Astroparticle Physics Projects

- **Gravitational Waves: LIGO/AdvLIGO** (GEO, VIRGO, TAMA, 11 countries)
- **Cosmological Neutrinos: IceCube** (NSF-OPP, Germany, Sweden, Belgium)
- **Underground Physics: DUSEL** (DOE-HEP, NP)
- **Dark Matter: CDMS, XENON, WARP, ZEPLIN, DRIFT, COUPP, LUX** (NSF-AST, DOE-HEP, INFN, STFC, Germany, Poland)
- **Cosmic Rays: AUGER, (HiRes), TA, Veritas, (Milagro)** (NSF-AST, DOE-HEP, Japan, Korea, Canada, Ireland, Smithsonian, 17 more countries)
- **Neutrinos: Borexino, Double Chooz, CUORE, Daya Bay** (DOE-NP, DOE-HEP, INFN, France, Germany, Brazil, Japan, Russia, Spain, UK)
- **Structure of the Universe: ACT** (NSF-AST)
- **B-Mode Polarization of CMB: QUIET** (NSF-AST)
- **Origin of the Elements: NSCL** (DOE-NP)

Cosmic Questions for DUSEL

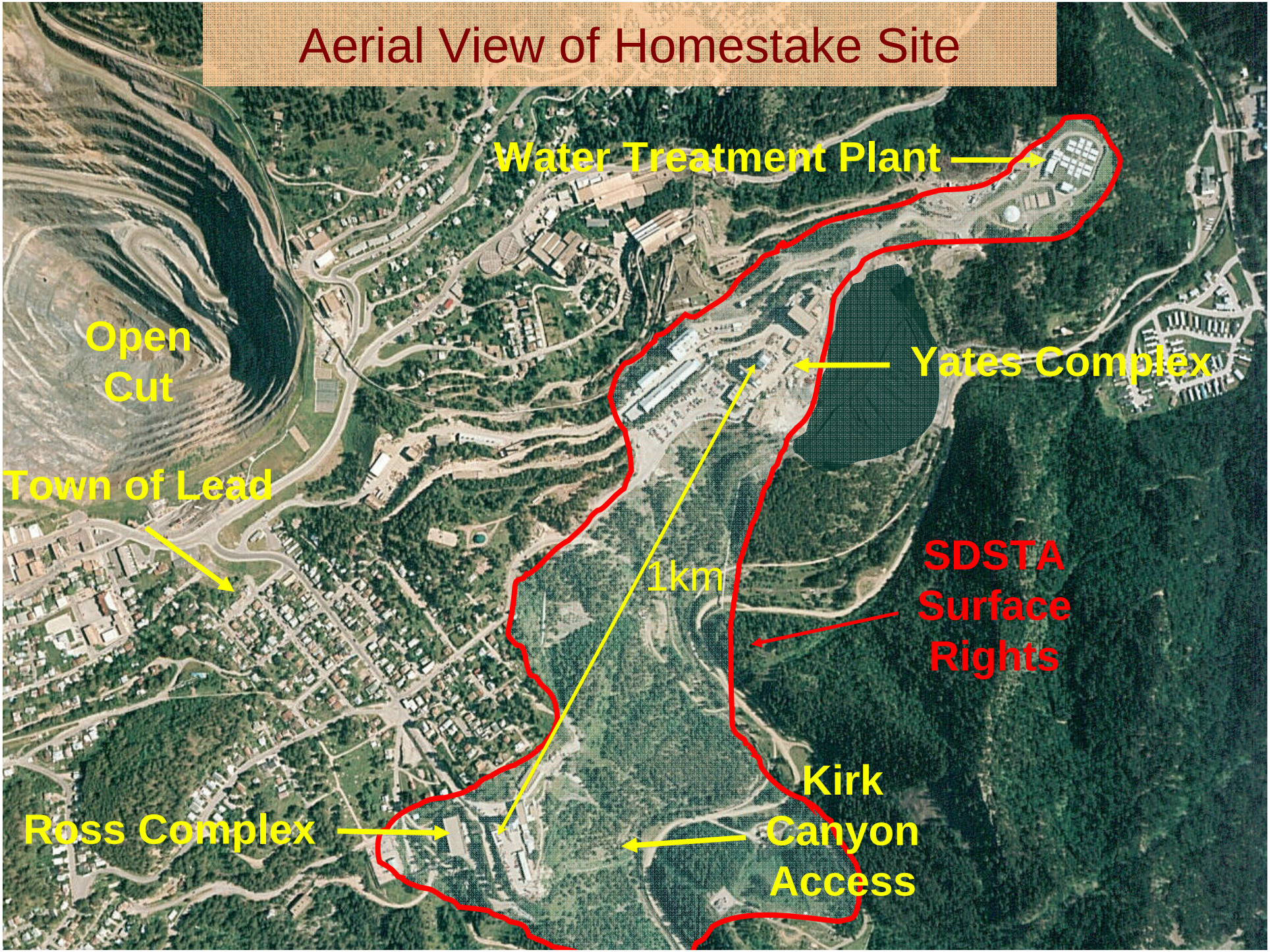
- Of what is the Universe made?
- What is Dark Matter?
- What are neutrinos telling us?
- Where did the antimatter go?
- Are protons unstable?
- How did the universe evolve?

