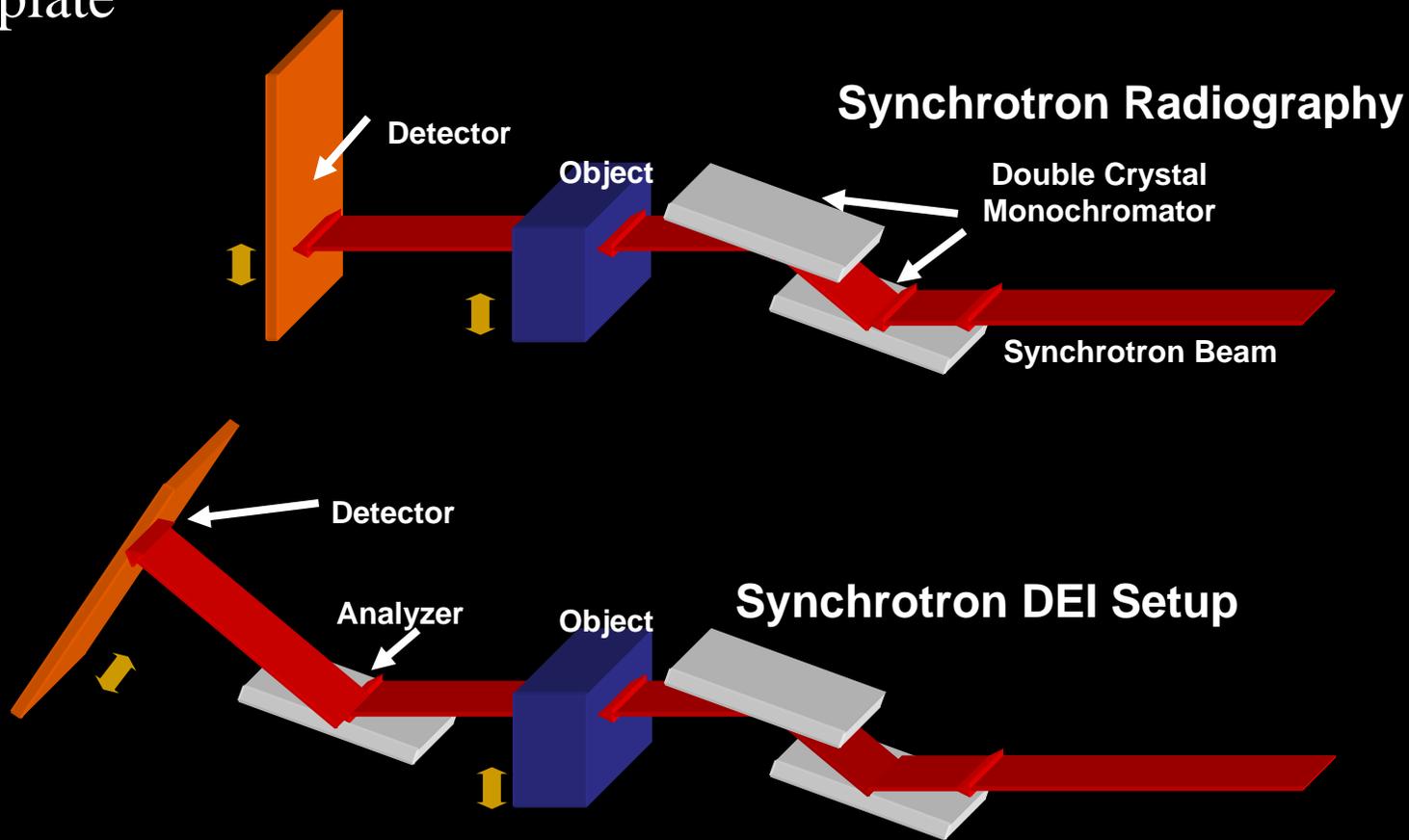


Diffraction Enhanced Imaging

Zhong Zhong

X15A - current resources

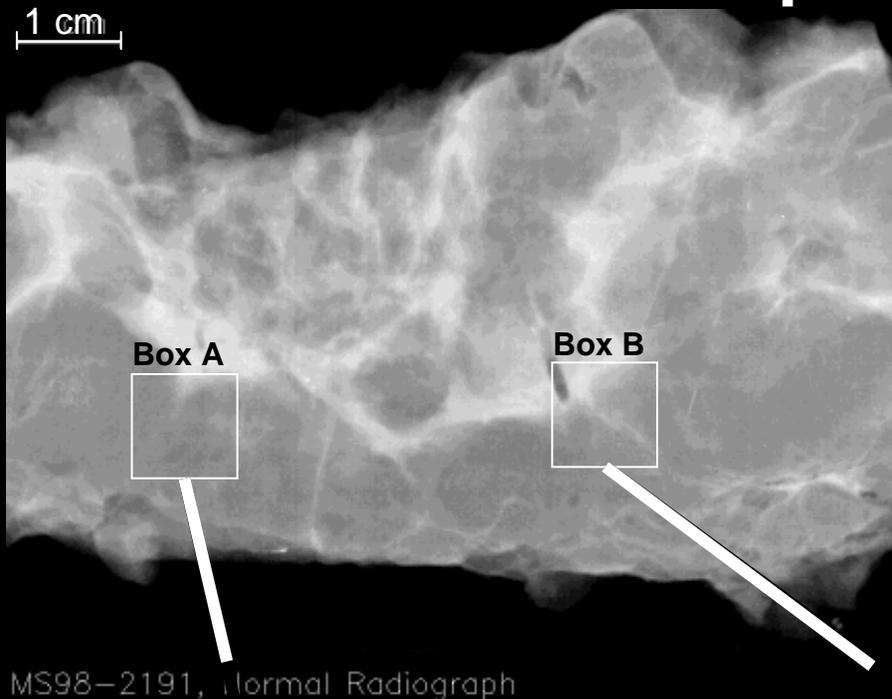
- Silicon 111 and 333 monochromator with matching analyzer
- 10 - 60 keV
- 3 detectors: 9 micron CCD, 30 micron CCD, 50 micron image plate



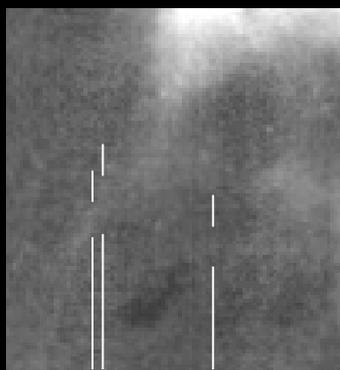
X15A – Research Programs

- Breast cancer imaging
- Osteoarthritis and cartilage research
- Alzheimer's Disease
- Small animal imaging

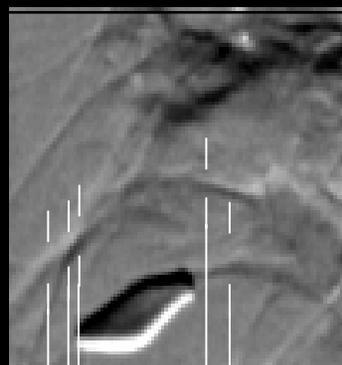
Science at X15A: Spiculations in Breast Cancer



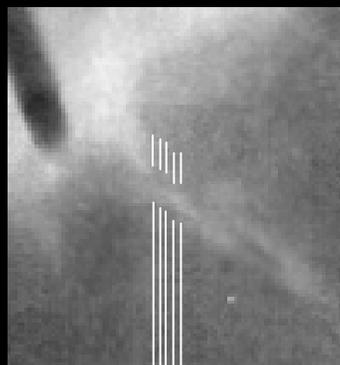
- Spiculations are due to cancer itself or the response of the host to the cancer
- Contrast quantified by measuring intensity change across spiculations
- DEI has 8 – 33 times greater contrast



