What is BTeV?

BTeV is an experiment that will study the B mesons (containing beauty quarks) and D Mesons (containing charm quarks) that will decay from the proton/anti-proton collisions generated by the Tevatron Collider at Fermi National Accelerator Lab. BTeV will test Standard Model predictions of CP violation, quark mixing and rare decays, and will also be an ideal tool to use in searches for new physics beyond the Standard Model.

What Sets BTeV Apart?

Other experiments share the prime goal of BTeV, which is to study the decays of the B_s particle. However, BTeV has more physics reach than many of these other experiments. Both BaBar and Belle use e^- e^+ collisions, which produce cleaner b particles. BTeV will record all species of B mesons, but neither is designed to take advantage of the topology of b quark production at the Tevatron, which occurs most frequently at small angles to the particle beams.

What is CP Violation?

CP is the combined transformation of charge (t + p -> -t - p) and parity (x -> -x). Here is an example of the CP operation on an electron:

CP violation is manifest when some particles behave differently than their corresponding anti-particles. An example would be a B_d decaying into a s and an s (above left) at a different rate than its anti-particle (above right).

CP violation is interesting because it is the only known process in which the early universe, which was thought to have been comprised of equal amounts matter and antimatter, could be transformed into today’s matter-dominated universe. Currently, CP violation, as observed, is too small to completely account for this matter/antimatter asymmetry, but it is still a good place to search for further answers.

What is the Origin Of CP Violation?

CP violation, as it is currently understood, occurs in the weak interaction. The CKM matrix is unitary, and this fact allows us to construct relations between its elements. These relations can be visualized as triangles in the complex plane, with the angles being referred to as the CP violating phases. BTeV will make precision measurements of the CP phases (J, g, and c).

The CKM Unitarity Triangles, CP phases, And The Decays Used To Measure Them

BTeV's main goal is to further constrain the elements of the CKM matrix by making precision measurements of the CP phases (J, g, and c). This will allow BTeV to test the Standard Model predictions of CP violation, quark mixing and rare decays, and will also be an ideal tool to use in searches for new physics beyond the Standard Model.

BeTV's Goals and Physics Reach

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Conclusions and Outlook

BTeV will be a powerful window into the Standard Model, and beyond, by supplying precise measurements of CP violation and rare decay parameters from a variety of sources. These insights can not only help us to understand and refine the Standard Model of particle physics and its many parameters, they may also reveal violations of current theories, and provide guidance toward new ones.

References and Acknowledgments


Picture of BTeV detector courtesy of Michael Wang, John Rauch, and Alex Toukhtarov
Photo of Silicon block courtesy of the BTeV collaboration
Photo of HV fusing test courtesy of Sasha Ledovskoy