Laboratory Source Developments for High Resolution X-ray Microscopy for Higher Throughput, Higher Data Quality and Energy Tunability

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X-ray microscopy with its high resolution, high contrast, 3D imaging capability can provide excellent insight into the understanding and characterization of materials by revealing details of micro and macro structure. Until recently, X-ray microscopy techniques requiring the high flux, monochromatic, energy tunable X-ray beam generated at large government operated synchrotrons has been unavailable in the home laboratory. As a result, imaging techniques such as high contrast propagation phase contrast, elemental contrast using absorption edges, grating phase contrast, high throughput imaging and dynamic experiments that are difficult to perform or not possible with traditional laboratory electron impact sources have been relegated to the large synchrotron. However, the recent development and commercialization of the Lyncean Compact Light Source (CLS) has created an opportunity to translate state-of-the-art microscopy techniques developed at synchrotrons to the home laboratory environment.

X-rays are produced in the CLS via inverse Compton scattering through the interaction of low energy electrons (25 to 45 MeV) in a miniature storage ring with a laser pulse (laser-undulator) resonantly stored in a high gain optical cavity. Tunable, monochromatic and high flux undulator synchrotron radiation is generated in the CLS “mini-synchrotron” as a result of the high repetition rate (~60MHz) of the interaction. The low divergence cone beam together with the small luminous source size of the CLS is well matched for full field imaging applications, adding unique capabilities to the home laboratory.

In this presentation we will describe the technology behind the Compact Light Source as well as a breadth of examples of measurements that have been either demonstrated or are possible with the CLS. The CLS is intended to be the cornerstone of a variety of future state-of-the-art small X-ray facilities.

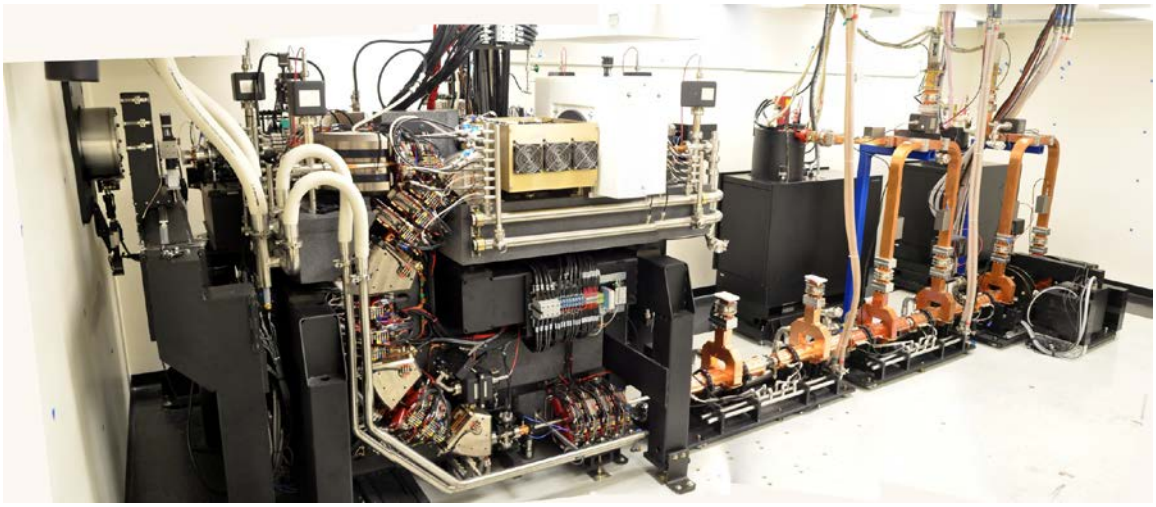

Figure 1. Photograph of the Lyncean Compact Light Source miniature synchrotron.