Specifications of a computed tomography dedicated to the breast with synchrotron radiation.

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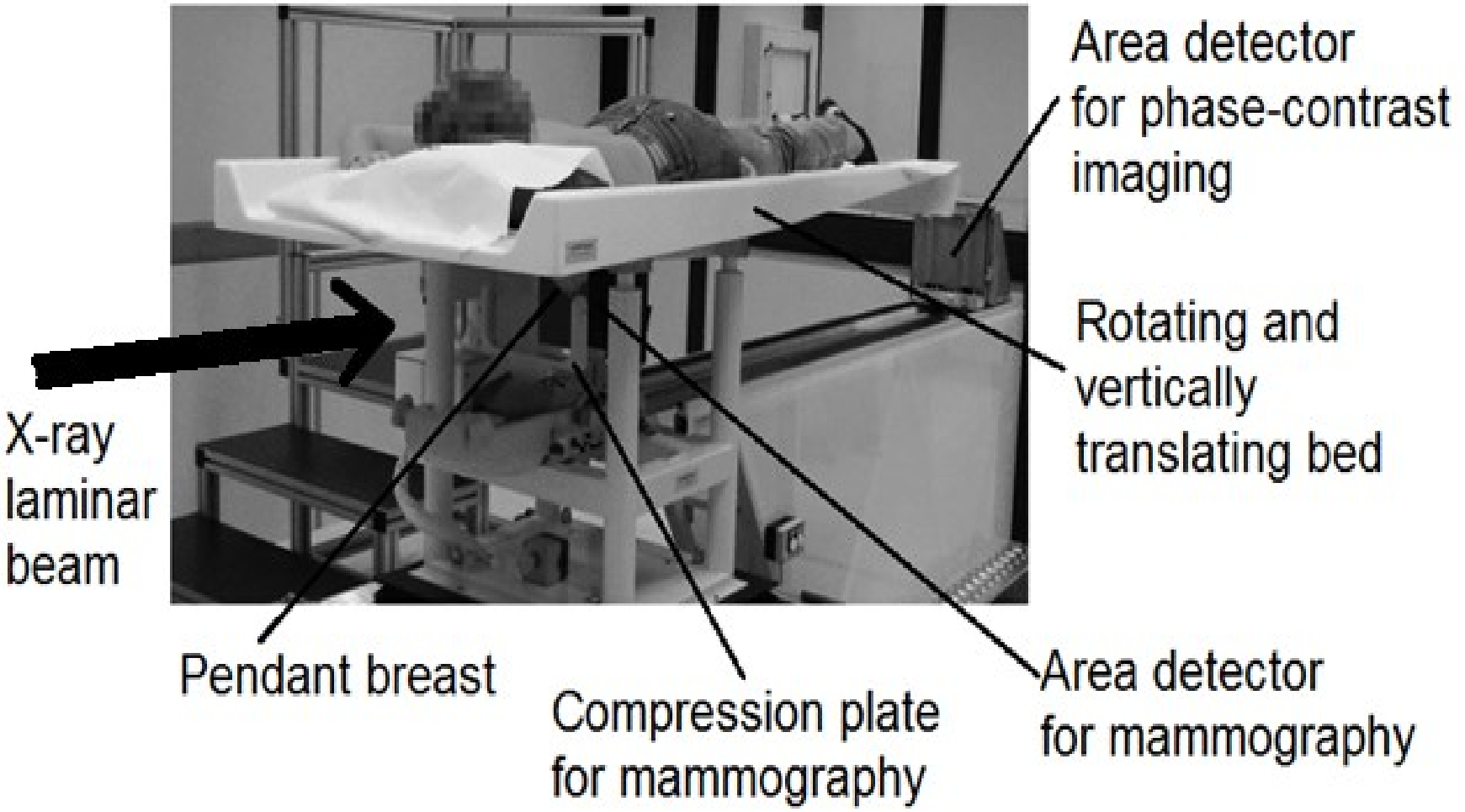
on behalf of the SYRMA-CT Collaboration

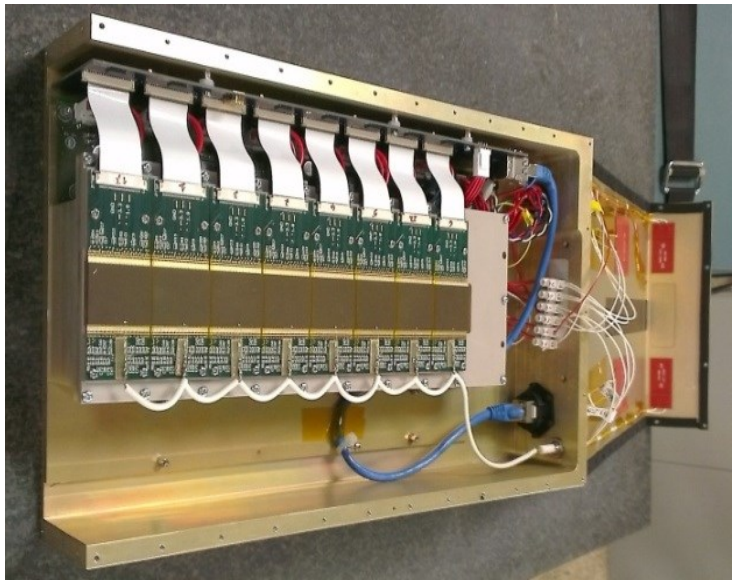
Università Federico II & INFN Sez. Napoli

