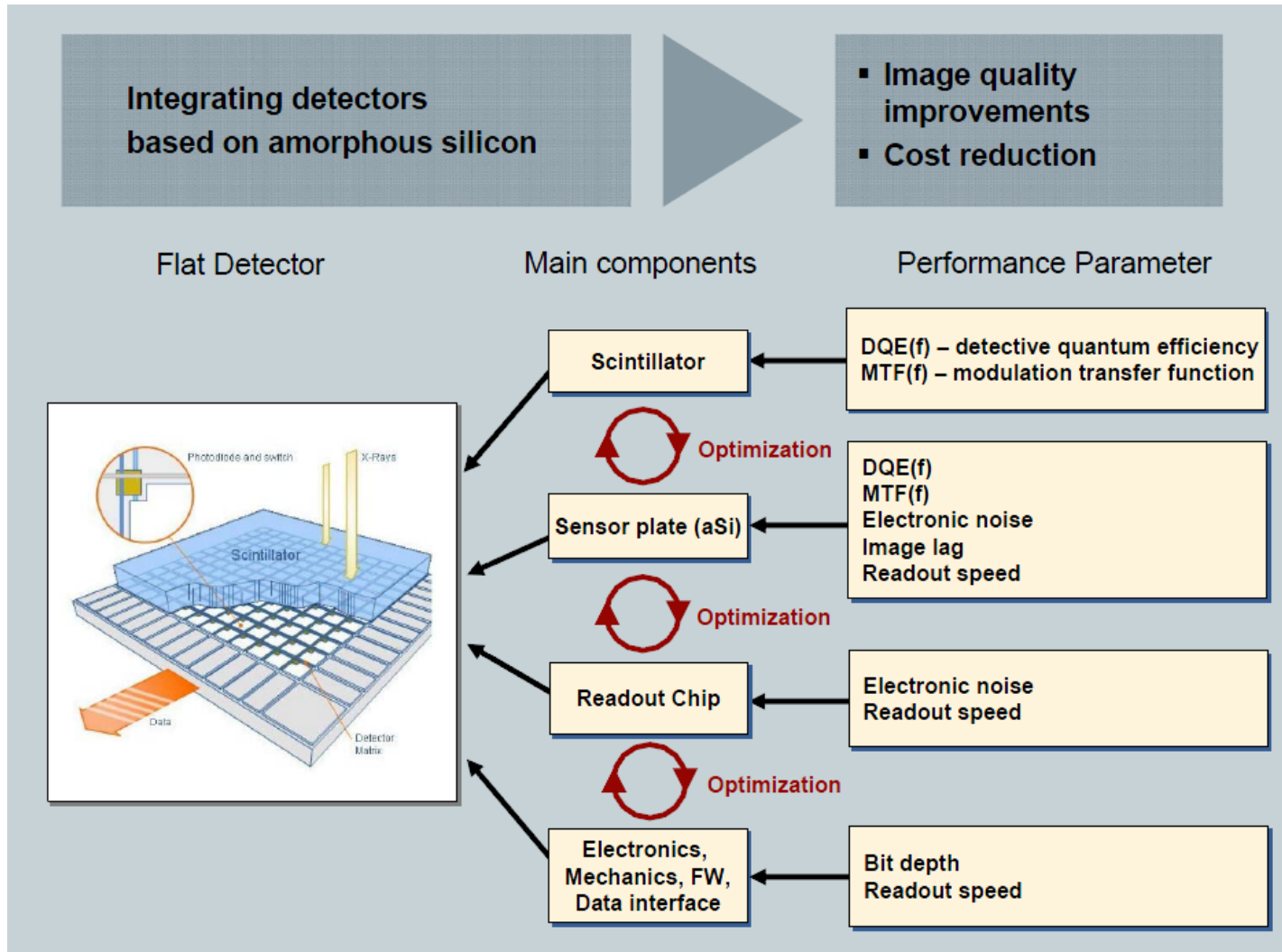


Analog film



Flat detectors

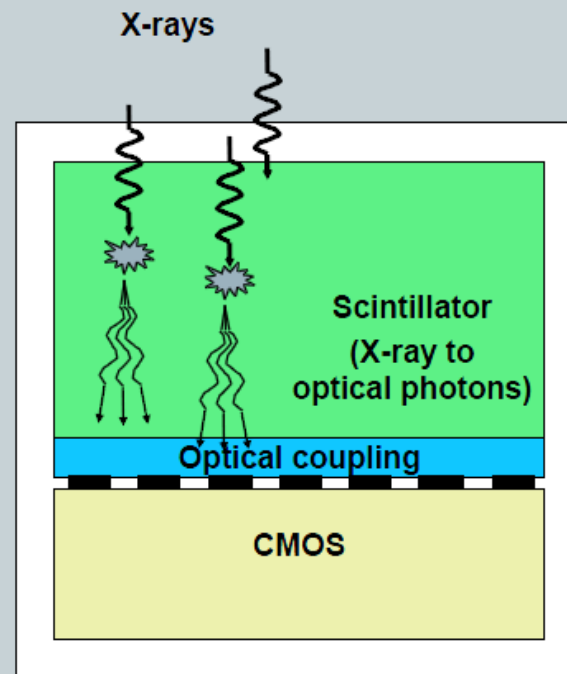
