X-ray imaging from different perspectives

Combining a new imaging method with existing ones

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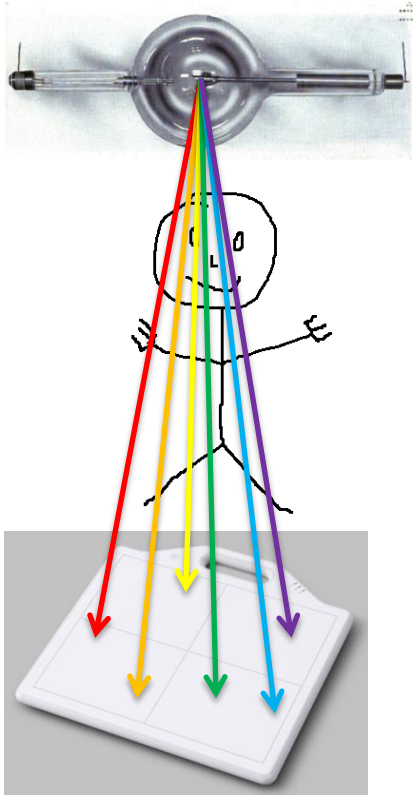
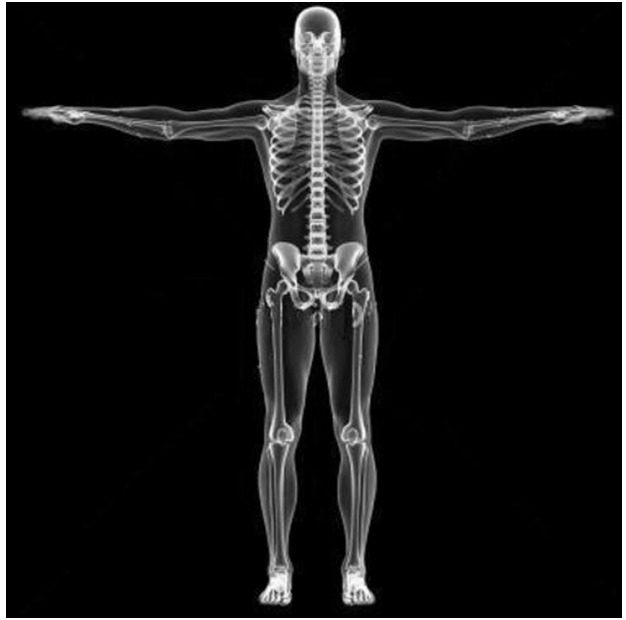
Nikhef

