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The Munich Compact Light Source – a laboratory-scale synchrotron facility for biomedical research

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Synchrotron X-ray sources have enabled scientists to push the limits of X-ray imaging towards nanometer resolution and extremely high sensitivity. However, for many of the techniques developed, the transition from synchrotron to preclinical or even clinical imaging is not straightforward. This is mainly due to the rather different characteristics of the X-ray tube sources typically used in the latter cases. The Munich Compact Light Source (MuCLS) at the Technical University of Munich (TUM) fills this performance gap and aims to provide an X-ray facility that allows modern synchrotron techniques to be applied in a university research laboratory environment. It consists of a commercial inverse Compton X-ray source (Lyncean Technologies Inc., formerly of Fremont, USA) and a beamline with two end stations designed and built by TUM scientists [1, 2].

The different applications exploit the unique properties of the MuCLS beam for a laboratory source [2]: The narrow tunable spectrum allows quantitative computed tomography (CT) without beam hardening [3], K-edge imaging [4, 5] or absorption spectroscopy [6]. The relatively high flux density allows radiotherapy studies [7], high-resolution micro-CT and fast dynamic imaging, e.g. for the study of respiratory processes [8, 9]. Finally, the partial coherence of the source enables grating-based phase-contrast and dark-field imaging [10-15], as well as propagation-based phase-contrast imaging [8].

Following a discussion of the X-ray source and the beamline, exemplary results for several of the aforementioned applications will be presented.

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