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# Advanced polarization and energy control for APPLE-II type undulator beamlines at MAX-IV

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Precise control of photon beam properties is essential for modern synchrotron beamlines, particularly those utilizing APPLE-II type undulators. This paper presents the control system architecture developed at MAX-IV by using IcePAP drivers and TANGO control system, to achieve advanced polarization and energy manipulation. The system implements the BLUES (Beamline Universal Polarization Mode) framework, allowing dynamic control of both helical and inclined polarization states through synchronized phase motor settings. Central to this approach is the use of parametric lookup tables to define non-linear motion trajectories for the undulator's gap and phase axes. This system enables linear energy ramps, supporting constant eV/s scans crucial for high-resolution spectroscopy and imaging techniques, taking full advantage of the high flux provided by fourth-generation light sources and improving data collection efficiency without compromising the stability or quality of the photon beam. Integration between the beamline and accelerator control systems allows for the complex coordination required to manage polarization settings. To ensure electron beam stability during undulator motion, the control system integrates feedforward correction loops that compensate for orbit and optics distortions induced by gap and phase changes. This approach offers a scalable and precise method for enhancing beamline capabilities, tailored specifically for the challenges posed by APPLE-II undulators.

## Footnotes

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