SYRMA-CT setup



Project features

High resolution single photon counting X-ray detector



- 650 μm CdTe, hexagonal pixel

  60-mm pitch
- Active Area 250 × 25 mm^2
- Energy range 1-100 keV

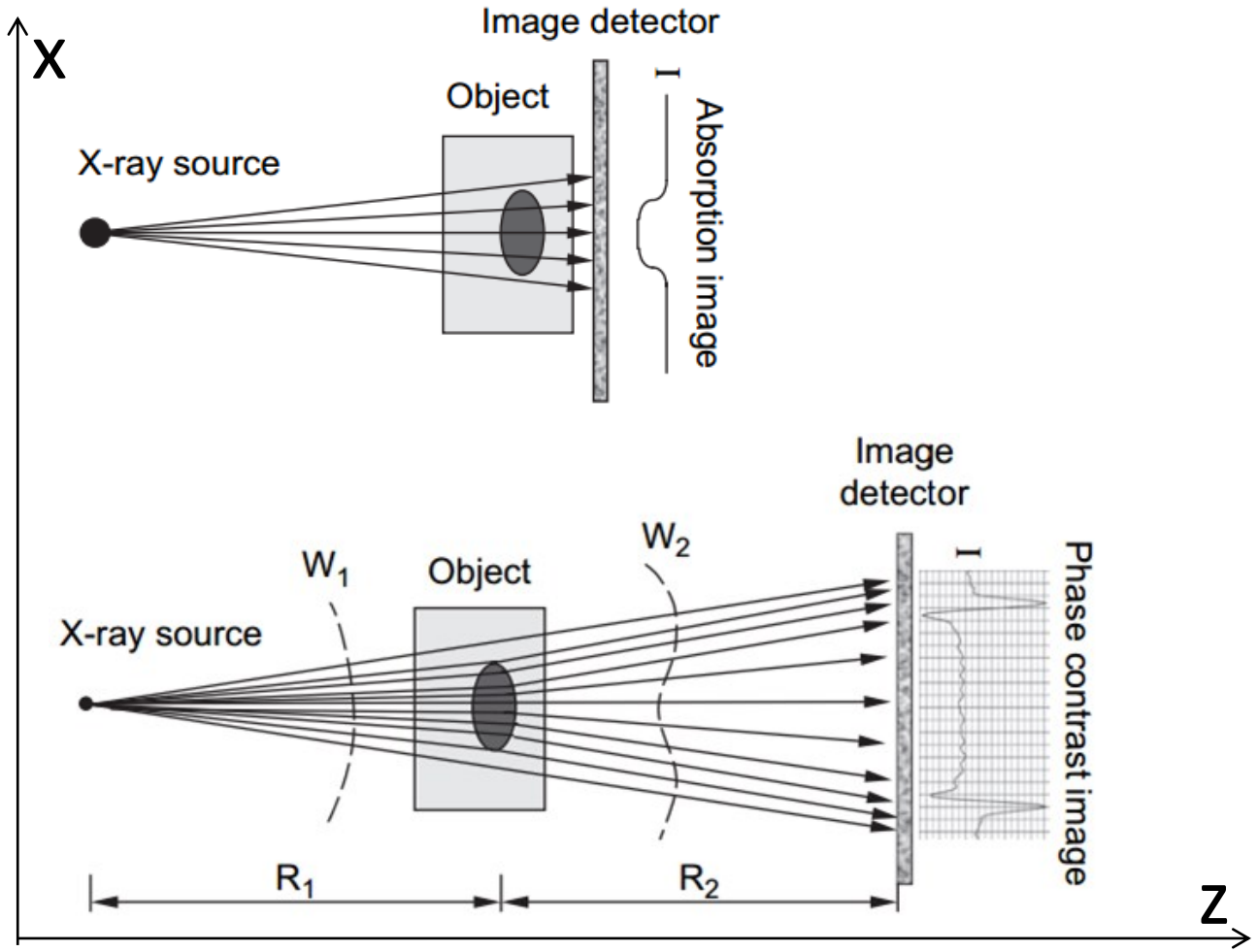
PiXirad Imaging Counters s.r.l. the chromatic photon counting

