APR08-2007-000028

Abstract for an Invited Paper
for the APR08 Meeting of
the American Physical Society

The Accomplishments of the CESR/CLEO Program[1]

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The CLEO experiment, that uses the Cornell Electron Storage Ring (CESR), took data from Nov. 1979 to April 2008. Both the machine and the detector have gone through several different major phases caused by implementing new technologies, mostly locally developed. The improved sensitivities usually resulted in major discoveries. Many particles were first seen at CLEO and many important decay modes were first seen, or measured with far more accuracy than done before. Discoveries include the first observations of the $\Upsilon(3S)$, $\Upsilon(4S)$, B^0, B^- D_S, $\Upsilon(1D)$ and $D_{SJ}(2460)$ mesons, and the Σ_c^+, Σ_c^{*+}, Σ_c^{*++}, Σ_c^{*0}, Ξ_c^0, Ξ_c^{*0}, and Ξ_c^{*+} baryons. First observations of new processes include b-quark semileptonic decays, including the rare semileptonic decay $b \to u\ell\nu$, the "Penguin" process $b \to s\gamma$, and the important exclusive decays $B \to J/\psi K_S$, and $D^+ \to \mu^+\nu$. Recently, the decay rates for $D_S^+ \to \mu^+\nu$ and $D_S^+ \to \tau^+\nu$ have been measured with unprecedented accuracy, posing a challenge to Lattice QCD calculations. New accelerator and detector technologies have also had an impact on ensuing particle physics experiments and detectors in other fields. Decreasing the size of the CESR beams in the interaction region (so called micro-beta sizes) led to a large increases in instantaneous luminosity. Multi-bunch schemes, where many particle bunches and bunch trains are are brought into collision also increased the luminosity. In a parallel effort, CESR has maintained a cutting edge synchrotron radiation facility that has produced many interesting results. Pioneering detector technologies were implemented in the areas of electromagnetic calorimetry, tracking, vertexing and particle identification. For example, in calorimetry, CLEO developed a system using CsI crystals with photodiode read-out inside a 1.5 T magnetic field, that provides excellent energy resolution as well as accurate measurements of photon positions and angles. Particle identification has a long history of developments starting with a separate stand-alone dE/dx system that was replaced with a 51 layer drift chamber having dE/dx measurement in each layer, and finally adding a Ring Imaging Cherenkov detector using LiF radiators and Triethylamine based wire-chamber photon-detectors. I will review these achievements and some of their impacts.

[1]Supported by the National Science Foundation and Dept. of Energy