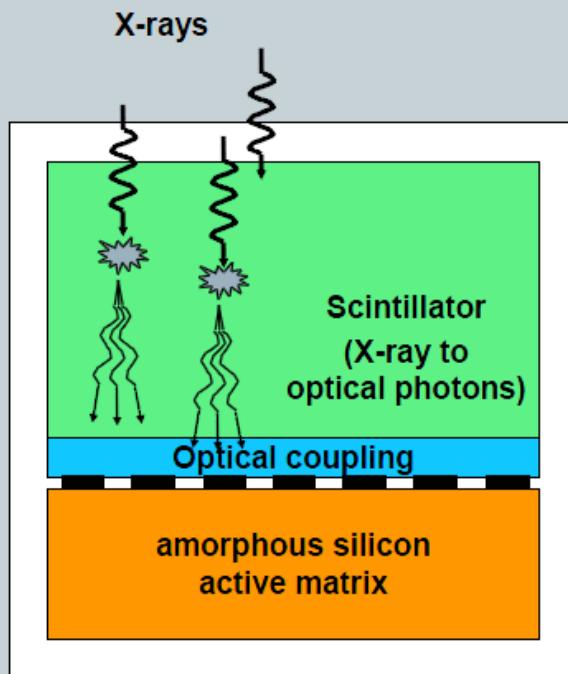
Detection Technologies for Medical Imaging



