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Testing the Compact Light Source: A Miniature Synchrotron for the Home Lab

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The Compact Light Source (CLS) is a new type of x-ray source, a miniature synchrotron light source, which has been developed at Lyncean Technologies, Inc. The CLS is a near-monochromatic, tunable, homelab-size x-ray source with up to three beamlines that can be used like the x-ray beamlines at the synchrotrons--but it is about 200 times smaller than a synchrotron light source. The compact size is achieved using a laser undulator and a miniature electron-beam storage ring. The photon flux on a sample will be comparable to the flux of highly productive synchrotron beamlines. This presentation will first introduce the basic principles of the Compact Light Source and show how it can bring the quality, tunability and flux of a synchrotron beam line into an x-ray scientist's local laboratory. At Lyncean Technologies, Inc. we have recently completed the construction of a production prototype source with funding from the NIGMS Protein Structure Initiative. The presentation will show details of the electron storage ring, laser system and x-ray optics and conclude with results of our initial testing of the prototype CLS and x-ray optics.

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Experiments using Ultrashort Coherent X-ray Radiation at the future European XFEL Facility

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X-ray free-electron laser (XFEL) radiation in the photon energy regime from a few 100 up to 15000 eV will enable to address new scientific problems in the areas of physics, materials science, chemistry and biology. Applications will be possible that are inaccessible with current x-ray sources. The new sources provide x-ray radiation pulses combining high photon number of more than 10^{12} photons per pulse, ultrashort duration of the order 100 fs and high degree of coherence. The best appreciation of this combination of properties gives the peak brilliance of an XFEL reaching about nine orders of magnitude higher than present-day sources. X-ray radiation parameters and the current status of world-wide XFEL projects and the European XFEL facility in Hamburg, Germany, will be discussed. In the focus of the presentation will be scientific applications and experimental techniques making use of the high degree of coherence, the ultrashort pulse duration or the combination of these properties. New experimental techniques have been proposed throughout the last years and are currently designed in order to prepare first experiments as soon as the first XFELs will become operational. Current research cannot use x-ray sources providing a similar combination of properties like the XFEL, instead experiments use sources providing only one, or two of them at a time. As an example the use of ultrashort x-ray pulses from the SLAC linear accelerator will be discussed. These experiments aimed to show the feasibility of femtosecond time-resolution using visible laser pump - x-ray probe techniques. A temporal resolution better 100 fs has already been achieved thus demonstrating successfully the possibility to use XFEL radiation for ultrafast time-resolved structure determination. Another, already operating source is the VUV-FEL at DESY, Hamburg providing FEL radiation of the above properties but at somewhat smaller photon energy up to 200 eV.