Synchrotron Radiation

The X-ray source for measuring an X-ray absorption spectrum (XAS) is *synchrotron radiation*, which covers all the wavelengths of the electromagnetic spectrum with an intensity of more than 100 times higher than the conventional X-ray tubes, used for crystallography or X-ray diffraction instruments. For producing synchrotron radiation, charged particles (electrons or positrons) from a *linear accelerator* with a speed close to that of light, are injected into a ring (called *storage ring*) under high vacuum. The storage ring consists of curved sections (with a small radius of 5-10 cm) joined with straight parts. Magnetic fields, from strong magnets (called *bending magnets*) around the ring, force the accelerated electrons to follow the ring in the curved sections. When the high-energy particles (3 GeV in Stanford Synchrotron Radiation Lab, SSRL) hit the curved parts, they lose part of their energy as *synchrotron radiation*, which is emitted tangential to these curved sections. A radio frequency cavity (called *RF-cavity*) in the ring occasionally "kick" the particles to restore their kinetic energy.

The wavelength of the synchrotron radiation can be tuned by changing the magnetic field, e.g., with *wigglers* or *undulators* consisting of an array of dipole magnets, giving a continuous energy range from infrared to hard X-rays. Wigglers and undulators increase the brilliance (intensity) of the light by several magnitudes. Wigglers are like undulators, but have stronger magnetic field and give radiation with a more uniform intensity distribution.

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