Project features

Propagation-based phase contrast imaging

Attenuation Based Imaging

Propagation-based Phase-Contrast Imaging



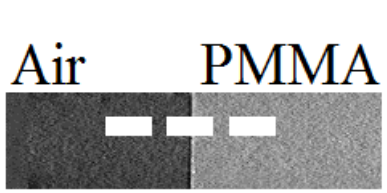
Breast specimen – 5-mm thick

Phase CT slice

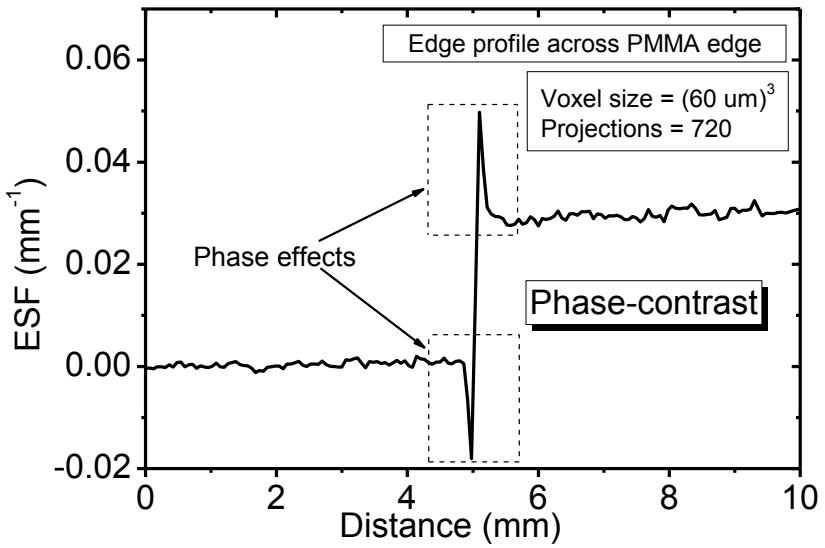