X-ray image

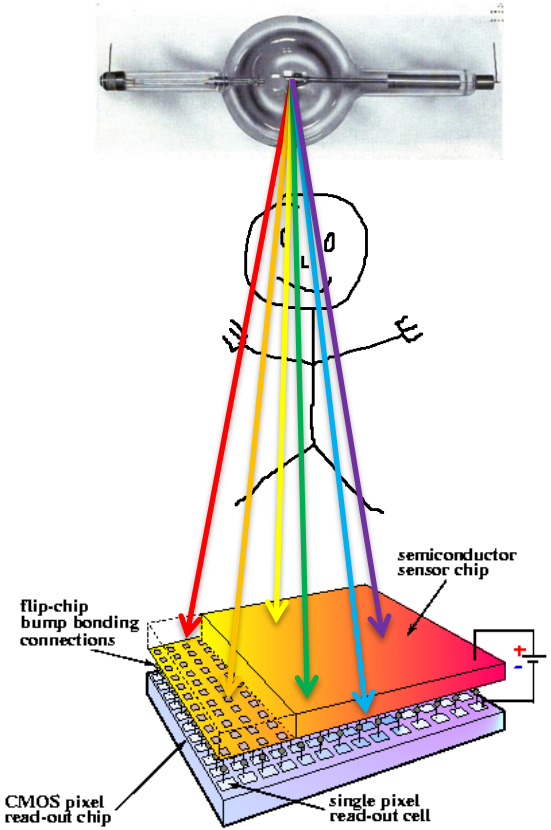


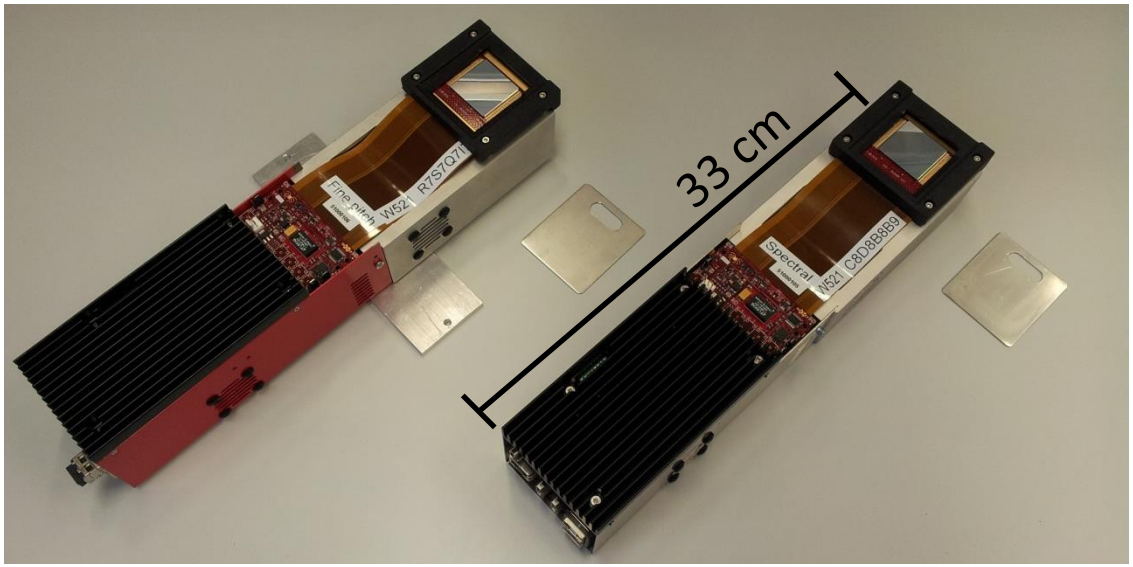
X-ray source

X-ray detector



Current research: Spectral X-ray imaging

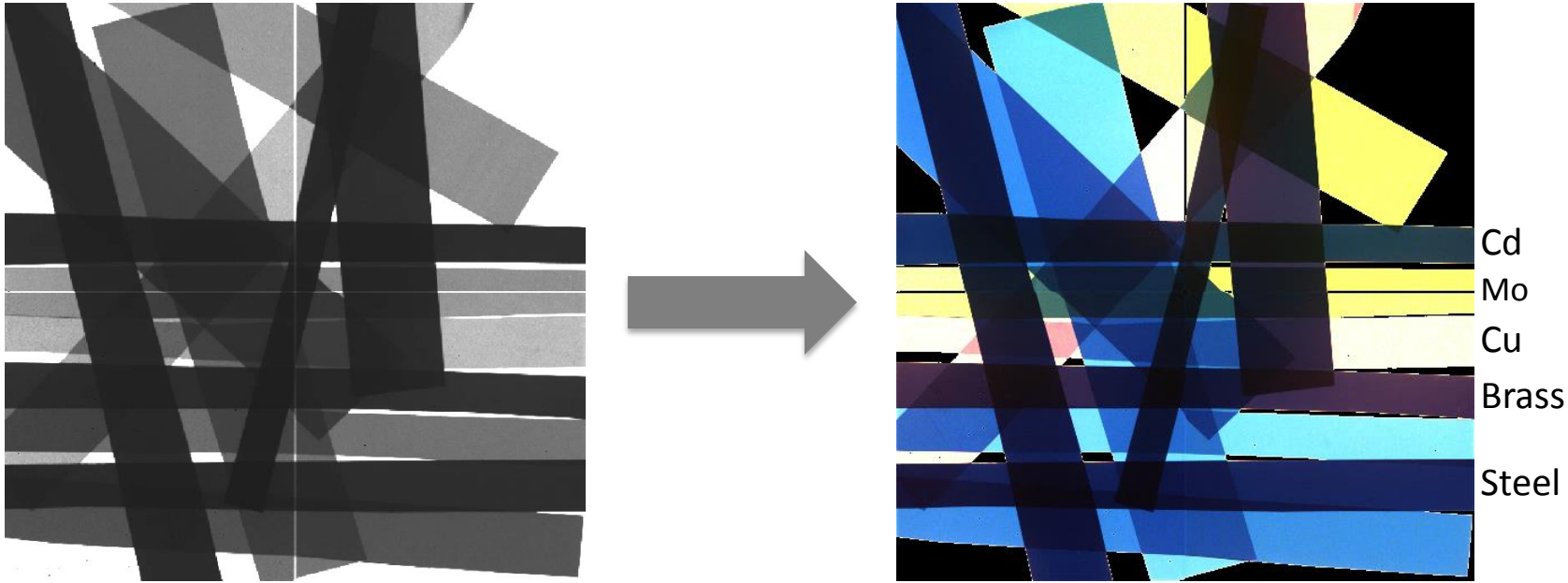




Medipix3 detectors. Electronics developed at Nikhef

