Justin K. Keung

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Education

Ph.D. Expected May, 2010. Physics, University of Pennsylvania, USA
Dissertation: *"Search for Standard Model Z Boson Production in Association with a W Boson."*
Advisor: Prof. Evelyn Thomson

Relevant Courses and Grades

Physics at UPenn: Particle Physics (A), Field Theory (A), Mathematical Methods (A), Quantum Mechanics (A), Statistical Mechanics (A), Electromagnetic Phenomena (A-), Modern Optics & Laser Spectroscopy (A)
Other courses: Accelerator Physics offered by USPAS (A), International Accelerator School for Linear Colliders 2006: ranked 11th out of 78 students

B.A.Sc. May, 2005. Engineering Physics, University of Toronto, Canada
Dissertation: *"The Design of a Water Cerenkov Muon Detector Using GEANT4."*
Advisor: Prof. David Bailey

Research Interests

I seek to further understand the subatomic building blocks that constitute our universe. My primary interest is to approach physics at the energy frontier at the LHC, where I would like to verify the existing of the proposed Higgs boson and investigate whether new phenomena such as Supersymmetry exist. In addition I am interested in the research of new particle accelerator technologies such as Superconducting RF, which will enable a new generation of particle accelerators, such as the proposed ILC, to probe new subatomic phenomena with ever more precision.

Research Experience

Doctoral Research, University of Pennsylvania, Philadelphia, PA, 2005 – present

- Analysis of WZ→lvbb production in progress, with the goal of validating the Higgs boson search techniques at the Fermilab CDF experiment
  - estimate the sample composition using a combination of fits from simulations and data distributions
  - train and use a multivariate discriminator to separate signal against background

- Developed novel calibration techniques to commission a new b-jet identification algorithm to improve the sensitivity of Higgs boson search: calibration involves measurement of identification efficiency and misidentification rate
  - extended the identification efficiency measurement technique to use electron, since the default measurement technique with muon biases the algorithm
    - used maximum likelihood template fitter to measure jet flavour composition to calculate identification efficiency
    - developed a method to estimate the uncertainty due to fake conversion electron contamination
  - developed a new algebraic technique to measure the misidentification rate without demanding symmetry, since symmetry is not available in this new algorithm
    - new technique leverages the simulation and the identification efficiency calibrations

- Measured the Laser synchronization (timing jitter) at the Fermilab A0 Photoinjector Linear Accelerator: good synchronization is needed for precise collider annihilation energy and increased luminosity, and for Lasing in a Free Electron Laser LINAC
  - measured the seed laser jitter using the Power Spectral Density technique, and measured the pumped and pulsed laser jitter using the Ringing Filter technique
  - performed laser alignment between free space laser and fiber optics based detector to improve signal level
  - performed spectral analysis using microwave spectrum analyzer, and phase analysis using oscilloscope FFT

- Assembled Piezo and Blade tuners for a 2-cell 1.3 GHz Cavity, a contribution to the Cornell ERL project
  - tuned the natural frequency of the cavity by changing its size with parts per billion accuracy
  - developed circuit to monitor and correct frequency tuning errors

- Developed a C++ based 9-cell 1.3 GHz Superconducting RF Cavity Simulator, useful for RF control system studies
  - simulated the effect of each component involved in controlling the precise oscillations of the cavities' electromagnetic fields
  - effects included in the simulation: vector sum linear I/Q feedback, Adaptive Feedforward, Lorentz detuning, fast piezo mechanical feedback, beam loading, klystron RF effects, loop latency, MO Phase Jitter, Cryomodule Mechanical Resonances, 8/9pi mode
    - example studies performed using this simulator:
      1) the effects of latency on feedback stability with the 8/9pi mode
      2) the effects of bunch charge fluctuation on flattop gradient stability
      3) the effects of different RF distribution configurations on flattop gradient stability

- Developed a FPGA based 1.3 GHz Superconducting RF Cavity Simulator, useful for training and testing the control system to recognize failure signatures that are dangerous to perform in physical systems
  - simulated the RF amplitude and phase response in real time with ADC/DAC for live control system testing

Undergraduate Research (thesis project), University of Toronto, Toronto, ON, 2004 – 2005

- Studied the feasibility of a new undergraduate cosmic ray experiment with a Water Cerenkov detector using Geant4 simulations

Summer Research, University of Pennsylvania, Philadelphia, PA, 2004

- Developed a circuit to measure the annihilation photon Time-Of-Flight for Positron Emission Tomography systems

Work Experience

Teaching Assistant, University of Pennsylvania, Philadelphia, PA, 2005 – 2006

- Lab instructor and recitation/tutorial section leader for undergraduate physics classes

Yield Enhancement Engineering Intern, Actel Corp., Mountain View, CA, 2003 – 2004

- Solved FPGA yield problems by optical and electrical characterization

Awards and Honors

Arnold M. Denenstein Prize, University of Pennsylvania, 2006

- Awarded annually to a graduate student, judged by the Univ. of Pennsylvania Physics & Astronomy Department, who shows the most promise of becoming an outstanding experimental physicist

NSERC Undergraduate Student Research Award (USRA), University of Toronto, 2002

- Awarded to undergraduate students based on academic merit and potential to conduct research

Computer and Laboratory Skills

- programming and scripting, in Windows and Linux based environments
- scientific computing: multivariate discriminators such as Artificial Neural Networks
- statistical methods: Bayesian limit calculations and maximum likelihood fits
- electrical diagnostic equipment: signal generator, oscilloscope, spectrum analyzer, network analyzer
- office and math software: Word, Excel, PowerPoint, Maple, MATLAB, Mathematica

Conference Presentations

"Search for Standard Model Z Boson Production in Association with a W Boson"
American Physical Society April Meeting, Denver, CO, 2009

"Laser Timing Jitter Measurements at the Fermilab A0 Photoinjector"
Linear Accelerator Conference, Victoria, BC, 2008

"ILC RF Cryomodule Software Simulator" and "FPGA Based ILC Cavity Simulator"
Particle Accelerator Conference, Albuquerque, NM, 2007

Publications

Principal author:

"Mistag Measurement of the Binary Mode RomaNN b-Tagger"
CDF internal note #9747, July 2009

"Efficiency Measurement of the RomaNN b-Tagger"
CDF internal note #9292, Dec 2008

Important contributions:

"Search for the Standard Model Higgs Boson Production in Association with W Boson using 4.3/fb"
CDF internal note #9868, Aug 2009