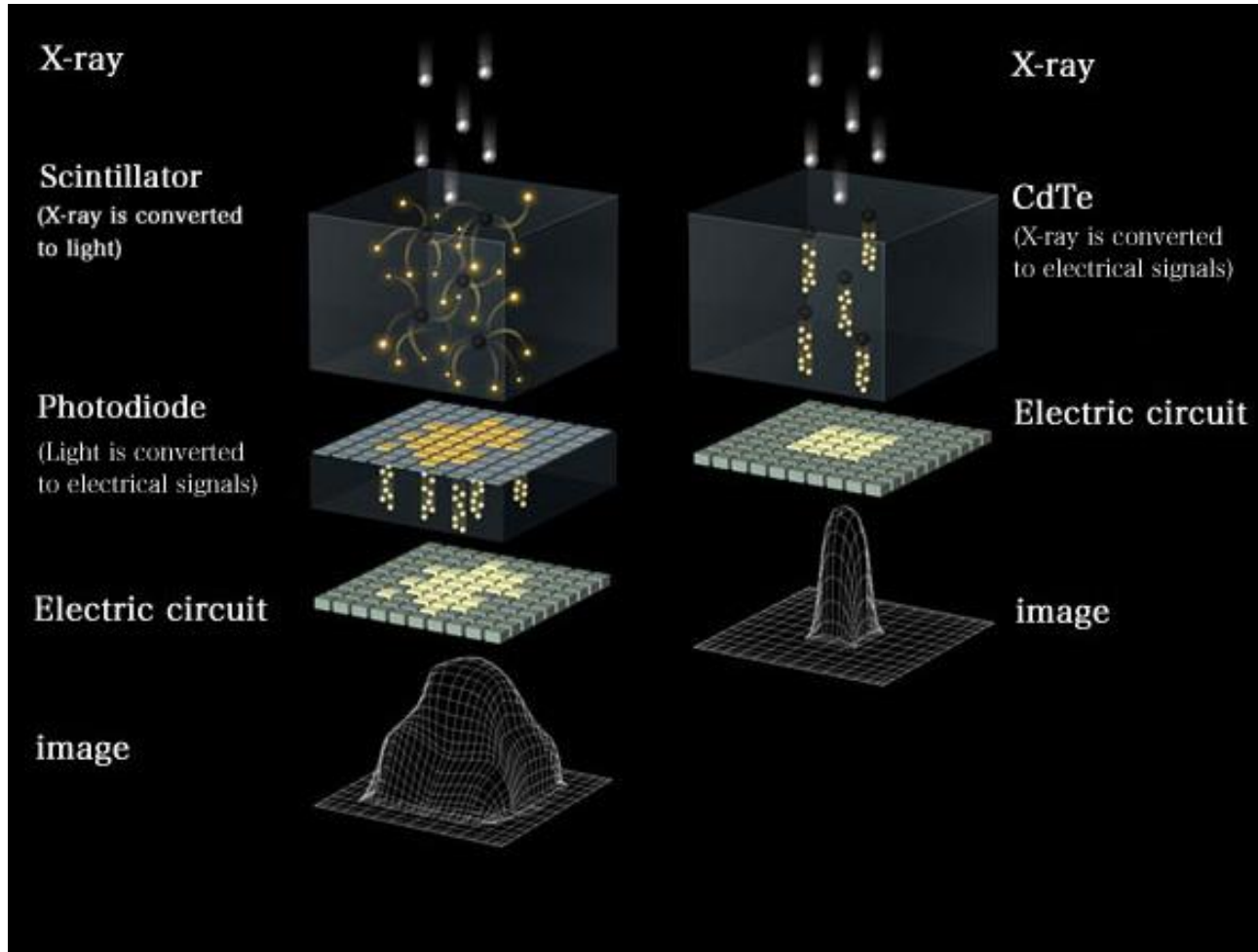
Detection Technologies for Medical Imaging

Integrating detectors based on CMOS

- Image quality and performance improvements
- Higher integration



Photon Counting



Photon Counting

Lower dose:

- Improved DQE (detective quantum efficiency)

$$SNR_{out}^2(f) = DQE(f) \cdot \underbrace{SNR_{in}^2(f)}_{\text{proportional to dose}}$$

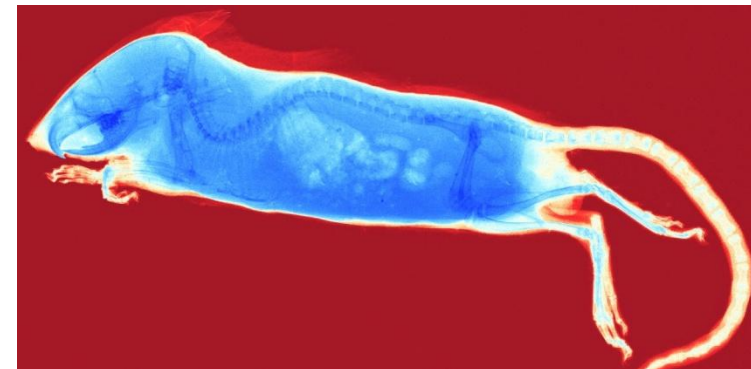
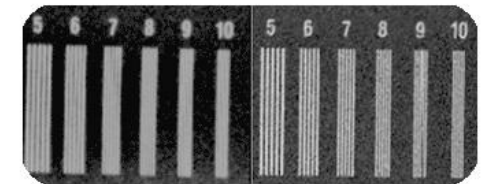
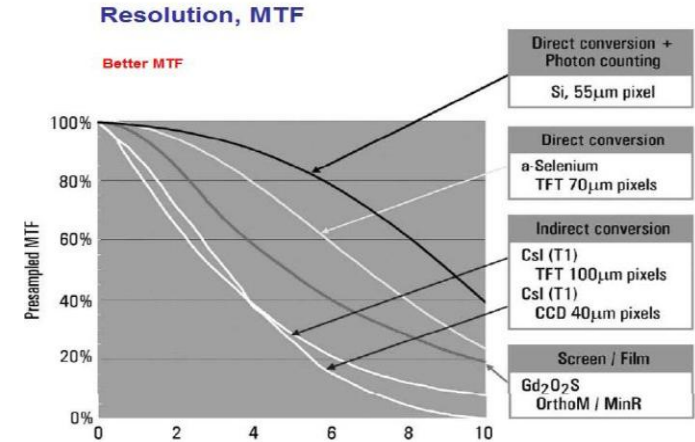
- Quantum-noise-limited imaging (no electronic noise)