DUSEL Physics Experiments

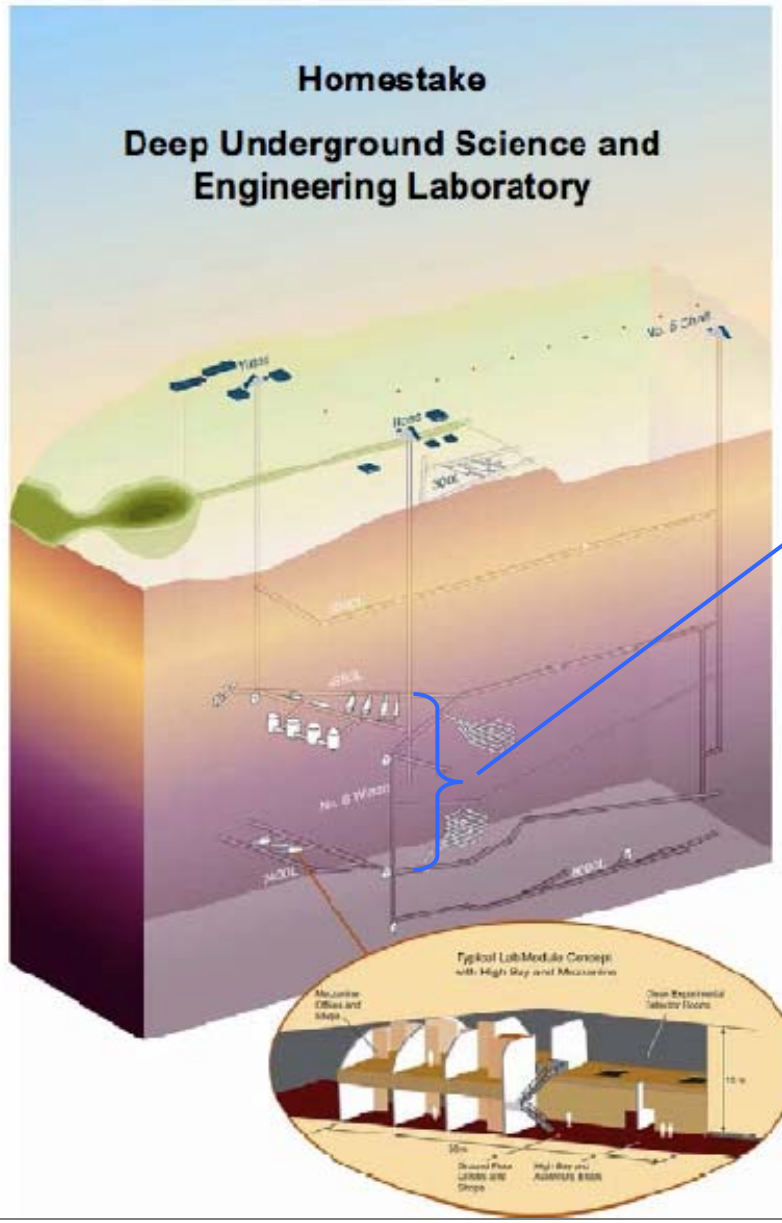
- The aforementioned questions are addressed at DUSEL via a variety of experimental probes:
  - Direct Detection of Dark Matter
  - Neutrino-less Double-Beta Decay
  - Nuclear Astrophysics
    - Accelerator-based cross-section measurements
  - Solar Neutrinos
  - Long Baseline Experiment, Proton Decay, and Supernovae Remnants (Mega-Detector)