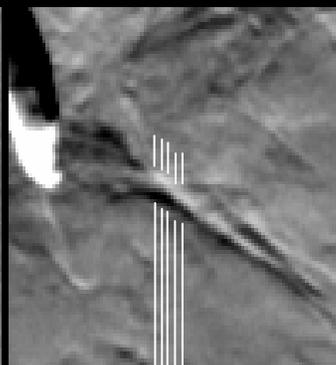
Rad



DEI

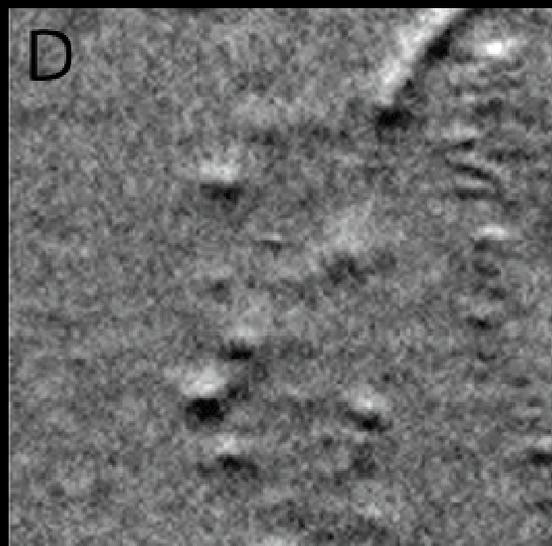
