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DEPARTMENT OF PHYSICS
Prof. Allen I. Mincer, Chair

André and Bella Meyer Hall of Physics
4 Washington Place
New York, NY 10003-6621
Telephone: (212) 998-7710
Fax: (212) 995-4016
E-mail allen.mincer@nyu.edu

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Prof. Dennis Shasha
Department of Computer Science
Courant Institute of Mathematical Sciences
New York University
251 Mercer Street
New York, N.Y. 10012-1110
U.S.A.

Dear Prof. Shasha:

This purpose of this letter is to briefly describe how your ongoing research has already benefited our work on Milagro and how the work you are now proposing could open up brand new possibilities for us.

Milagro, a water cerenkov detector at an altitude of 8600 feet near Los Alamos, New Mexico, is the first experiment capable of monitoring the full overhead sky for photons at very high energies (VHE photons are of energies about 100 GeV to 100 TeV). The experiment is run by a multi-institutional collaboration and is funded the NSF, the DOE, and The University of California. It consists of a large man-made pond filled with water and instrumented with detectors sensitive to radiation produced by energetic particles. Milagro is also uniquely capable of detecting new astrophysical sources that preferentially emit energy in the form of VHE photons. Among the sources we could detect in this manner are gamma ray bursts, active galactic nuclei, and (if they exist) primordial black holes.

The largest source of background in our experiment is that due to high energy cosmic rays, on which we trigger at a rate of about 2 KHz. Time varying astrophysical sources will give rise to signals with time scales anywhere from small fractions of a second to weeks. The problem we face is thus how to find a "burst" signal of apriori unknown duration which is unlikely to come from fluctuations of the cosmic ray background, and to do so quickly enough to keep up with the large data rates.

It is already the case that we compare our findings with that of satellite detectors where data from such experiments is available. As we have improved our understanding of this new detection method, we have begun to publish our results in a manner which will allow these experiments to search for signals which coincide with those we measure, or even to point their detector in a direction we identify as interesting. This increases the importance of our being able to quickly identify bursts and to reliably estimate their statistical significance (underestimation of significance implies missing interesting events, whereas overestimation means wrongly informing the community that it is worth pointing a detector to some location).

Your work on burst detection has already provided us with an algorithm that reproduces that of our current one but is faster by a factor of three. It also allows us to search on additional time scales with an improvement in speed upon our current algorithm by as much as a factor of 7. We therefore very much look forward to further collaboration having to do with such burst detection.

Recently, we have also detected variations in our detector's cosmic-ray rates which are associated with variations in the solar magnetic field. These rates can be compared with those measured by the large number of neutron monitors which continuously measure low energy particles.

The main thrust of your current proposal – correlation among different sensors – is thus of great interest to us for use in comparison of our data with those of telescopes when studying bursts, for comparison with neutron monitors when studying solar events, and also for studying correlations in different parts of our own experiment. We look forward to the possibility of collaborating with you on this work also.

Sincerely,

Allen Mincer
Professor and Chair