Voxel size = $(120\ \mu m)^3$

Mammogram

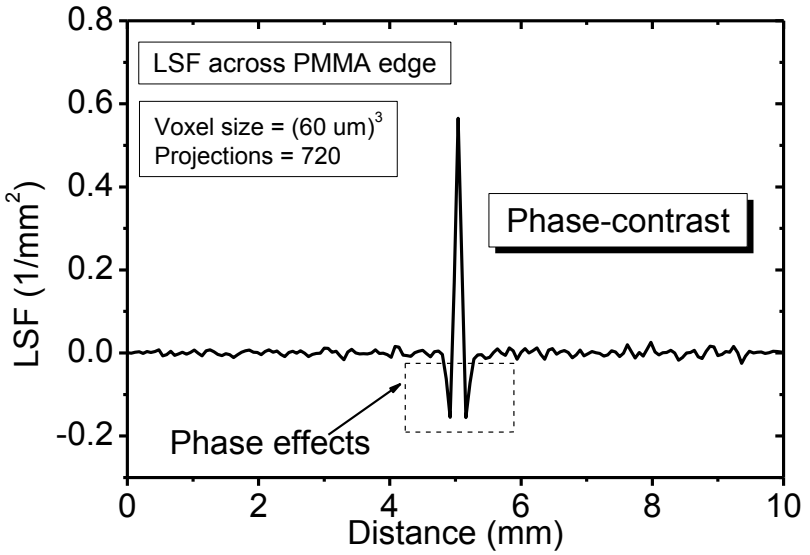
Pixel size = $(100\ \mu m)^2$

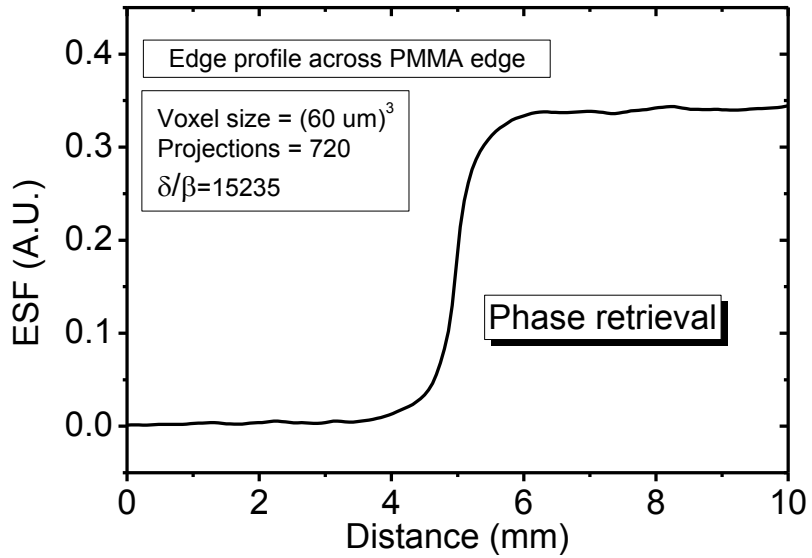


Edge Spread Function and Line Spread Function

