# Project Summary

We propose to develop a conceptual design and a science and engineering program for a Deep Underground Science and Engineering Laboratory (DUSEL) at the Henderson Mine, Empire, Colorado, owned by the Climax Molybdenum Company, a subsidiary of the Phelps Dodge Corporation.

The Henderson mine is one the largest operating underground mines in the world. It is located about 70 miles west of Denver International Airport and is easily accessible via major highways. Established in the 1970s and modernized in 1999, the mine has an extensive infrastructure including high capacity rock removal, electric power, water, water treatment, and communications systems. The mining company owns all the land required for DUSEL, including the tailings site. It has all the environmental and mining permits required for excavation, core drilling and rock disposal, so none additional are expected to be necessary for DUSEL. The site owners are enthusiastic supporters of this initiative and are actively developing a plan that will demonstrate the feasibility of inter-operation of the mine and DUSEL. A national organization - Henderson Underground Science and Engineering Project (HUSEP) Collaboration - has been formed to guide the development of Henderson DUSEL. The collaboration has representatives from Henderson Mine, the science and engineering departments of several regional and national universities, and the local community.

**Intellectual Merit:** The proposed series of engineering, geotechnical, and scientific tasks will result in a comprehensive report detailing the feasibility of Henderson DUSEL including construction schedule and cost estimates, geotechnical analyses, and evaluation of ground support requirements. The benefit of leveraging the huge commercial investment in the vast infrastructure of the mine will be highlighted. To illustrate the potential of this site, we present a conceptual design for an underground complex that accommodates the physical science modules as well as the geological and biological science modules described in the NSF DUSEL solicitation. The design includes: an Upper Campus (2500-3300 mwe overburden) for experiments requiring modest depths, readily available within a year; a Central Campus (4200 mwe overburden) for multi-purpose caverns and for "Large" module experiments; a Lower Campus (at least 6000 mwe overburden) for experiments that require extreme depth; stations for geological and biological experiments near the molybdenum ore zone; and various outposts for isolated geological and biological experiments in a pristine environment. The main campuses are served by the mine infrastructure but are underneath an adjacent mountain (owned by Henderson), well away from mining operations. A 2500-ft core-drilling from an existing access drift into the region of the central campus has demonstrated that the rock in that region is highly competent porphyritic granite with few fracture planes and little water.

Since SNOLab in Canada will soon provide additional access to a very deep site in North America, phasing the development of DUSEL to optimize the complementarity, flexibility and cost of the US facility is proposed. Discussions will continue with the SNOLab management on the possibility of a cooperative alliance between Henderson DUSEL and SNOLab that includes coordination of the experimental programs at the two sites.

**Broader Impact:** An essential ingredient of the Henderson proposal is strong support from local communities, state government, and academic institutions. Indeed, the possibility of Henderson as a potential laboratory site was first raised by members of the local county planning commission. This local support is also a key component of our plans for education and outreach to the public. An increasingly important role for any major scientific facility is to take advantage of its huge intellectual resource to communicate the excitement of science and engineering to a broader population. We have already begun this process by leveraging an existing outreach program - the Snowmass Area Large Time-coincidence Array (SALTA) project. Using the same instruments, the cosmic ray flux inside the Henderson mine has been measured by regional high school students and teachers. We propose to integrate the SALTA experience with successful existing outreach programs at the regional universities. An anticipated visitor center at Henderson will be near major tourist destinations, allowing us to maximize public outreach opportunities. We plan to provide the general public with scheduled, limited, controlled and supervised tours of the underground laboratory.

**Summary:** We propose to continue development of a conceptual design of DUSEL at Henderson that meets the facility requirements of the NSF DUSEL Solicitation 1 report and to further explore the science and engineering that take advantage of Henderson's unique features. The results of this investigation will include proposals for near and long term science programs, a conceptual design, and plans for facility management, international collaboration, and education and outreach.