Improved contrast (CNR):

- Low energies contribute more (equal weighting of spectrum)
- Weighting of energy bins in case of energy discriminating counting detectors.

New imaging applications:

- Material discrimination techniques ("color imaging")
- Material-selective imaging (K-edge imaging)

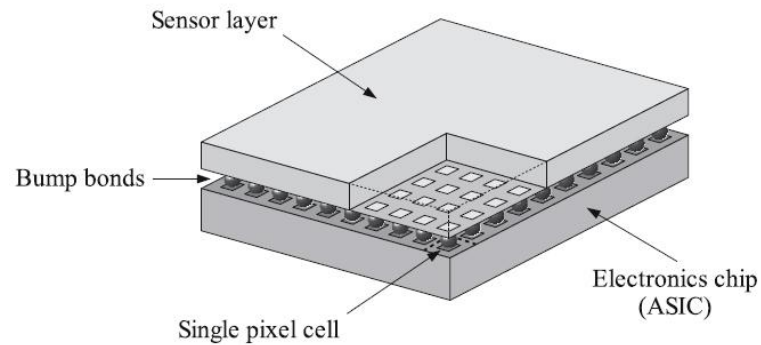
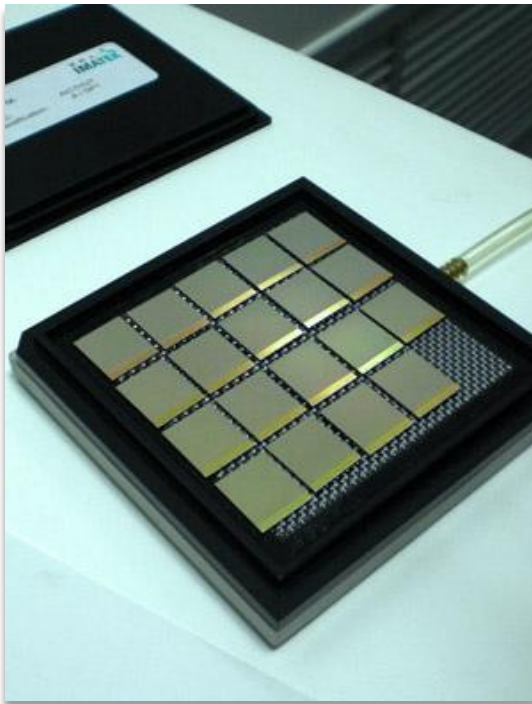


Medipix2/Timepix

The Medipix2/Timepix CMOS is a photon counting detector developed by the Medipix2 Collaboration at CERN.



The Medipix2 Collaboration



Main Features

- Pixels: 256 x 256 (65,536)
- Pixel Size: 55 x 55µm
- Area: 14.1 x 14.1 mm²
- Count Rate: 1 MHz
- Low Noise: < 75 e⁻
- Sensors: Si, CdTe GaAs...