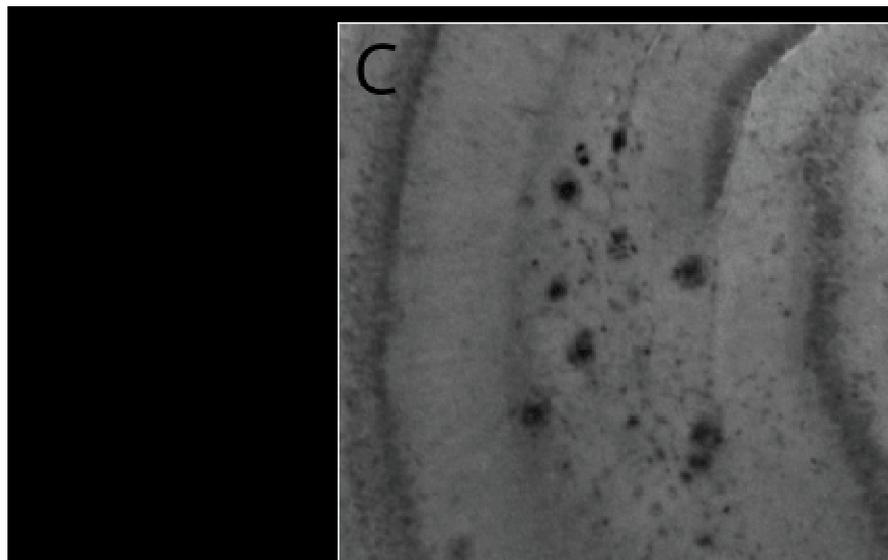
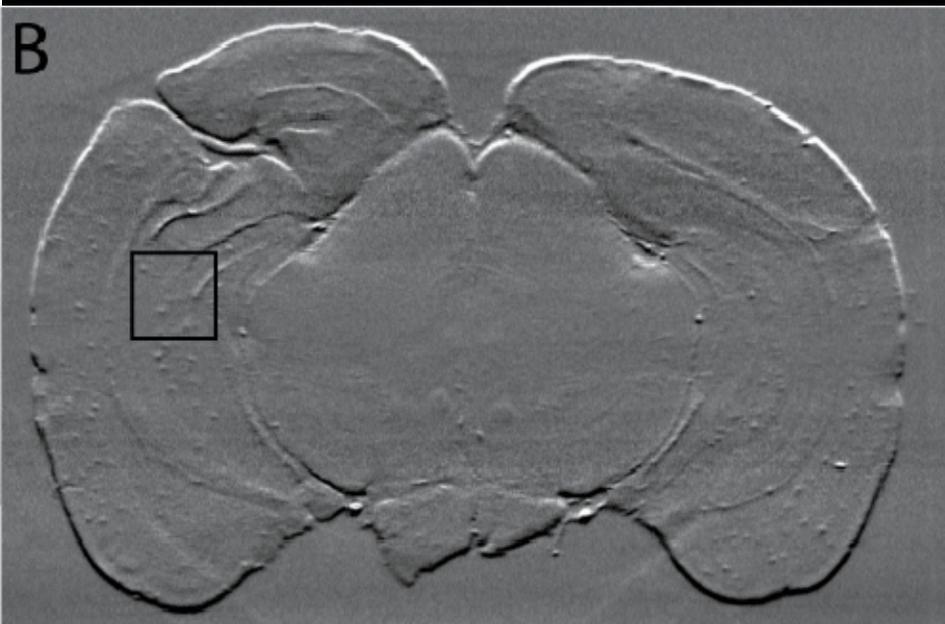
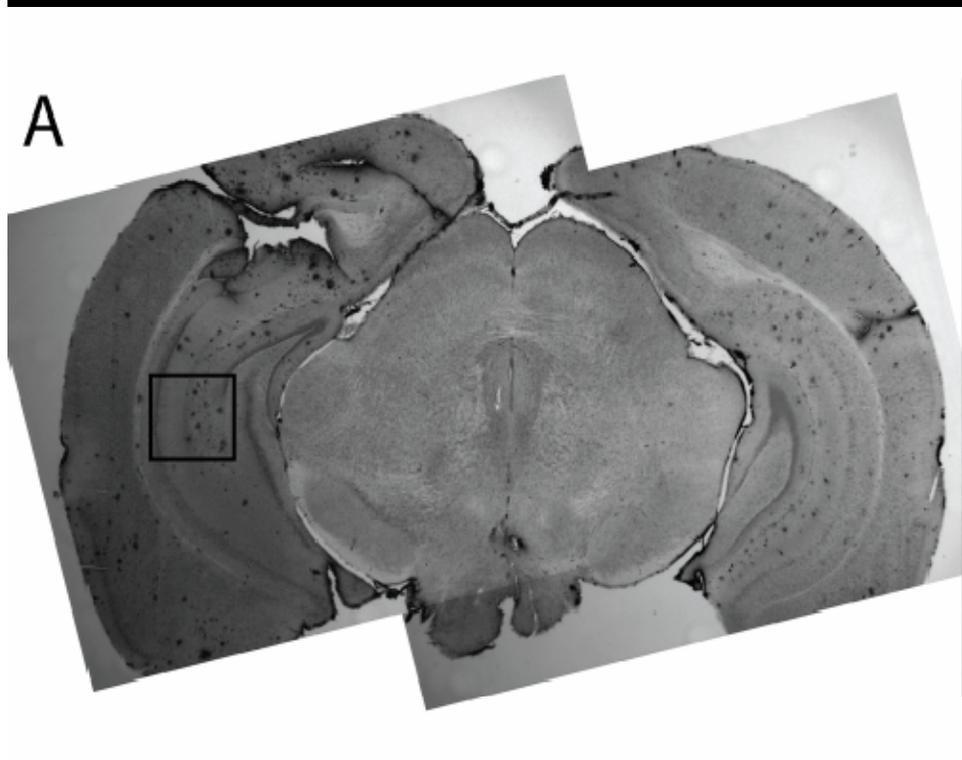