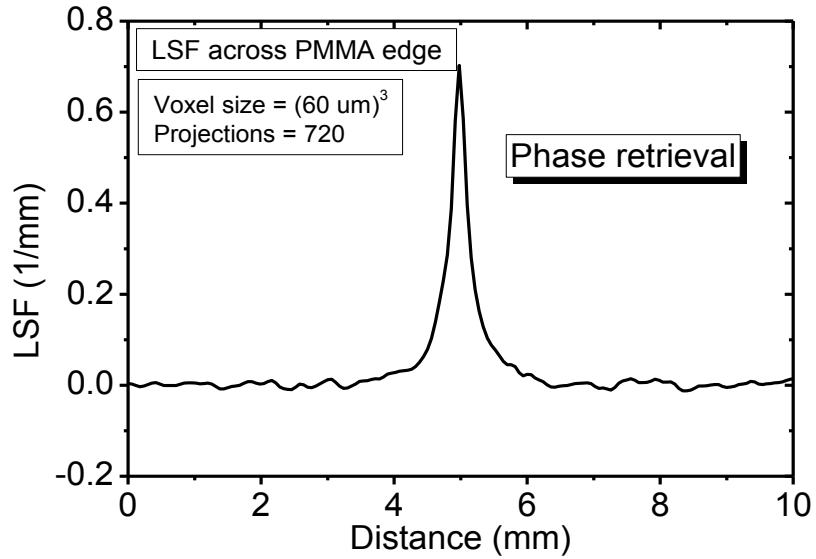


d/dx

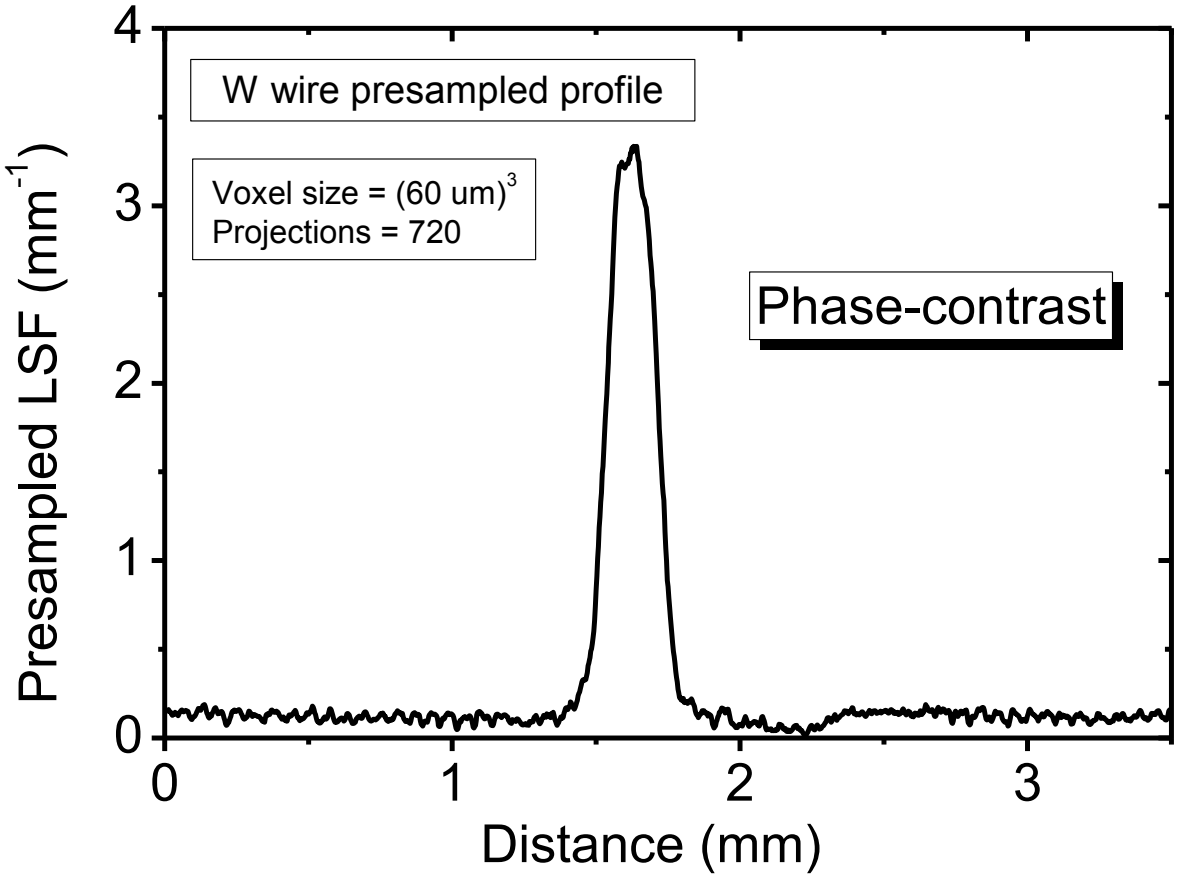




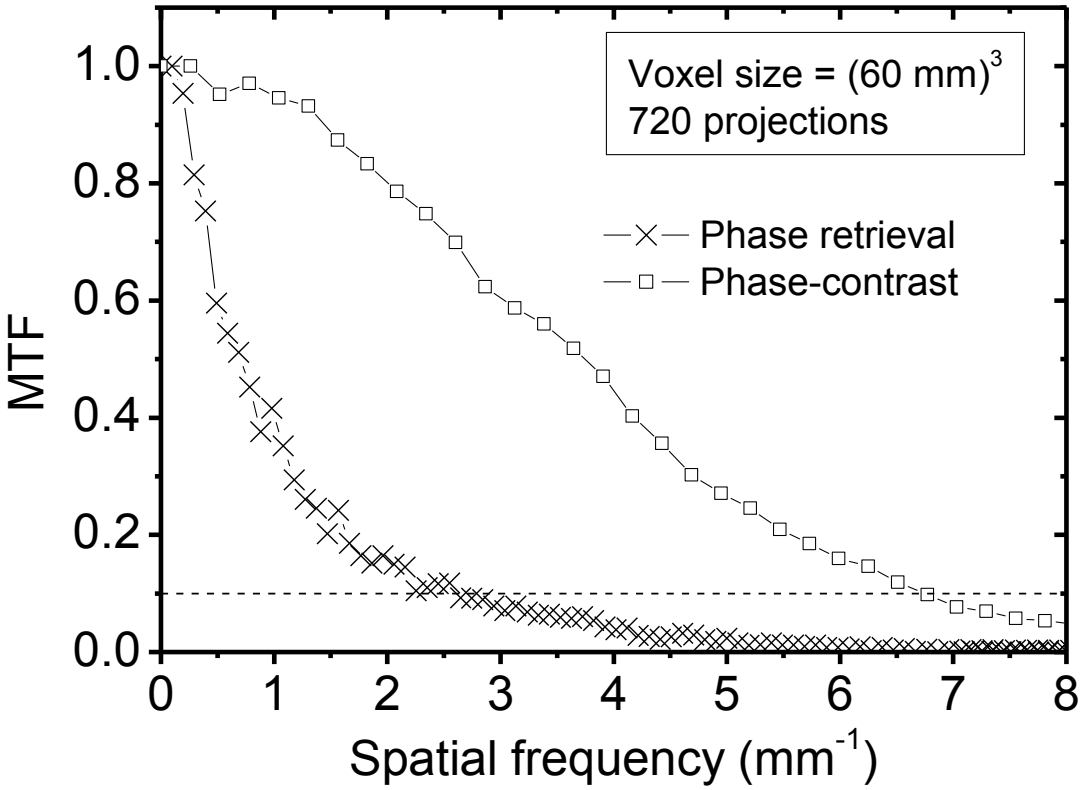
d/dx

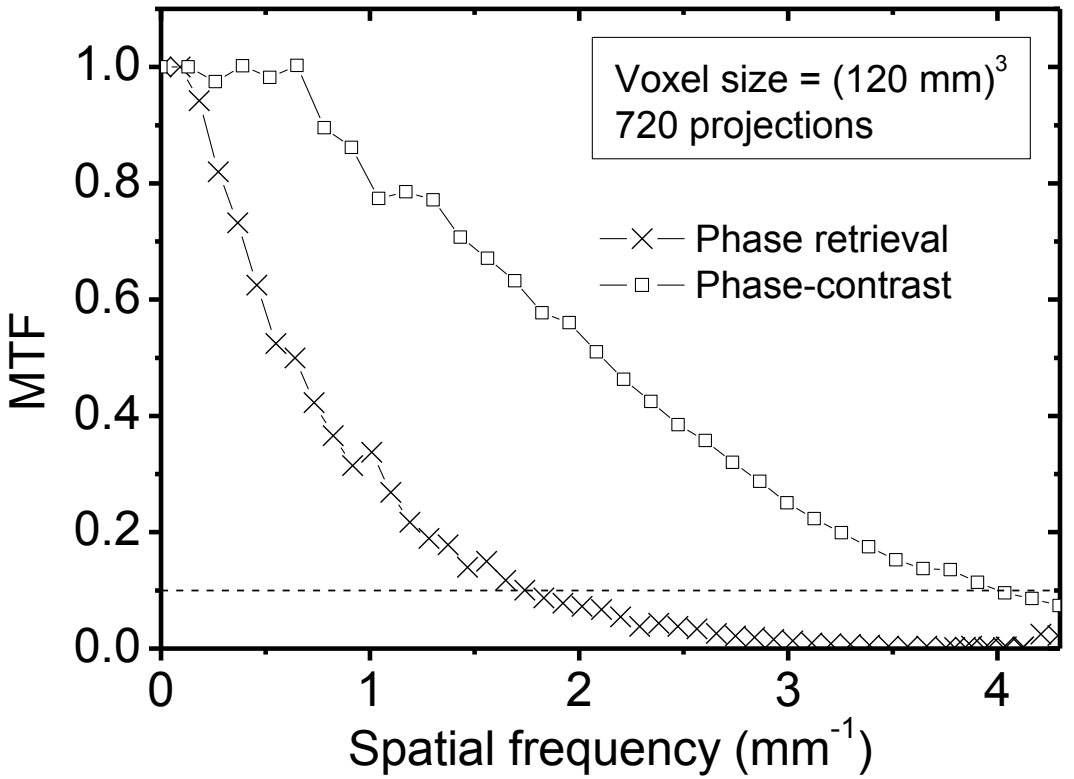


Presampled PSF on W wire in attenuation imaging

