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X-ray Imaging at IMBL: Detailed Considerations of Contrast and Resolution

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The Imaging and Medical Beamline (IMBL) at the Australian Synchrotron has three hutches, centred at 22, 36 and 140m from the source, in which user experiments are performed. Radiotherapy experiments are currently performed in the first of these hutches, and imaging (including tomography) in the second and third hutches. The X-ray source is provided by a superconducting multipole wiggler (SCMPW) insertion device. A double-crystal Laue monochromator (DCLM) can be used to select the desired X-ray energy within the range 20 - 120keV at present. Alternatively, a white (pink) beam can be employed, using appropriate in-vacuo filters.

We will provide a detailed description and analysis of the key factors which influence the quality of X-ray images which can be recorded. In addition to the nature of the sample itself, the factors considered include the SCMPW field, X-ray energy or spectrum used, source size, detector resolution, source-to-sample and sample-to-detector distances. The key parameters used in describing the “quality” of an X-ray image are contrast (both absorption and phase) and resolution. An objective assessment of the point-spread function will be central and some discussion of signal-to-noise ratio will also be included. Other factors such as the presence of a small harmonic-contamination contribution for certain operation of the DCLM will be considered.

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