

LLRF Topical Workshop - Timing, Synchronization, Measurements and Calibration



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IETS: The new APS Injection-Extraction Timing and Synchronization System

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The new APS storage ring has about 40 cm smaller circumference than the ring it replaced. Consequently, the 6-GeV Booster synchrotron is no longer able to operate at the same rf frequency as the storage ring. Rather than rebuilding the Booster, a novel synchronization system (IETS) was developed that dynamically modifies the Booster rf frequency using a cosine-like frequency program, thus aiming the bunch in the Booster into any desired rf bucket in the storage ring. While the storage-ring frequency was raised by about 140 kHz, the PAR accumulator ring remains at its previous frequency, and the Booster starts synchronous to the PAR but then ramps following the pre-calculated frequency program. The IETS system allows to change the Booster rf frequency at extraction, moving the beam off-momentum and thus allowing reduction of the momentum spread of the extracted beam. A considerable complication arises from the existing line synchronization of the Booster magnet ramp, which causes Booster injection to occur at seemingly random times relative to the rf. The whole system includes triggering and rf-reference generation. The presentation will cover theory, development and commissioning of the system that is now in operation at the APS.

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