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Panofsky Prize Talk: Measurements of Direct CP Violation in the Decays of Neutral Kaons at Fermilab
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For many years after its discovery, CP Violation appeared to be a phenomenon isolated from the rest of physics. The first goal was to see if CP violation was due to a “superweak” interaction in neutral kaon mixing (“indirect” CP violation) or if there were a “direct” effect which would be manifest in the kaon decays themselves. For years, it seemed to be an interaction of the former kind, one that might not have any additional manifestations. A few years after the discovery, Sakharov realized that CP Violation in the very early Universe, in particular direct CP Violation, could lead to the matter-antimatter imbalance. A key development was the Kobayashi-Maskawa model which provided a framework in which to think about the problem, connecting it to quark mixing. This motivated a series of 2nd, 3rd, and 4th generation experiments to isolate the predicted direct effect. This talk will review how the problem was addressed in 3 Fermilab- based experiments spanning a 20 year period which culminated in a definitive detection of the effect by KTeV. The motivation and technical approaches to isolate this tiny effect with good control of systematic uncertainty will be reviewed together with the results and future prospects.