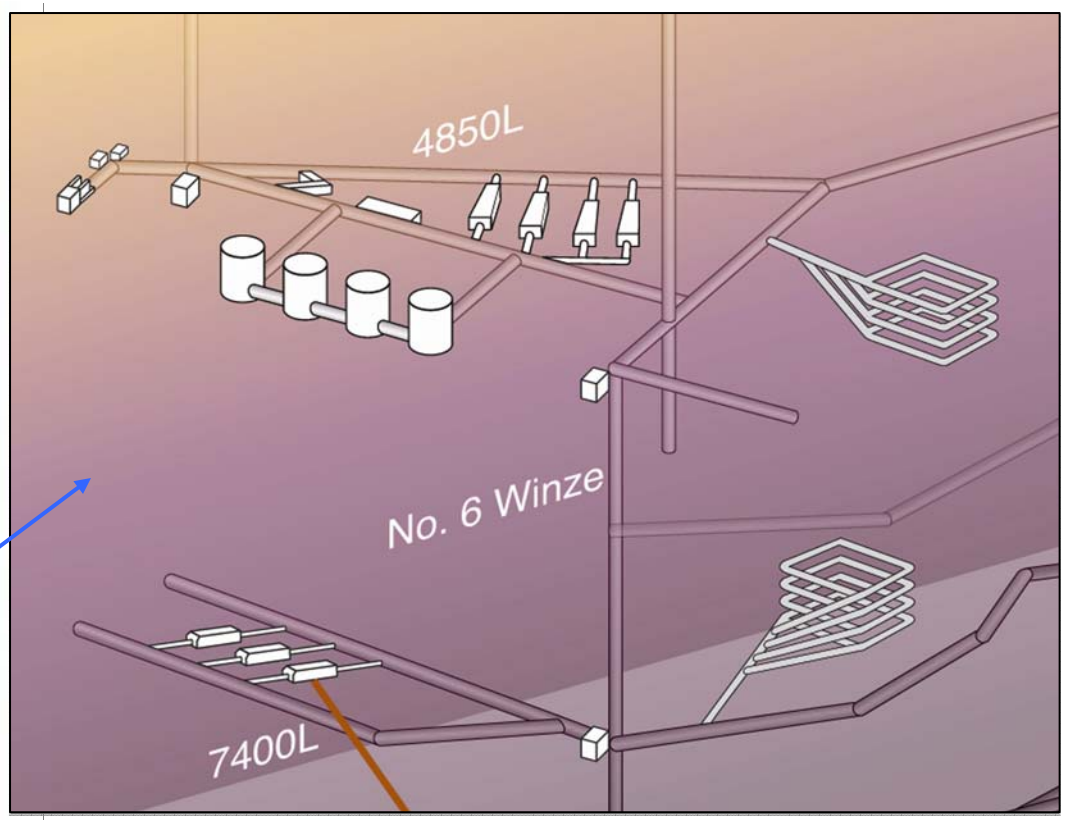
DUSEL MREFC funding would support the construction of forefront experiments in nuclear- and astro-physics, and in particle physics using the Fermilab accelerator as a high intensity neutrino source.

