“1B_PC.avi”, “2B_PC.avi” & “3B_PC.avi”

- 1024 μm × 1024 μm
- Al 0.1 mm
- \( R_1 = 20 \text{ m (1B), 34 m (2B) & 138 m (3B)} \)
- \( \sigma_d = 5 \text{ μm, } \sigma_{s,h} = 320 \text{ μm & } \sigma_{s,v} = 16 \text{ μm} \)
- 25 keV
Phase retrieval: Phase contrast CT, and alternative reconstructors

Andrew Stevenson
MCT, Australian Synchrotron & CSIRO Future Industries

CT@IMBL workshop – 18th March, 2019
wave-optics picture of X-ray beam passing through a sample where only absorption or only phase effects occur - X-ray refractive index given by \( n(\lambda) = 1 - \delta(\lambda) - i\beta(\lambda) \)

\[
\mu = 4\pi\beta/\lambda \\
\sim O(\lambda^3)
\]

\[
\Phi = -2\pi\delta/\lambda \\
\sim O(\lambda)
\]
absorption and phase data for Carbon

<table>
<thead>
<tr>
<th>E(keV)</th>
<th>λ(A)</th>
<th>t_a(μm)</th>
<th>t_p (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>~50</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>1.2</td>
<td>~10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>~1</td>
<td>5000</td>
<td>30</td>
</tr>
<tr>
<td>50</td>
<td>~0.25</td>
<td>435,000</td>
<td>133</td>
</tr>
</tbody>
</table>

\[\mu = \text{linear absorption coefficient}\]
\[\phi = \text{phase difference/unit length}\]

absorption thickness \( t_a \mu = 1 \)

phase thickness \( t_p \phi = 2\pi \)
A phase gradient represents a change in direction of propagation ...

... leading to interference.
phase contrast/ refraction
pure phase object
images of a polymer glue containing 10 µm fibres and bubbles

contact image

phase-contrast image
image comparison

images of a small aquarium fish - spine

contact image

phase-contrast image
first quantitative experimental results from Imaging and Medical Beamline (IMBL)

Quantitative phase-contrast data for refinement of experimental parameters such as source size.
source & detector considerations

Hutch 3B
100\(\mu\)m polyethylene edge (\(\sigma_{\text{blur}}=4\mu\)m) @ 25keV

- \(R_2=1\)m, \(\sigma_{\text{source}}=16\mu\)m
- \(R_2=5\)m, \(\sigma_{\text{source}}=16\mu\)m
- \(R_2=1\)m, \(\sigma_{\text{source}}=320\mu\)m
- \(R_2=5\)m, \(\sigma_{\text{source}}=320\mu\)m
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Thank you for your attention