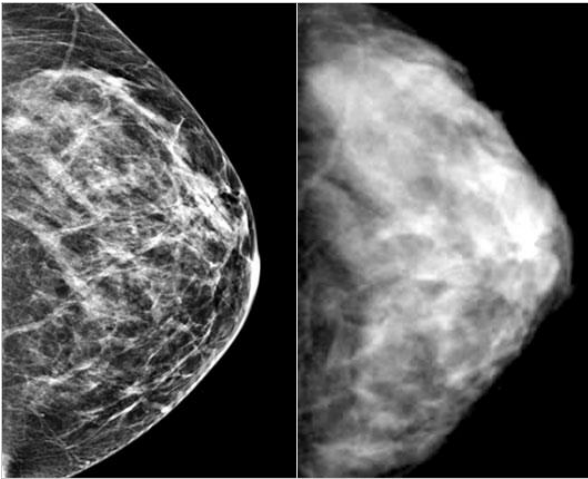
It is a pixel-detector readout chip consisting of 256 x 256 identical elements, each working in single photon counting mode for positive or negative input charge signals. Each pixel occupies a total area of 55µm x 55µm where a 20µm octagonal opening connects the detector and the amplifier via bump bonding.

Case Study: the XRI-1

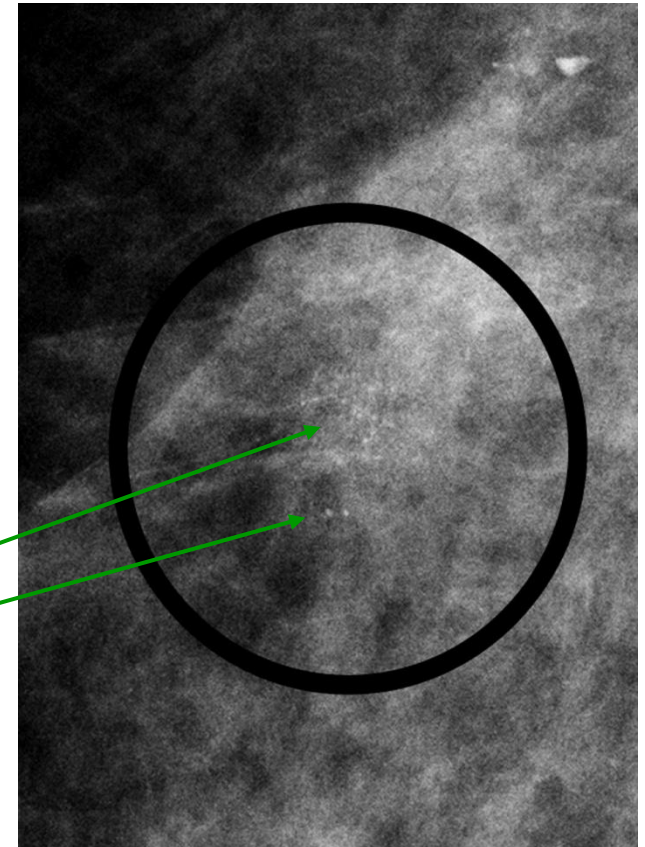
Standard image area in mammography is 24 cm x 31 cm (or 396 MPX chips)

Digital technology surpasses analog results (DMIST study)

