High-Brilliance Compact X-ray Sources:
A Small Revolution in X-ray Sources and Applications

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The process of inverse Compton scattering (ICS), in which an electron of 20-50 MeV backscatters an optical photon into the hard x-ray spectral range, offers the opportunity to produce high-brilliance hard x-ray beams with a laboratory-scale facility. Demonstration experiments have been performed in many laboratories using conventional low-repetition rate copper linacs, and recently with an innovative small storage ring. All these efforts have confirmed the x-ray production in quantitative detail, but yielded x-ray beams of relatively low brilliance. However, by using a 2-meter long, high-repetition rate superconducting linac, and a 1-kW laser system, the time-average brilliance of such beams can reach the level of 2nd generation synchrotron facilities. Furthermore, two important characteristics will make these sources unique and particularly relevant to the topic of this workshop. First, beam size can be below 10 microns, and second, the pulse length could be 100 femto-seconds or less, yielding high peak brilliance. This talk will discuss the conceptual design of such a source, which we hope to construct in the next few years, and the scientific program it could support. Also we will speculate on the possibility of achieving coherent x-ray emission in the ICS configuration.