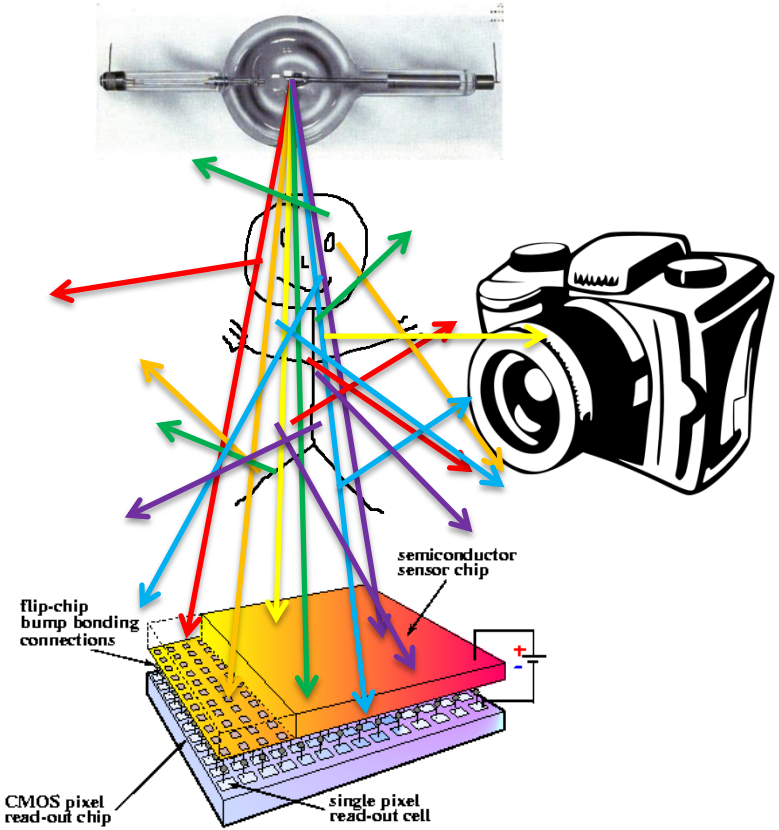
From conventional to spectral

Metal foils (sample 3 x 3 cm)



Reducing ambiguity between sample ‘thickness’ and composition.

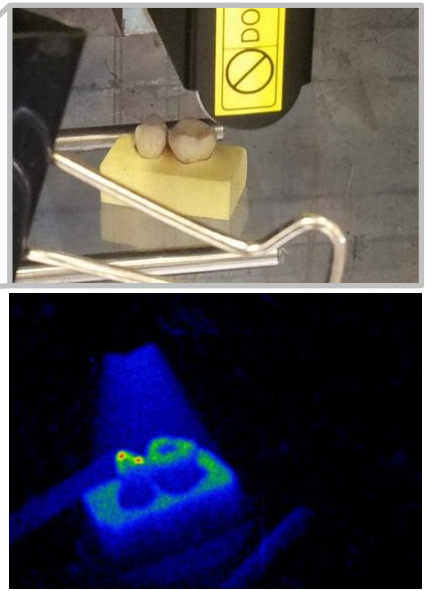
There is more to ‘see’



