

Compact source of tunable, monochromatic, picosecond x-rays.

Many applications in medicine, material studies, and basic scientific research can benefit tremendously from a source of tunable, monochromatic, polarized, and picosecond x-rays. These include the K-edge differential angiography, high contrast mammography, x-ray magnetic circular dichroism, picosecond resolution of phase transitions and energetic dynamics, and many others. At present, these applications can only be carried out at national synchrotron laboratories where tunable, monochromatic x-rays are obtained by filtering the broadband synchrotron radiation. A Laser Synchrotron Source can produce these valuable x-rays in a much more compact configuration by replacing the undulator of a synchrotron with a laser beam and the multi-GeV electron beam with a modest tens of MeV electron beam. Monochromatic, tunable, polarized x-rays are generated by the process of Thomson scattering of the laser beam from the relativistic electron beam. The laser radiation is Doppler up-shifted to x-ray frequency by as much as $4\gamma^2$ (in a back-scattering geometry) where γ is the relativistic mass factor of the electron beam. For example, a 527 nm (2.35 eV) laser photon, when back-scattered from a 30 MeV electron beam, is up-shifted to an x-ray photon of 33.55 keV (a suitable energy for Iodine K-edge differential angiography). Since the laser is a monochromatic and polarized source, these x-rays are also monochromatic and polarized. With the advent of picosecond electron beams and laser beams, sub-picosecond x-ray pulses can be generated. Antonio C. Ting of NRL (202-404-7568, ting@nrl.navy.mil) will discuss the principle of x-ray generation by Thomson scattering, and the many experimental efforts at NRL and other laboratories to demonstrate the x-ray generation and its applications. (**Paper** [W11.001](#))