Rad

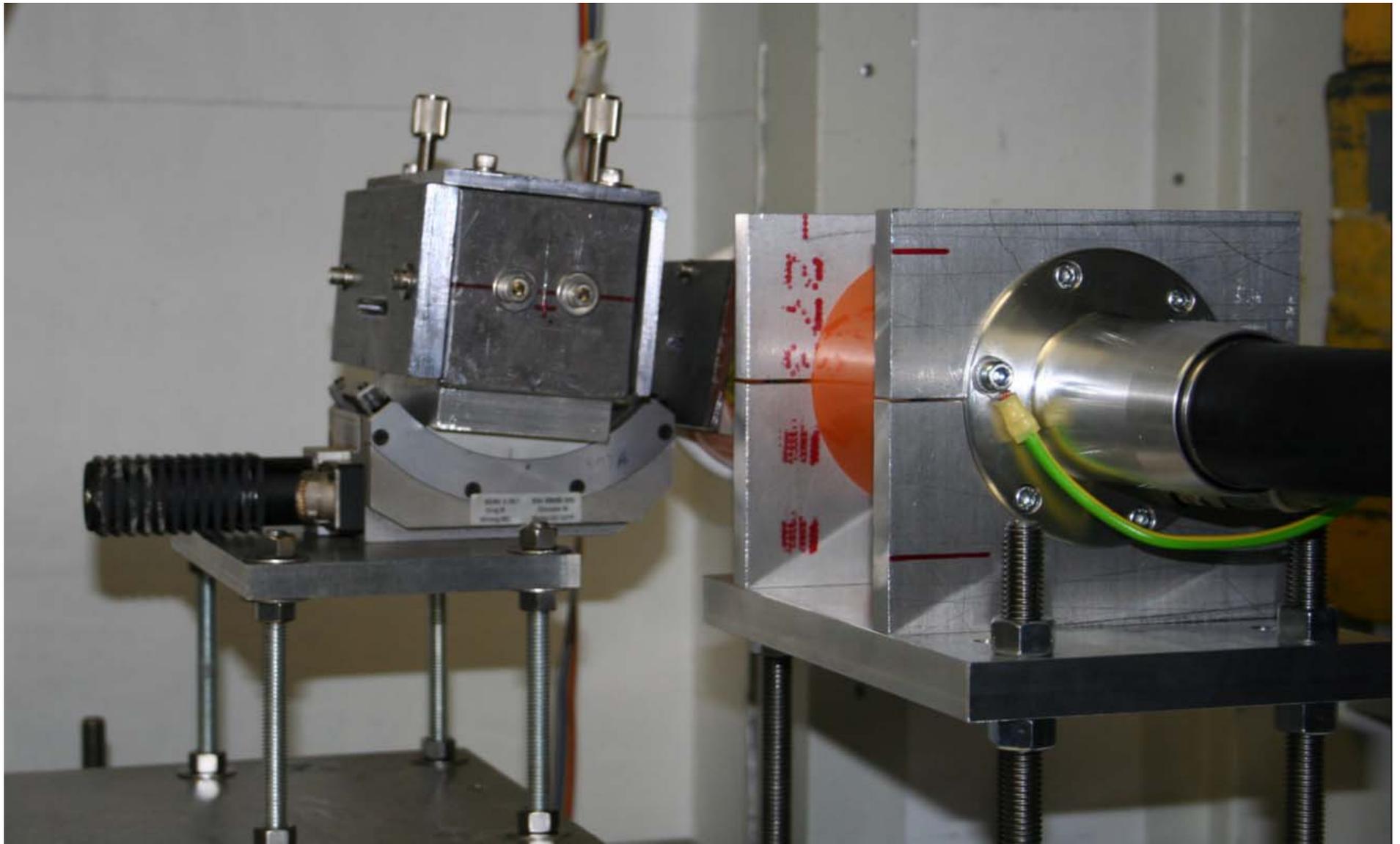


DEI

