Extreme Imaging with the synchrotron pink beam

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The Imaging and Medical Beamline (IMBL) of the Australian Synchrotron is recognised as one of the most advanced facility for the Computed Tomography (CT) experiment. It was designed for the macro-imaging, just touching the microscopy ranges in the highest magnification configuration. This design makes the beamline capable of imaging large objects up to 1m in size. The monochromatic beam available on the IMBL can penetrate through the large object only if it consists of softer materials usually met in the biological tissues, while the samples of higher densities are not transparent enough to form the contrast of sufficient quality. In order to overcome this limitation we have been testing the pink-beam imaging modality. In this mode we are not using the monochromator but instead apply extensive filtration which suppresses the low-energy component of the beam allowing only the highest energy fraction to pass through. In the last year the tests were carried in two major beamline configurations: the near-source imaging in the enclosure 2B and the far-end in the enclosure 3B. The first of these configurations is optimal for the highest energy beam due to the high flux which is achieved for the price of the relatively small beam - up to 70(w) x 8(h) mm. Combination of this beamline configuration with the most sensitive of our detector (Hamamatsu flat panel, 200µm pixel size) defines the most extreme imaging conditions available on the IMBL. The pink beam produced under these conditions has the peak energy above 360keV and allows to perform a successful CT scan of a 4cm led sample in less than one hour. In the far-end configuration of the IMBL the beam reaches 45(w) x 4(h) cm, what reduces the flux and dictates softer filtration with the peak energy of the pink beam being close to 300keV. In both beamline modalities the method was tested with the resolutions ranging from 20 to 200 microns and corresponding sample sizes between 10 and 1000mm. This presentation describes the method in details and shows some of the results. The samples discussed in the presentation were selected to illustrate the most extreme sets of parameters in terms of size, density, photon energy and special resolution (see figures for example).

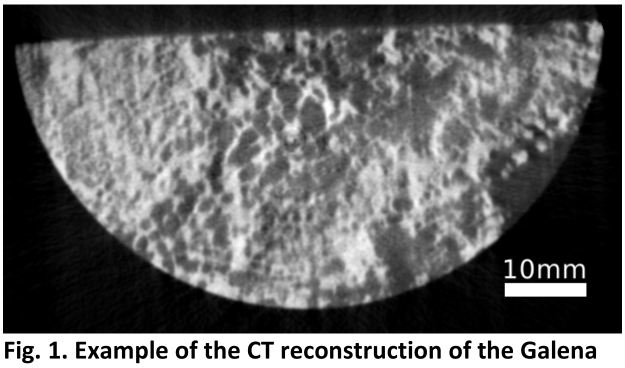

Fig. 1. Example of the CT reconstruction of the Galena mineral (lead-sulfide in the quarth matrix) with mean density of 8.3g/cm^3 (73% of the pure lead).

Fig. 2. 3D rendering of the rhinoceros skull. The sample is approximately 70x50x60cm in size.