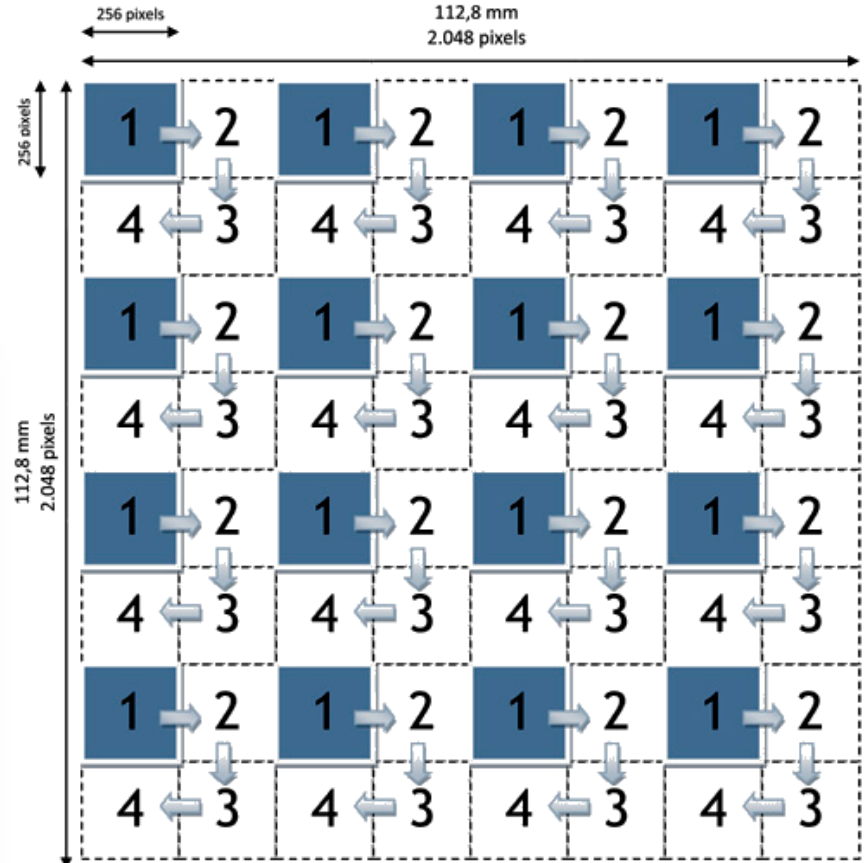
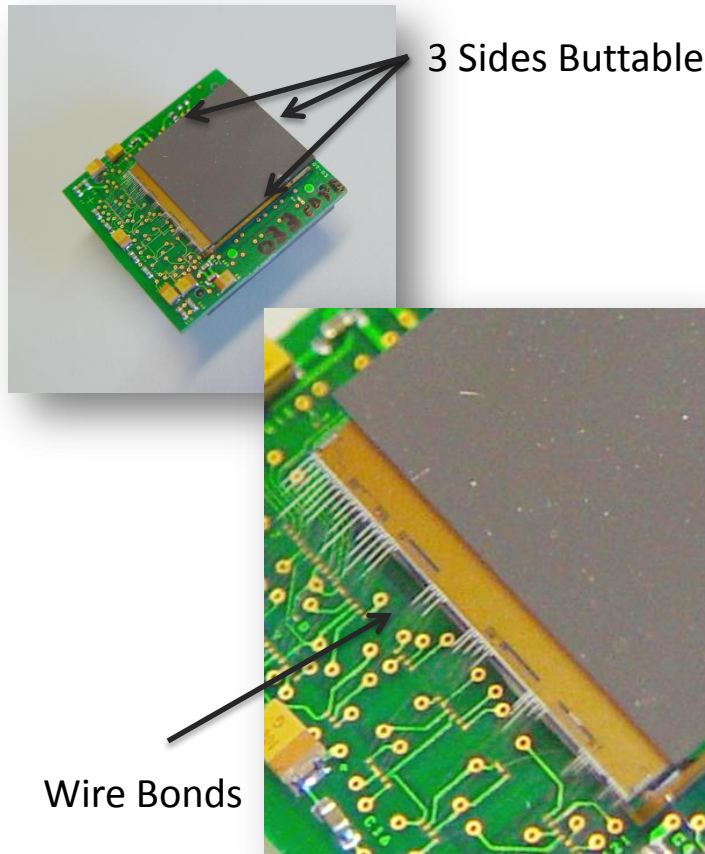
Image enhancement plus Computer-Aided Diagnosis (CAD)