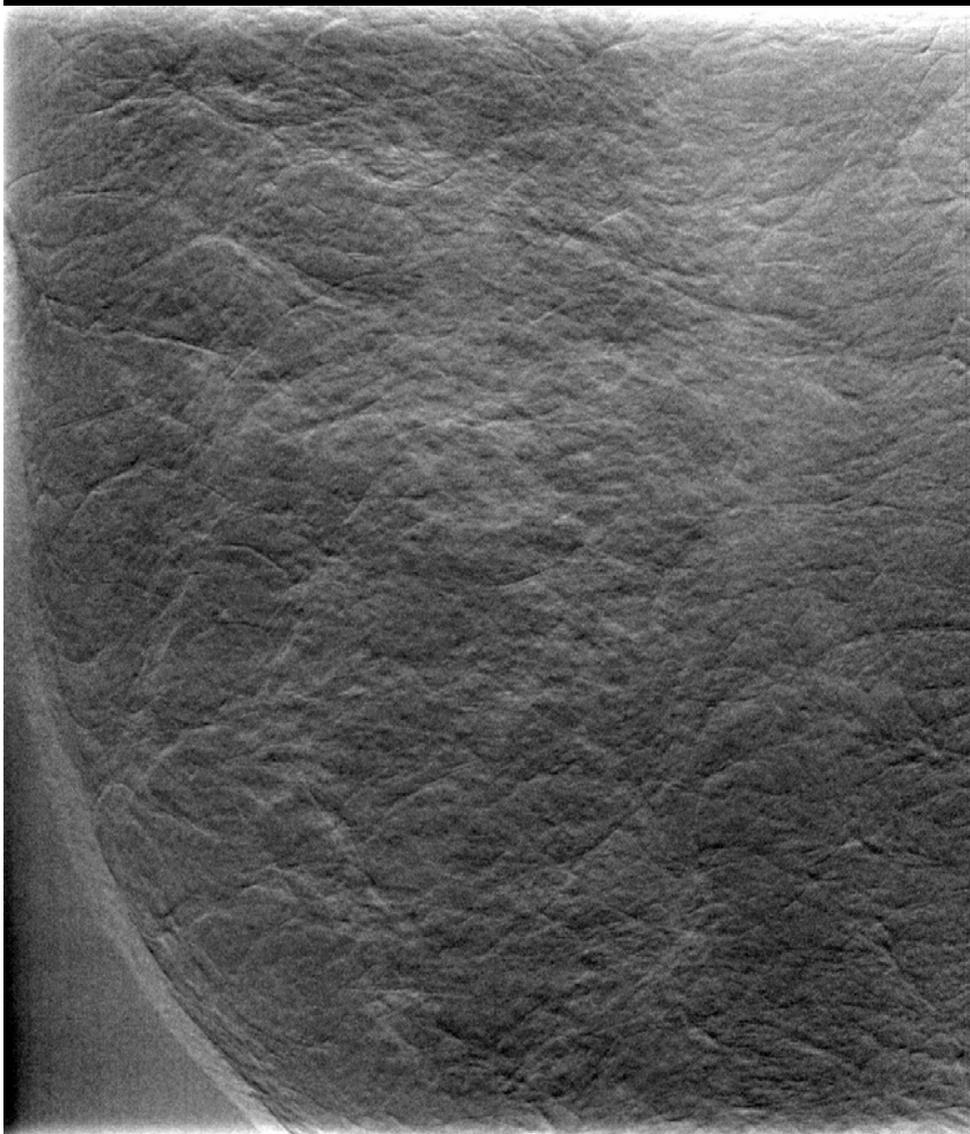
Imaging Alzheimer's Plaques in Mouse Brain