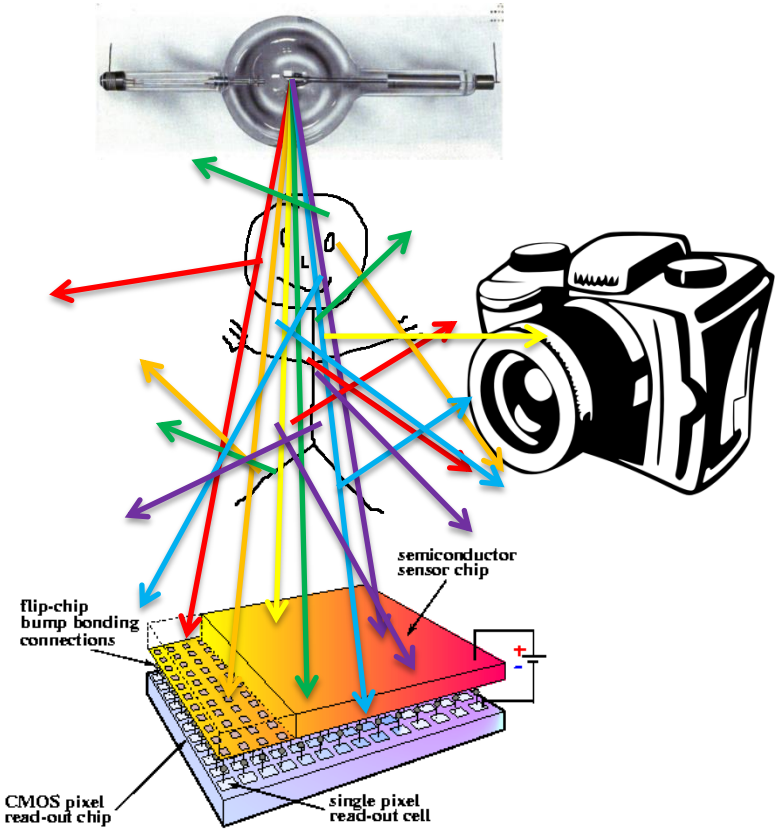
- (Compton) scattered X-rays
- Fluorescence

Medipix3 pinhole camera

(fake?) teeth



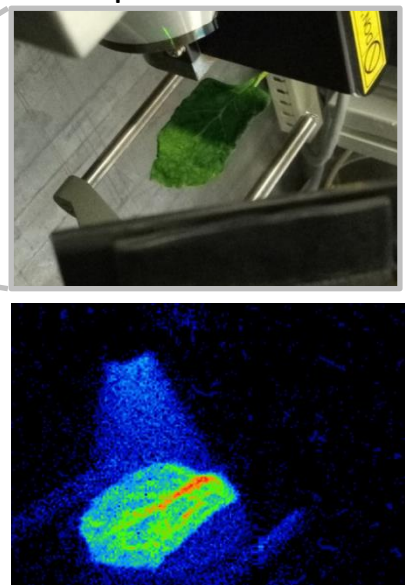
There is more to ‘see’



- (Compton) scattered X-rays
- Fluorescence

Medipix3 pinhole camera

Spinach leaf



Our goals

- Single shot combination of:
  - ‘Direct’ X-ray imaging
  - (Compton) scattered X-rays imaging
  - Fluorescence imaging

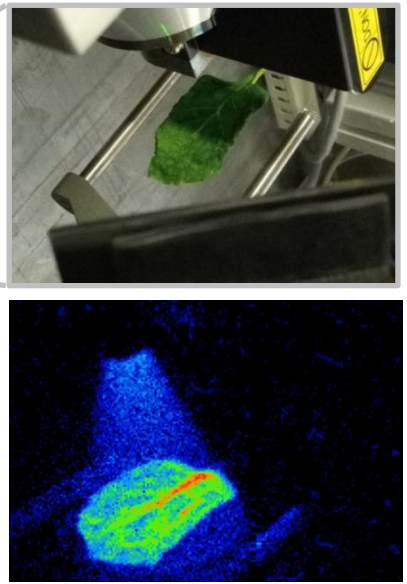
→ *Sample structure and composition*

- Single shot ‘4π’ imaging (just add cameras)