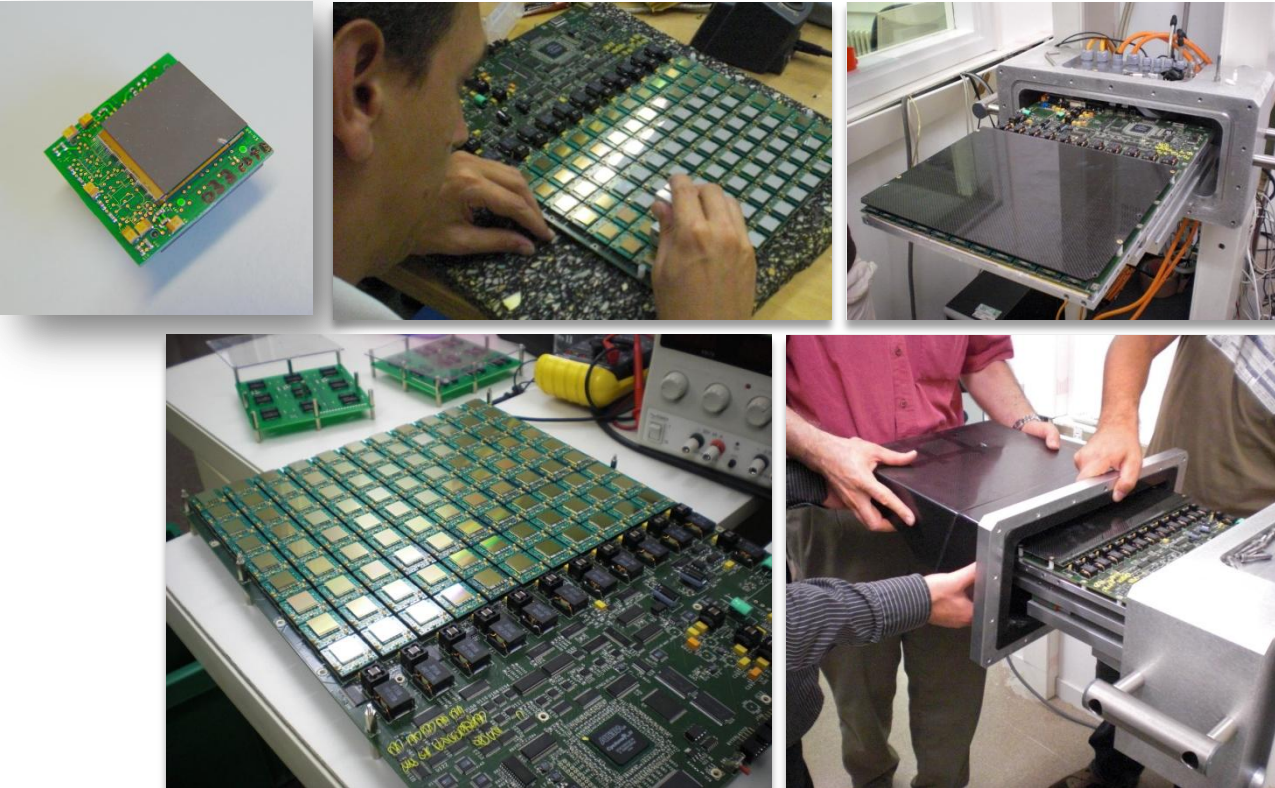
- Most challenging of radiographic disciplines
- Early signs of breast cancer
 - ~ 100 μm microcalcifications
 - Low contrast objects



Case Study: the XRI-1



Case Study: the XRI-1



Case Study: the XRI-1



Fish
5632 x 4608 pixels
FOV: 24cm x 30cm.
RAW Image
Total Acquisition Time: 1,5 sec

Conclusions

- The Medipix2/Timepix is a working X-Ray detector ready for research and commercial use
- It is a photon counting multipurpose CMOS chip
- Modularity allows multiple form factors depending on the application, like Tiling and Scanning 1D or 2D
- Modularity Available with Si, GaAs and CdTe sensors.
- A large area detector for digital mammography has been built and tested
 1. Excellent image quality although statistically limited due to Si
 2. Current implementation is not competitive in the current digital mammography market due to its costs.
- More fields of application in Medical Imaging
 - Pre-clinical Imaging (In Vivo)
 - microCT
 - SPECT
 - Spectral CT
 - PET systems
 - Dental Imaging



Thank You For Your Attention

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