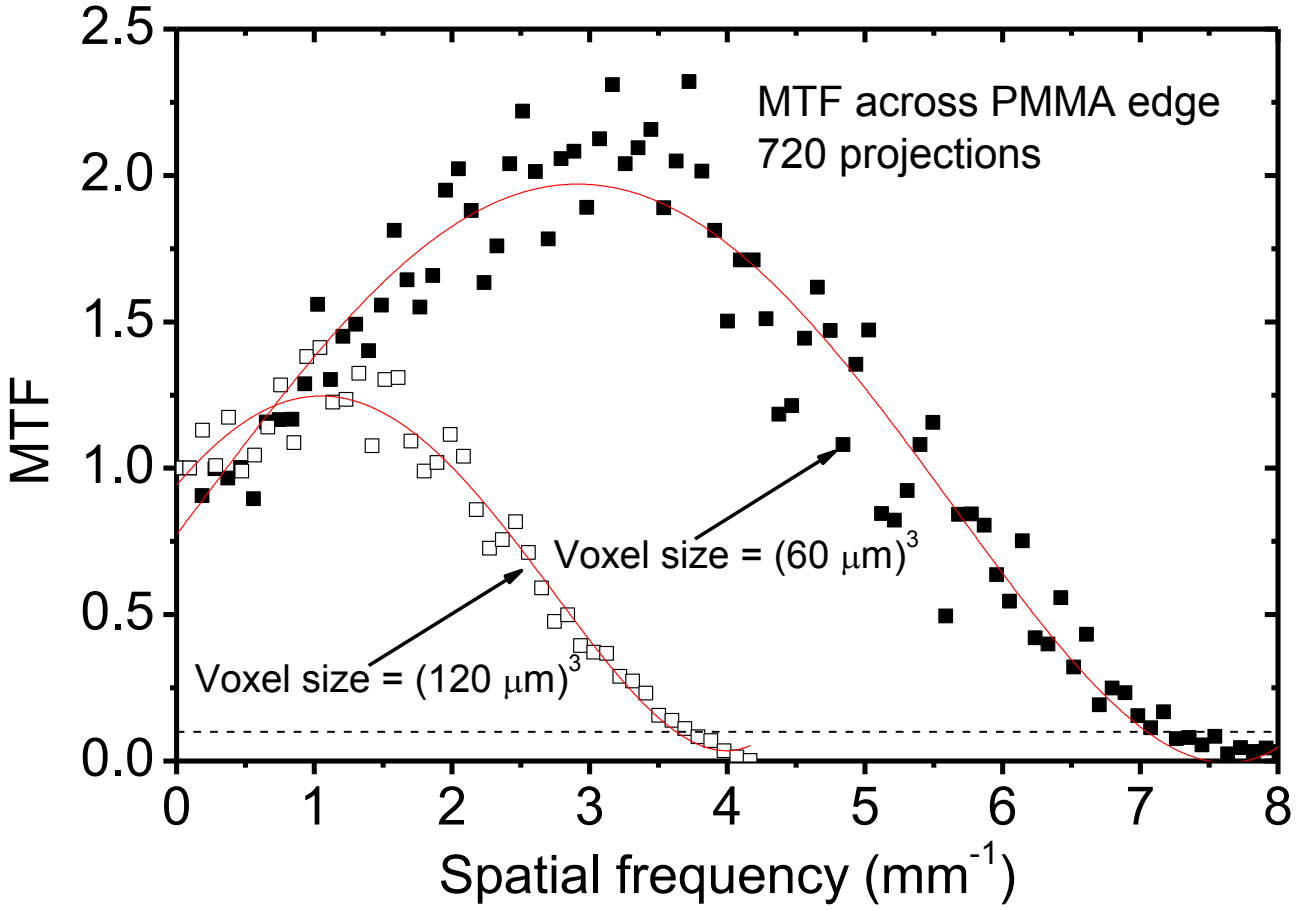


MTF curves

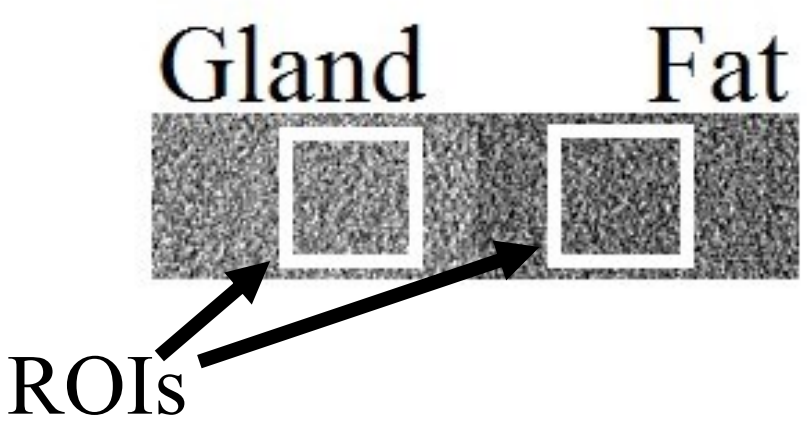

Voxel size = (60 mm)3
720 projections
Phase retrieval
Phase-contrast
MTF
Spatial frequency (mm-1)
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
5
6
7
8