→ *Spatial information*

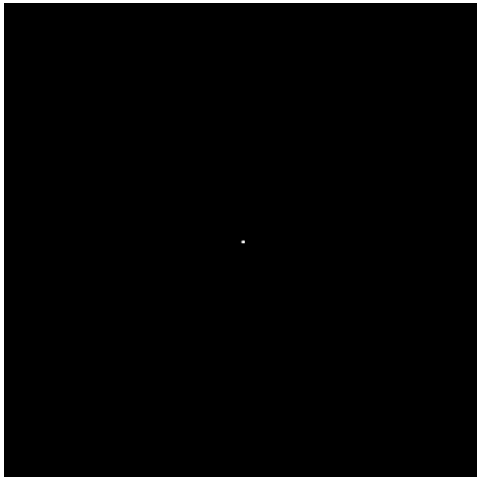
Medipix3 pinhole camera

Spinach leaf



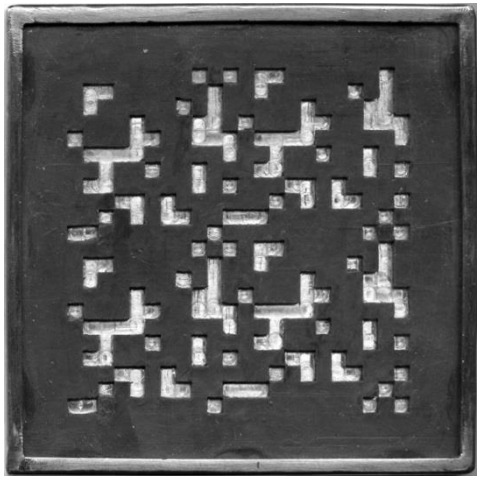
Two lens-less imaging methods

Pinhole



- Point and extended sources
- *Light efficiency < 10^{-3}*

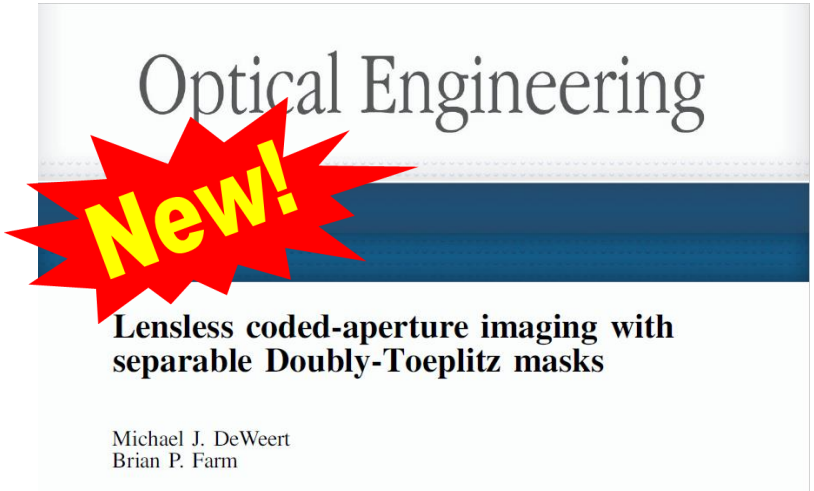
Coded aperture



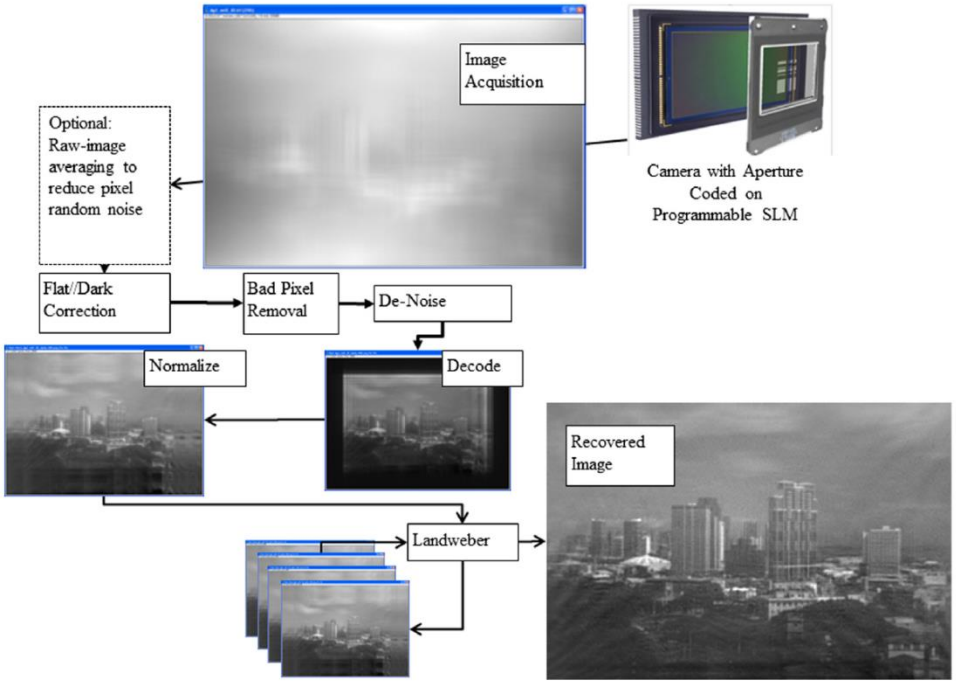
- *Point sources*
- Light efficiency > 10^{-1}

Take the best of both!

Coded aperture for extended sources



Optical Engineering 54(2), 023102 (February 2015)



Seems promising!

Challenges and opportunities

Coded aperture:

- Noise sensitivity?
- Sensitivity to systematic effects?

→ Sufficient light efficiency?

- Other (lens-less) imaging methods?

- What applications benefit most?
  - Currently looking at mammography

Opportunity for a new X-ray imaging technology!