# HEPP-CPV-project

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(Dated: October 18, 2013)

### A. CP Violation

CP violation was first observed in the mixing of neutral K-mesons by Christenson, Cronin, Fitch and Turlay in 1964 [1]. They observed the $\hat{C}\hat{P} = -1$ state $K_L^0$ decaying to 2 pions, a state with $\hat{C}\hat{P} = 1$. Although the fraction of $K_L^0$ decays violating $\hat{C}\hat{P}$ in this way is tiny, the discovery was significant.

Direct(asymmetry in branching ratio due to quantum interference between two paths of decay) and Indirect (From mixing due to basis vectors not aligning with particle and anti particle states, quantum interference between these states)

Direct:

"The situation can be compared to rolling two dice say, a blue die for a B and a red one for an anti-B. To take the comparison further, suppose that getting K+pi- from a B corresponded to the blue die landing on 1, while getting a K-pi+ from an anti-B were like getting the red die on 6. In a symmetric world, by rolling both dice a million times one would expect to get 1s from the blue as often as one gets 6s from the red.

But the weak force has a preference, as if its dice were loaded."

`http://www2.slac.stanford.edu/tip/special/cp.htm`

### B. Consequences

### C. $\hat{P}$, $\hat{C}$and $\hat{C}\hat{P}$

### D. Time Reversal ($T$)

temp

### Appendix A: Appendix

Difficult calculations in here.

[1] "Evidence for the $2\pi$ Decay of the $K_2^0$ Meson" - J. H. Christenson, J. W. Cronin, V. L. Fitch, and R. Turlay (1964) Phys. Review letters, vol. 13, issue 4