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Neutron Laue Diffraction - A spotted history, a scintillating future

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In 1912, Max von Laue first demonstrated atomic diffraction produced by passing a beam of polychromatic X-rays through a single crystal [1], and was awarded the Nobel Prize for Physics two years later for his discovery. Laue diffraction, as this phenomenon was later called, was also demonstrated with neutrons [2], shortly after the pioneering monochromatic experiments by Schull and co-workers at Oak Ridge in the 1940s. The Laue technique largely languished for many decades however, due to the perception that harmonic overlap and complicated wavelength-dependent corrections yielded data of lesser quality than monochromatic diffraction. The extreme demands of protein crystallography for higher data collection rates, for both X-rays [3,4] and neutrons [5], coupled with high-resolution, large area detectors, and powerful image-analysis techniques, allowed Laue diffraction on a continuous source of radiation to return to the forefront of crystallography in terms of increasing unit-cell size, decreasing sample volume, and higher-throughput experiments, advantages that translate directly to chemical crystallography, materials science, and exotic physics [6]. Modern reactor-based neutron Laue diffractometers with large image-plate detectors permit extensive continuous sampling of reciprocal space with high resolution in the two-dimensional projection and a wide dynamic range with negligible bleeding of intense diffraction spots, qualities that are highly suited to detection of incommensurate structures, high-pressure crystallography, and diffuse scattering.
Although time-of-flight (TOF) neutron diffraction on a white beam was first demonstrated at the Dubna pulsed reactor in 1964 [7], it was not until a position-sensitive (scintillation) detector became available that the full utility of the technique for single-crystals could be realised in a landmark experiment at IPNS in 1984 [8]. Using a scintillator gave negligible parallax, which allowed the detector to be moved close to the sample to increase significantly the solid angle of detection and thereby make the data-collection efficiency comparable to that on a monochromatic diffractometer with a point detector at a reactor source. Such detector developments [9] will continue to play a key role in broadening the application of neutron Laue diffraction.
A survey of pioneering studies of neutron Laue diffraction in the recent past at reactors and spallation sources guides us to what we can expect to achieve with upcoming instrumental and data-analysis advances.

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