Jaehoon Yu

Research and Teaching Interests

The Standard Model(SM), as a theory unifying three of the known four interactions, has been extremely successful in almost every aspects of high energy physics. However, the model is not complete in the sense that there still are many questions remaining to be answered. In addition, the model is not self contained but needs arbitrary theoretical parameters and inputs from experimental measurements.

Particularly, it is not understood why there are three generations of quarks and leptons that form the basic building blocks of matter, nor why the masses between the species are dramatically different. The origin of the electroweak symmetry breaking mechanism which, according to the Standard Model, generates mass is not understood. Not only the causes of mixing between different species of quarks poorly understood but also the magnitudes of the mixing needs to be put into the theory from experimental measurements. Similarly, while some degree of the CP violation is intrinsic to the Standard Model, the origin of it is not known.

Another question that draws tremendous interest in both high energy physics and astrophysics fields is the neutrino oscillation that has been presented and been confirmed by the Super-Kamiokande and other neutrino experiments. Since the mass differences between different flavor of neutrinos cause the mixing between mass eigenstates and since in the Standard Model the neutrinos do not have mass, the solid verification of this exciting result means physics beyond the Standard Model. In addition, it is extremely important to vigorously perform the searches for particles predicted by models beyond the Standard Model.

Many current and planned experiments will address the issues discussed above. The Higgs particles which originates electroweak symmetry breaking have been pursued at LEP-II electron-positron collider experiments and will be searched even further in the kinematic phase space at Fermilab Tevatron collider experiments. The mass ranges of the Higgs bosons will be far better understood via precision measurements of W boson and the top quark masses. The CP violation issue will be addressed in both upcoming Kaon fixed target experiments and asymmetric electron-position collider B-factory experiments at SLAC and KEK.

Neutrino oscillation will be continuously pursued from atmospheric and solar neutrino experiments, together with accelerator based long baseline experiments such as K2K at KEK and the MINOS experiments at Fermilab for small mass difference and high mixing angle regions. Large mass difference small angle oscillation space will be probed by many low energy reactor experiments and the MiniBooNE experiment at the Fermilab Booster.

While these experiments are expected to run within the short time scale, the LHC (Large Hadron Collider) at CERN will commission in the year 2005 providing farther reach in masses. For more distance future, other types of accelerators are in their conceptual design stage, such as muon collider, next linear collider, and high center of mass energy lepton-hadron colliders which will open up a new regime of physics. Of course there are other non-accelerator based experiments that use satellites to take advantage of higher energy cosmic-ray particles.

Given all these opportunities in High Energy Physics, I plan to devote the majority of my research effort to my current involvement at DØ experiment in searching for Higgs particle and physics beyond the Standard Model for the near term physics result. In addition, I would like to continue my involvement in neutrino physics by investing part of my research time keeping in touch with current neutrino experiment involvement on NuTeV and possibly a future neutrino experiment. This mid-term plan is going to serve for my plan for the longer term involvement in developing future neutrino accelerator facilities and experiments that takes the field to the use of such facilities. My involvements in neutrino factory using muon storage ring facility should serve well in my future endeavor.

Despite the plans I have laid above, I still do my best to keep myself flexible in different areas of research in the field, widening the horizon to such projects as LHC or next generation linear colliders. I believe that my expertise in both hadron collider and in neutrino experiments will put me in an excellent position to take full advantage of any opportunities arise in the future and that I would be an invaluable asset to the current and future physics programs of your high energy group.

My basic philosophy concerning teaching is that a research can not be as valuable as it could be unless it is tightly coupled with teaching. In other words, in my opinion, a research cannot be completed until it is balanced with teaching. I also believe it is our duty to the community to transfer as good of an understanding of the knowledge that we acquired from research as possible.

One of the means to transfer our knowledge is through the classes given in educational institutions. Physics is one of the most fundamental subject that cannot be separated from everyday life. Thus, it is important to help students realize what the physics principles involved in their everyday lives are. This can be most effectively achieved via "hands-on" physics which involves more experimentation of the physics principles they learn in their classes.

Another method of knowledge transfer to the community is out-reaching via internet. Since a large fraction of American families have internet access, and the fraction is growing fast, Web can be used as one of the tools to

directly transferring the knowledge. I have joined the nation-wide QuarkNet effort that connects high energy community with various levels of educational institutions. I have established the Fermilab QuarkNet site in the year 1999, and have organized the second year associate teachers' institute in the summer of the year 2000. I have assembled a team of summer employees to implement a first version of QuarkNet Web site for some basic training and am improving the functionality of the page gradually. I am currently planning to submit funding proposal for implementing simple cosmic-ray angular distribution measurement devices in the seven associate teachers' schools within the next 5-7 years. This effort will also be associated with balanced effort in developing high school physics curriculum using the equipments. The effort also includes about a week of self training program of the associate teachers every summer to keep the teachers up-to-date. In conclusion, while there are many more ideas of teaching students and out-reaching to the community, I can assure you that I am firmly committed to an excellence in teaching.