Voxel size = (120 mm)3
720 projections
Phase retrieval
Phase-contrast
MTF
Spatial frequency (mm-1)
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4

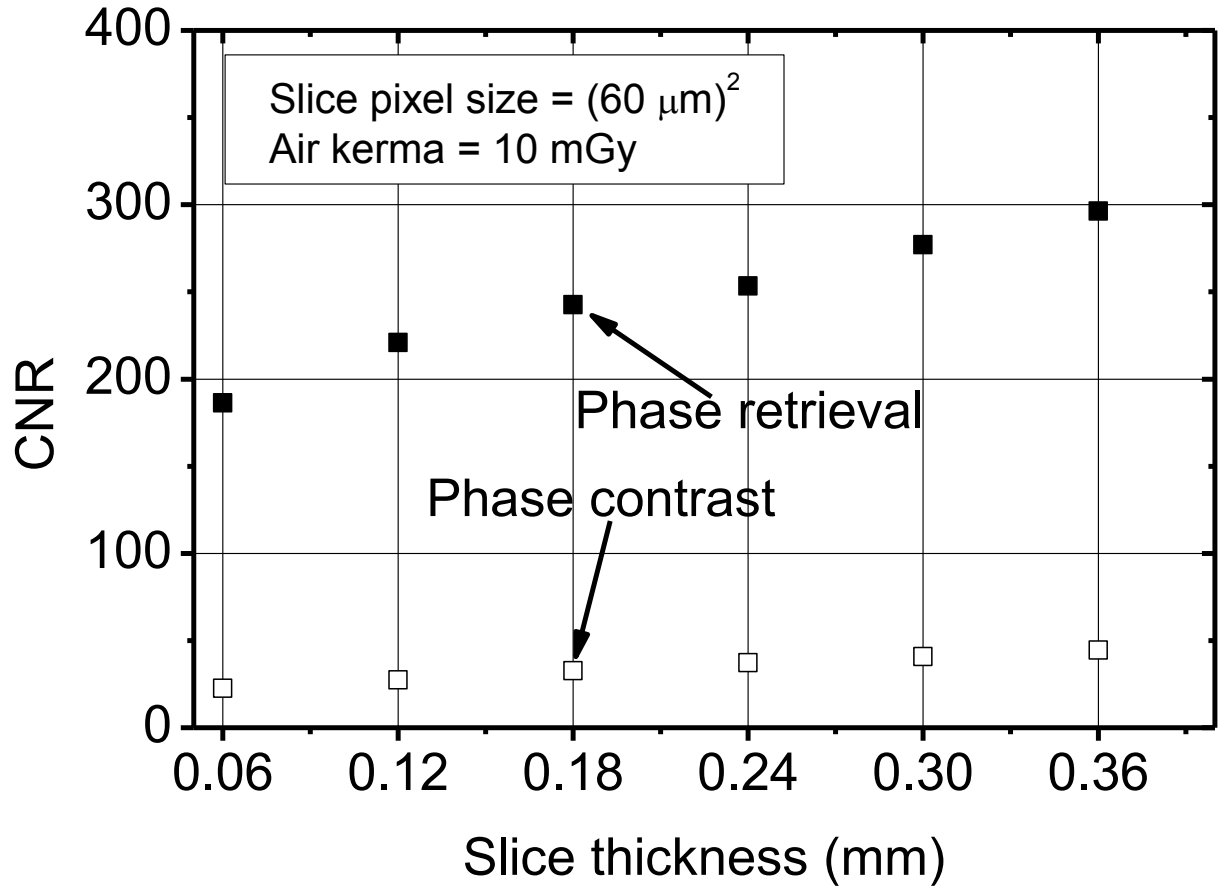
MTF curves over PMMA edge: attenuation imaging



