Statement of Research and Professional Interest of Aaron Dominguez

My research has focused on an experimental understanding of the Higgs mechanism and the question of how mass is generated. This effort has centered around using precision silicon microvertex detectors to search for high mass particles decaying into b quarks. In particular, I've played a leading role in the search for neutral Higgs boson production in electron-positron collisions at L3 as co-chair of the Higgs group, and now in proton-anti-proton collisions at CDF. I wish to continue to take advantage of the unique opportunity at the Tevatron to discover Higgs bosons with production cross sections larger than those in the Standard Model, and then transition to LHC detector work and analysis. Lastly, I would like to expand upon an educational outreach program I developed in Aurora, Illinois, to involve the community surrounding the laboratory.

The first step in experimentally establishing the Higgs mechanism would be the observation of a new massive particle decaying into other particles preferentially based on their mass. This is possible at the Tevatron in RunII if we consider models, such as the Minimal Supersymmetric Standard Model (MSSM), which predict Higgs production cross sections one to several orders of magnitude larger than the Standard Model. For example, there are unexcluded regions of MSSM parameter space where the production of neutral Higgs bosons in association with a pair of b quarks is several times larger than the top quark production cross section. During RunII, with integrated luminosities of less than 4fb^{-1}, it will be possible to discover Higgs bosons at moderately large values of $\tan\beta$ in the MSSM. I would like to spearhead this effort as part of a broader program of high P_T physics involving the tagging of b quarks.

In contrast to LEP, at the Tevatron we are sensitive to regions of $(\tan\beta, m_{\text{A}})$ in the MSSM which were not possible to explore previously. This is due to the large enhancement of the b quark coupling to neutral Higgs bosons at high values of $\tan\beta$. This makes neutral Higgs searches complimentary to

those of LEP, which were insensitive to values of $m_{\rm A} \gtrsim 90$ GeV for large values of tanβ.

An important step in searching for new physics with two or more high P_T b-jets is the successful measurement of Standard Model cross sections with similar final states. For example, the measurement of the $\rm t\bar{t}$ production cross section using events where both W's decay hadronically will be key. As an active member and co-convenor of first CDF's silicon detector optimization group and then the high P_T b-tagging group, it was my responsibility to ensure a common effort and set of tools needed to establish these known physics signatures in order to give us confidence in our detector and measurement techniques. In addition, I played an important role in building and commissioning CDF's new silicon microvertex detector, which is fundamental to our ability to tag b quarks.

Recently, I have organized a group of CDF physicists and students to search for the Higgs signature $gg \rightarrow \rm b\bar{b}A/h \rightarrow b\bar{b}b\bar{b}$. (As a side note, recent theoretical work has also indicated that the three-b final state has an even larger cross section. This analysis would be sensitive to such events as well.) This would be one of the more likely discovery modes in RunII data. But within the framework of a single model, such as the MSSM, it is possible to combine multiple production modes and decay channels, such as $gg \rightarrow A/h \rightarrow \tau^+\tau^-$, $gg \rightarrow \rm b\bar{b}A/h \rightarrow b\bar{b}\tau^+\tau^-$ and direct charged Higgs searches, and other experiment's results, to perform a more sensitive and broad based search for Higgs production. As leader of the CDF Higgs group I would like to help with such a combined search. This is strengthened not only by my experience on the LEP Higgs working group, which performed LEP-wide Higgs combinations, but also by the fact that several of my colleagues from this group are now in both CDF's and D0's Higgs groups.

A broad search for non-Standard-Model Higgs bosons at CDF will be important to future experiments. I would like to continue my search for new phenomena in high P_T physics at the LHC, building on my experience gained by measurements in both hadron and $\rm e^+e^-$ collisions. Heavy flavor tagging will still be an important part of this effort, and my previous experience will have an immediate effect on its success. In addition, my experience with building, commissioning and the optimization of CDF's silicon detector would be an asset at the LHC during the similar phases of silicon detector development during which LBL should be taking a leading role.

Lastly, I would like to expand an educational outreach program I founded to involve the communites surrounding LBL. At the end of the school year in 2001, I started a pilot project in Aurora at Archbishop Romero School called BEST (Bilingual English/Spanish Tutors), which pairs up high achieving bilingual high school students with elementary school children to help them with their homework after school twice a week. This year, I expanded the program to three schools in Aurora: two public elementary schools in addition to the private Romero School. It now includes more than 60 students. I organized 35 bilingual tutors from area high schools, and raised money to pay for three staff members. The monies come from several sources, including the city of Aurora, charitable organizations, and a block grant through Communites in Schools Aurora funded by the federal "No Child Left Behind" act. The goal of BEST is to improve the future of our community through the accomplishments of its young people. The bilingual tutors in BEST not only help their younger peers with their homework, reading and math, they gain a sense of responsibility for the successful education of their own Latino community. I began this program in response to some personal experiences as one of a very few number of Mexican-American physicists. I see opportunities to implement such programs in the communities near the laboratory and to make LBL a focal point for the mentorship of Latino and underrepresented high school and undergraduate students.