Measuring $|V_{td}|$ with E949 at BNL

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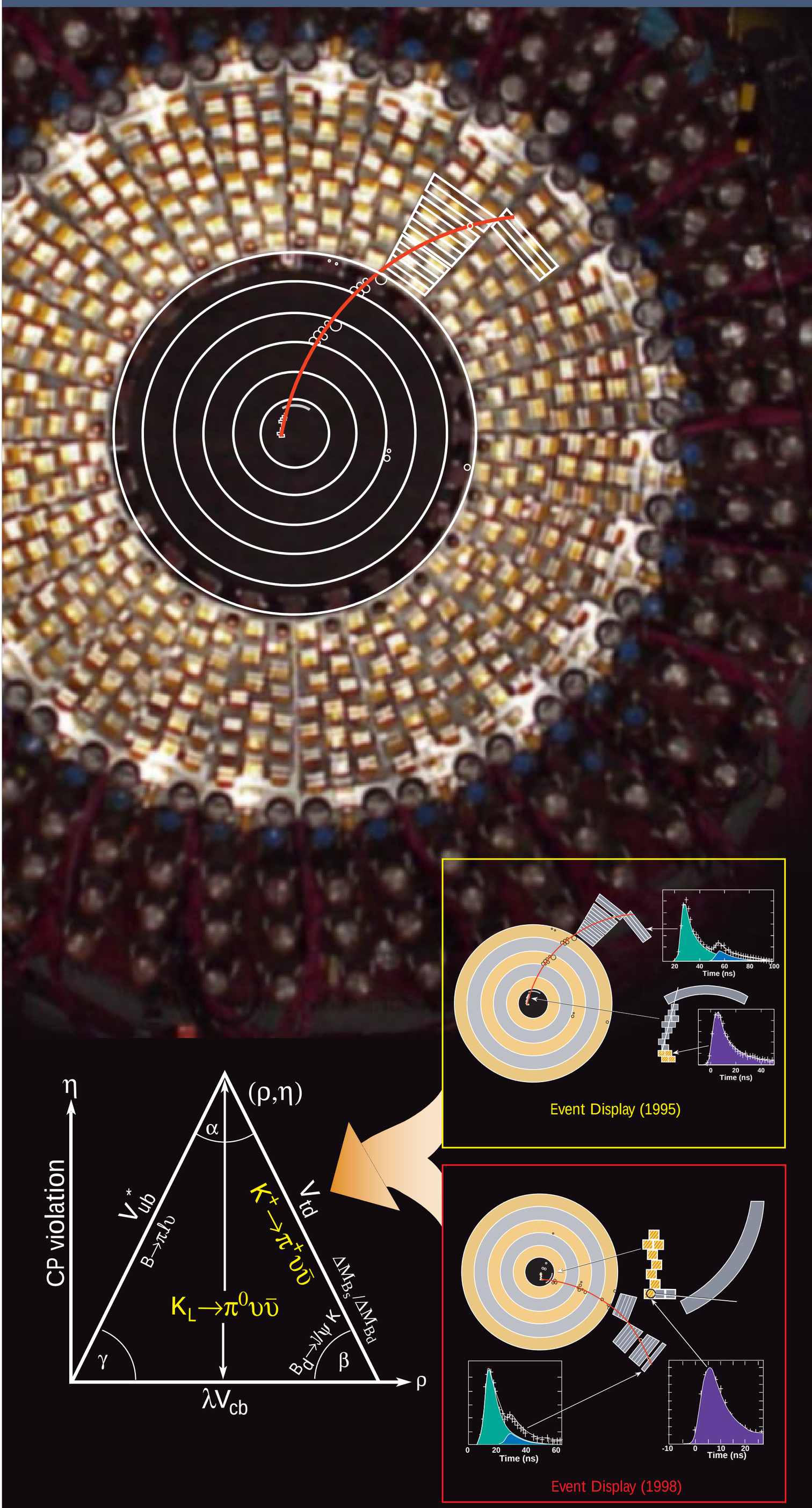

The E949 experiment at the Alternating Gradient Synchrotron at Brookhaven National Laboratory is an international collaboration of 70 scientists from the United States, Canada, Russia and Japan. This experiment follows the successful E787 discovery of $K^+\to\pi^+\nu\bar{\nu}$ with a detailed study of this mode at an order of magnitude improved sensitivity.

The $K^+\to\pi^+\nu\bar{\nu}$ decay is one of the 'Golden Modes' for study of CP violation and quark mixing, and along with the neutral analog $K_L^0\to\pi^0\nu\bar{\nu}$ can completely determine the CKM triangle. These $K\to\pi\nu\bar{\nu}$ modes have small theoretical uncertainty, allowing unambiguous extraction of quark mixing and CP violation parameters. The $K\to\pi\nu\bar{\nu}$ measurements are timely and important and complementary to those obtained from the B system. Measurement of $K^+\to\pi^+\nu\bar{\nu}$ directly complements the results expected soon on B_s mixing from the CDF and D0 experiments presently collecting data at the Fermilab Tevatron, since the ratio $\Delta M_{B_s}/\Delta M_{B_d}$ also gives a clean determination of $|V_{td}|$. Any discrepancies in the values found in the K and B systems would be unambiguous indicators of new physics.

The E787 experiment presented evidence for the $K^+\to\pi^+\nu\bar{\nu}$ decay based on the observation of two clean events with an expected background of 0.15 ± 0.05 events at a branching ratio of $1.57^{+1.75}_{-0.82}\times10^{-10}$. The result is consistent with the SM expectation of $B(K^+\to\pi^+\nu\bar{\nu}) = (0.72\pm0.21)\times10^{-10}$, but the central experimental value exceeds it by a factor of two.

The goal of E949 is to reach a sensitivity of 10^{-11} after 3 years of running at full intensity of the AGS during RHIC operations. E949 encompasses many improvements to the E787 apparatus that decrease backgrounds and allow for running at higher rates. The experience of E787 provides a high level of confidence in projecting the sensitivity of E949, which has been borne out by preliminary examination of the data from the first 12-week run of E949 in 2002. This brief run demonstrated the superior performance of E949 and achieved sensitivity comparable to E787. The possibility of a larger than expected branching ratio gives strong impetus for E949 to fully explore the possibility of new physics, or alternatively to make a precise measurement of the magnitude of V_{td}.