Statement of Research Interests

Yuri Gershtein

It's an exciting time to do particle physics. A plethora of new experimental data accumulated in the past decade has confirmed the Standard Model to an impressively high precision. Deep relation between particle physics and cosmology is being revealed. The last two missing blocks of matter, the top quark and the tau neutrino, have been established.

Ironically, the overwhelming success of the Standard Model seems only to emphasize its limitations. Can the three independent gauge couplings in the SM be manifestations of a single force? What is responsible for proliferation of lepton and quark types, their mixings and CP-violating phases? What gives particles their masses and why they are so much smaller than the Planck scale? Where is the place for gravity in this model?

The experimental program at Tevatron is of great interest to me because it might shed light on some of these puzzles. Observation of supersymmetric particles, for example, would strongly influence theories with unification of gauge forces. Discovery of the Higgs boson (or its non-observation, leading to possible contradiction between experimental bounds and the Standard Model prediction on the Higgs mass from measured masses of top quark and W boson) would advance our understanding of mass.

Searches for supersymmetry and the Higgs boson are especially interesting at the Tevatron because of the indications that the Higgs boson is light and perhaps even light enough to suggest that the Standard Model can not remain valid up to the Planck scale. In models with supersymmetry, on the other hand, a light Higgs boson is not only easily accommodated but also essentially required. I am very excited to be able to play a leading role in these searches, potentially resulting in a major discovery.

I started my work in the field of experimental high energy physics with the analysis of data from the ARGUS experiment at e^+e^- storage ring DORIS-II (DESY). In my PhD work "A Study of $\overline{B}^0 \to D^{*-} l^+ \nu$ and $B^0 - \overline{B}^0$ mixing using partial D^{*-} reconstruction", I have introduced a new method of partial reconstruction of $\overline{B}^0 \to D^{*-} l^+ \nu$ decay, which allowed for precision measurement of this decay, as well as $D^0 \to K^- \pi^+$ decay and $B^0 - \overline{B}^0$ mixing. This method proved to be so useful that almost all experiments with interest in B-physics had employed it (CLEO, LEP experiments, and B-factories).

Since then I have been an active participant of several experiments in various stages in their lives, from conception to design and prototyping to construction, commissioning and data analysis. I enjoyed working on both hardware and software and intend to keep maintaining the balance between working on design and construction of future experiments and doing physics with existing ones. I also found that switching the experimental environment (in my case, from clean e^+e^- to fixed target to hadron super-colliders to Tevatron) was invariably a tremendously enriching and idea provoking experience.

Currently, I am working on the search for di-photon events with large missing transverse energy with the D∅ experiment. Observation of enhancement of the yield of such events would signal physics beyond the Standard Model. A prime candidate for such physics is SUSY with gauge-mediated breaking for the case when neutralino is next-to-lightest SUSY particle. First results of this analysis based on the Run II data where already presented at the ICHEP 2002 and other recent conferences.

As we accumulate more data, I plan to take a leading role in broader searches for new phenomena in a variety of channels. I believe that the most promising direction is to study production of the third generation of matter. This requires excellent triggering and off-line identification of b-quarks and τ-leptons. As I've joined DØ at the time when the experiment's design still was not frozen, I proposed and participated in the implementation of several new features of the track trigger, which significantly increased trigger efficiency for events containing τ-leptons. I also developed the strategy for off-line identification of τ-leptons and made major contributions to the reconstruction software. I am serving as a convener of the D∅ Tau Identification group.

The main tool for b jet identification in D∅ is the silicon detector. I played a major role in its construction and was in charge of the project to assemble individual silicon detectors into barrels. To achieve good trigger efficiency for the events with b jets, DØ has the ability to reconstruct tracks in the plane perpendicular to the beam and to measure their impact parameters at the second trigger level. One of the most important problems that I had to solve was to make sure that the detectors were placed with a precision of better than 15 microns, so that the impact parameter resolution of the trigger is not compromised.

Soft muon tags provide a complementary way to identify b jets. The subsystem that provides both the trigger and off-line measurement of time of flight for soft muons in D∅ is based on an array of scintillating counters just outside of the calorimeter. I was involved in the counter's design, tests of the prototypes and setup of the production line at ITEP.

The first step towards discovery of new physics in Run II (with higher collision energy and improved detector) is observation and precision measurement of well-known Standard Model processes, which are major background to the searches. I have been very active in the work on measurement and calibration of the first signals of Z and W bosons decays into e^+e^-, $\mu^+\mu^-$ and eν in the Run II data. This work included the measurement of the reconstruction efficiency for EM objects and tracks with high transverse momentum.

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My longer-term plans are to take an active role in the Higgs searches in Run IIb of the Tevatron. The objective of the Run IIb is to accumulate about 15 fb^{-1} of data per experiment before the turn-on of the LHC, which would make it possible to discover the Higgs boson in a wide mass range. I plan to make significant contribution to the hardware components of the detector upgrade, which is necessary to take full advantage of increased data sample. As a part of my involvement in the design of the Run IIb upgrade I served on the Trigger Task Force, which was charged to identify needed upgrades for DØ trigger in Run IIb. At high instantaneous luminosity of the Run IIb occupancy in the tracker rises and jeopardizes performance of track triggers. This leads to a severe degradation in muon and hadronic tau triggers performance, crucial for the Higgs searches. I have proposed an upgrade for the track trigger and estimated its performance. Recently, this upgrade, together with other trigger and silicon detector upgrades, has successfully passed the Lehman review.

In the course of my career I have been working a lot with students. I enjoy finding ways to explain (and popularize) physics. I was an informal mentor to two ITEP PhD students working on ARGUS and now I'm assisting my senior colleagues at Brown to advise two students. As a leader of the Tau ID group I direct and closely monitor activities of students in the group. I like to work with students and am looking forward to the opportunity to involve more students in the topics I'll be working on. I am excited by the opportunity to teach undergraduate and graduate students, offered by a university position. I was lucky to have excellent teachers and know how big a difference one can make.

For the long term I see a lot of opportunities to continue my involvement in particle physics. A natural continuation of my research program at Tevatron would be to join CMS or ATLAS experiments at the LHC, which will give the ultimate answer on existence of supersymmetry and the Higgs boson(s) if they are not discovered at the Tevatron. If our space has hidden extra dimensions they are likely to reveal themselves (may be in a quite dramatic way) at LHC energies. On the other hand, investigating physics of quark and lepton flavor and CP violation is very enticing. I'm sure that as time goes on and the field of particle physics evolves, other opportunities will present themselves and I shall keep an open mind to them.