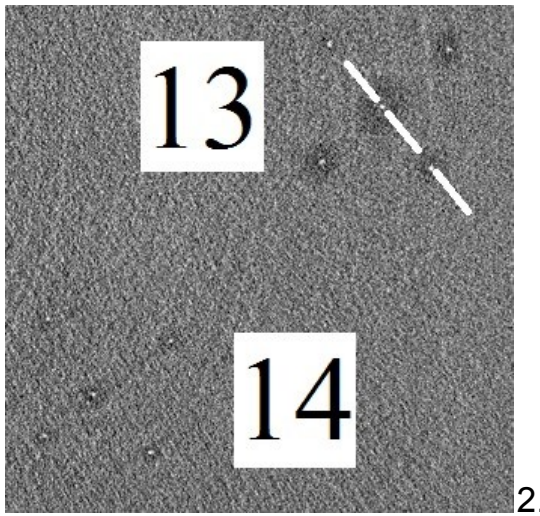
Contrast to Noise Ratio

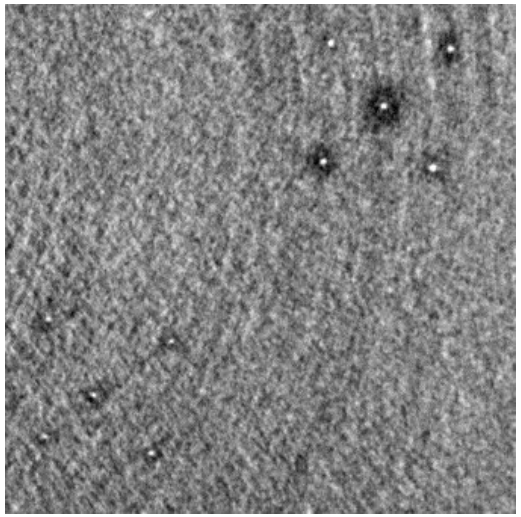


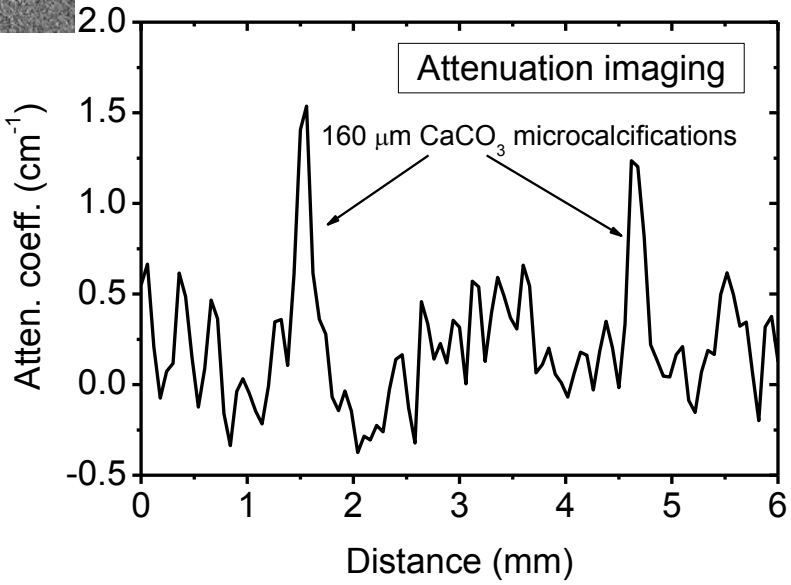
$$\mathrm{CNR} = A^{1/2} \frac{|S_g - S_f|}{\sqrt{\frac{\sigma_g^2 + \sigma_f^2}{2}}}$$

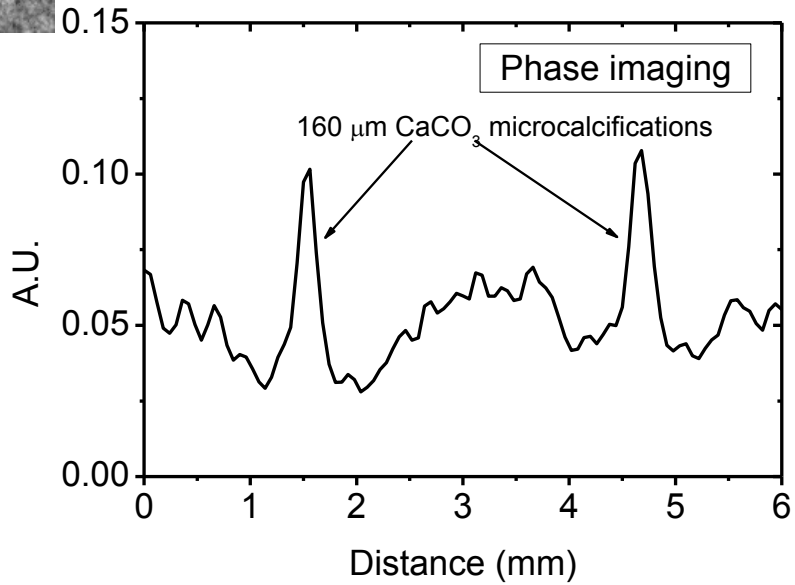


Microcalcifications visibility
Voxel size = 60x60x120 μm^3; air kerma = 10mGy









Conclusions

Synchrotron radiation phase contrast CT of the breast

- Spatial resolution up to 7 mm^{-1} (phase contrast) or 2 mm^{-1} (phase retrieval);
- CNR one order of magnitude greater in phase imaging than in phase contrast imaging;
- Microcalcifications down to 0.13 mm detectable both in phase and in phase contrast imaging.

Thanks for your attention