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W.K.H. Panofsky Prize in Experimental Particle Physics: The BABAR Detector and PEP-II B Factory at SLAC

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The discovery and elucidation of CP violation in the B meson system presented daunting challenges for the accelerator and detector facilities. This talk discusses how these challenges were met and overcome in the electron-positron colliding-beam accelerator facility PEP-II and the associated BABAR detector at SLAC. The key challenge was to produce unprecedentedly large numbers of B mesons in a geometry that provided high-statistics, low-background samples of decays to CP eigenstates. This was realized with asymmetric collisions at the Y(4S) at peak luminosities in excess of $310^{33}/\mathrm{cm}^2/\mathrm{sec}$. Specialized optics were developed to generate efficient, low background, multi-bunch collisions in an energy-asymmetric collision geometry. Novel technologies for the RF, vacuum and feedback systems permitted the storage of multi-amp, multi-bunch beams of electrons and positrons, thereby generating high peak luminosities. Accelerator uptimes greater than 95 percent, combined with high-intensity injection systems, ensured large integrated luminosity. PEP-II rapidly attained its design specifications and ultimately far exceeded the projected performance expectations for both peak and integrated luminosity. The BABAR detector, designed to efficiently reconstruct, flavor-tag and time-order entangled B meson decays at the Y(4S), performed at an unprecedented level of reliability.