

**Project name**

Ground Motion studies versus depth<sup>1</sup>.

**Classification (accelerator/detector:subsystem)**

Accelerator: Interaction region stability.

**Institution(s) and personnel**

Northwestern University, Department of Physics and Astronomy:

Gokhan Ünel (Postdoc)

Michael Schmitt (Assistant Prof.), Mayda Velasco (Assistant Prof.)

Heidi Schellman (Prof.)

Fermi National Accelerator Laboratory:

Vladimir Shiltsev (Staff scientist)

Stanford Linear Accelerator:

Andrei Seryi (Staff scientist)

**Contact person**

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**Project Overview**

Ground motion can cause significant deterioration in the luminosity of a linear collider, due to the vibration of numerous focusing magnets which cause the beam emittance to grow. For this reason, understanding the seismic vibration of all potential LC sites is essential.

The proposed studies will focus on how the ground motion varies with depth. This information is needed in order to decide how deep the LC tunnel should be.

The measurements will be made in the NUMI tunnel at Fermilab. We will take advantage of the fact that from the beginning to the end of the tunnel there is a height difference of about 800 m and that there are about five different types of dolomite layers.

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<sup>1</sup>Item ID 55: R & D list for NLC available in <http://www-conf.slac.stanford.edu/lcprojectlist/asp/projectlistbyanything.asp>.

The proximity of Northwestern to Fermilab allows us to go to the tunnel every two weeks in order to change the location of the probes and exchange batteries for the equipment. The members of the group have experience with NuMI (Laughton, Velasco, Ünel) and with seismic measurements (Seryi, Shiltzev).

### Description of the project activities of the first year

Northwestern has already invested \$25K in equipment toward this project using ICAR funds (see table below). All of the equipment is currently being tested, and an inter-calibration with the seismometer used in the Aurora Mine measurements (Shiltzev) is ongoing (Stevens, Ünel). Concurrently, we are in the process of understanding the data format provided by the data acquisition system of the GEOTECH equipment to make it compatible with the programs previously used to make the Fourier analysis needed to obtain ground motion frequency spectrum.

After the calibrations are understood, we will start making measurements in the NuMI tunnel and the MINOS near-detector hall. Given the number of measurements needed and that access is limited, the full set of measurements will take at least a half year to complete.

2	broadband seismometers	\$6,500.00	\$13,000.00
2	seismometer cables	\$325.00	\$650.00
1	DL-24 data recorder w/ 1 GB microdrive	\$11,240.00	\$11,240.00
1	12V 33 Ah battery	\$175.00	\$175.00
1	control interface	\$700.00	\$700.00
1	power supply	\$160.00	\$160.00
	handling charge		\$5.00
	shipping and insurance		\$160.00
total			\$26,050.00

### Budget

We have a grant from the state of Illinois to do accelerator development, ICAR. The grant provides \$450K/year for five years, and we are now at the start of the third year. Most of this grant will go into the development of linear colliders, with  $\gamma\gamma$  colliders as the ultimate goal.

The grant covers all technical and post-graduate personnel and equipment cost for the project proposed here. However, this grant will not cover graduate students. We request DoE to cover that cost.

We have one student who would like to concentrate on accelerator physics. She would take this project as her first task before moving on to beam stability and final focus system designs.

Institution	item	cost
Northwestern	Graduate student	\$26,436.00
Grand total		\$26,436.00