Prototype DEI with x-ray tube



Prototype DEI with x-ray tube

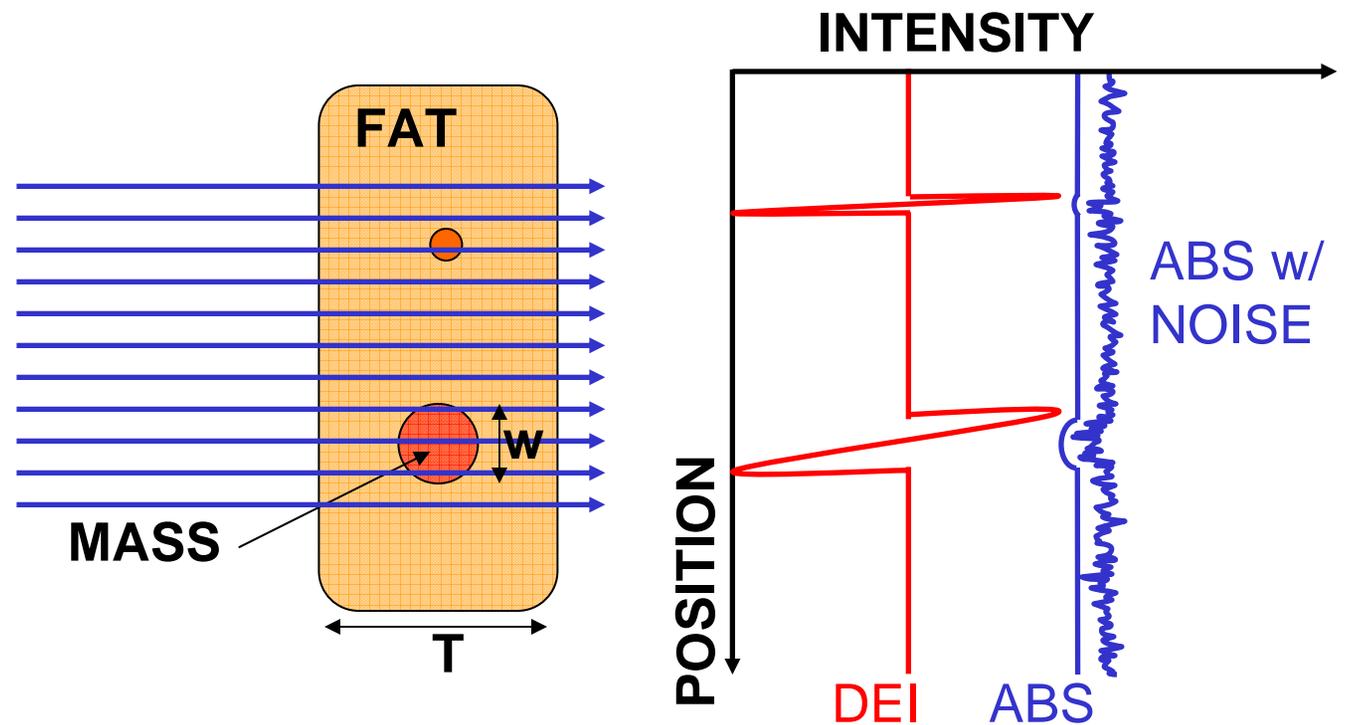


DEI (8 mrad)



GE Digital (400 mrad)

Where is the limit? Dose and Resolution



Absorption: Contrast proportional to object size w

- Dose $\sim 1/w^4$
- 1 mGy for $w=100$ microns, 10^5 Gy for $w = 1$ micron

DEI : Contrast independent of object size

- Dose $\sim 1/w^2$
- 0.1 mGy for $w=100$ microns, 1 Gy for $w = 1$ micron

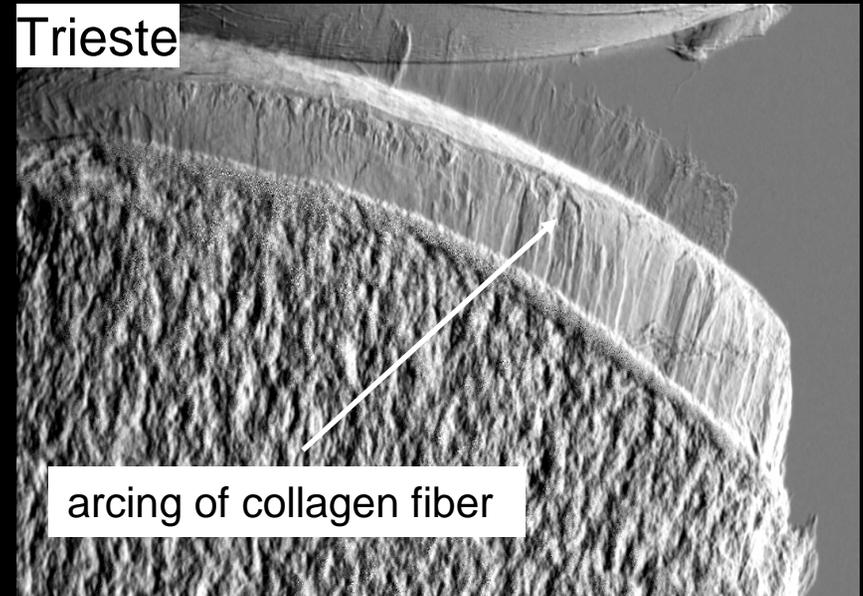
NISL-II, High-res DEI reveals micro-structure

Currently Limited by:

- Source size -> Spatial resolution ~ 50 microns
- Brightness -> Sensitivity ~ 0.1 micro-radians
- The advantages of DEI are not realized for small features

High brightness of NSLS-II will allow:

- 1 micron resolution
- 0.01 micro-radians sensitivity
- Micro-structure in animal models, e.g., amyloid plaques in Alzheimer's disease models



My next DEI beam line

- Superconducting wiggler to enable imaging above 60 keV
- Sample environment more appropriate for live animals (humans included)
- Part of biomedical research suite
- Incorporate:
 - Lessons learned at Trieste, ESRF, Spring8
 - Lessons that will be learned at CLS and Australian Light Source and Shanghai Light Source