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Quantitative X-Ray Phase-Contrast Microtomography from a Compact Laser Driven Betatron Source

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With excellent resolving power and tissue contrast, X-ray phase-contrast imaging holds great promise but the source requirements have limited its use. Here we present the first quantitative phase-contrast microtomogram of a biological specimen produced by a laser driven Betatron source.

The fundamental mechanism behind the so called betatron radiation is the wiggling of the electrons in the radial fields of the plasma wake during the acceleration process. The um source size enables its use for producing high resolution phase contrast images by the free space propagation technique. These images combined with computed tomography technique are able to provide detailed information about the specimen.

Along with the tomogram we present a comprehensive characterization of the electron acceleration process, which defines the Betatron source. For this purpose we have indirectly measured and analyzed the main X-ray properties, like source size and photon spectrum.

We address the optimization of the source for phase-contrast imaging and the essential steps necessary for a quantitative reconstruction. Also a successful crosscheck of the retrieved electron densities against the values measured with an electron microscope confirming the accuracy of the source characterization and the validity of our approach will be presented.

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