Aerial View of Homestake Site



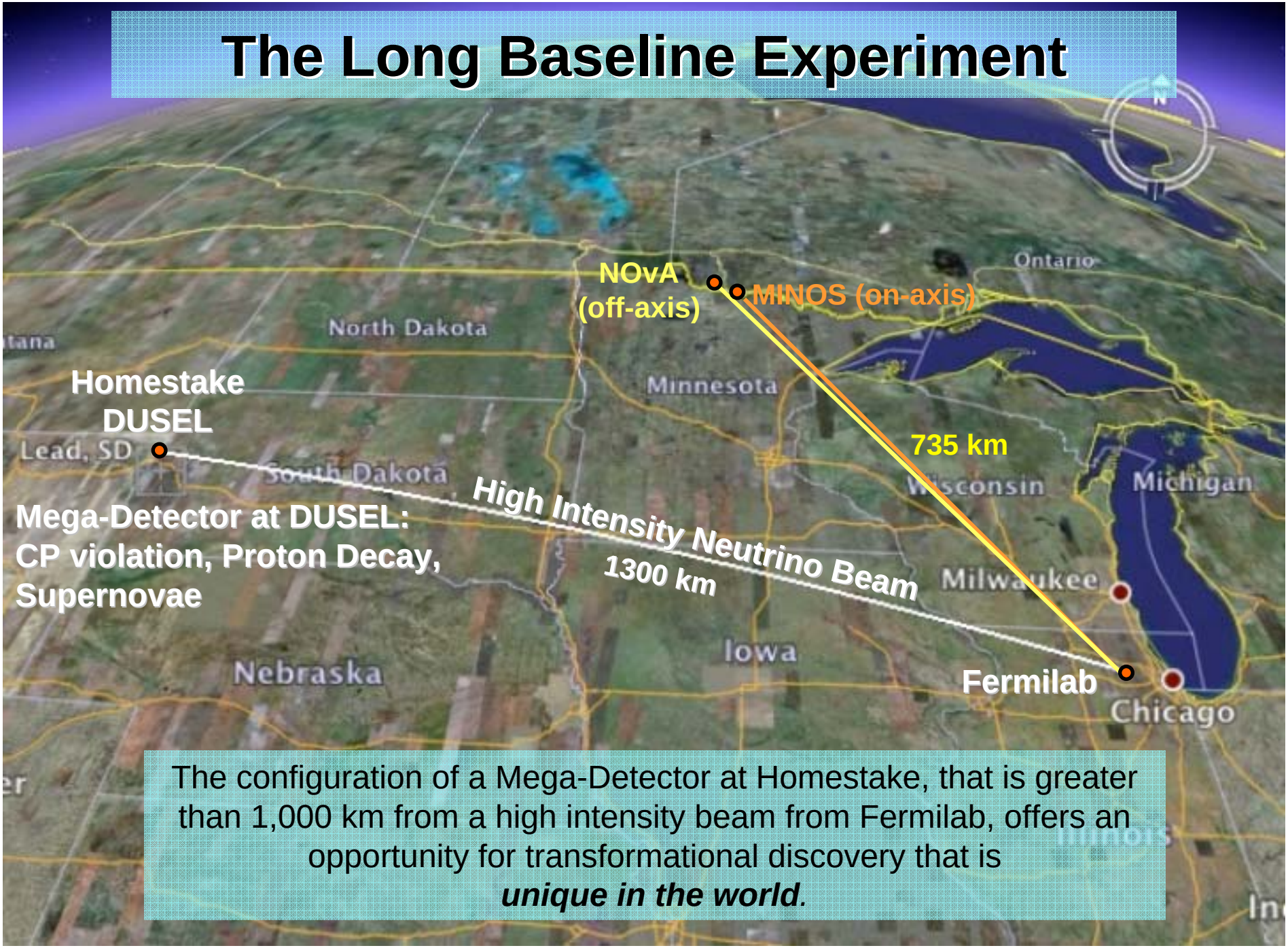
An Illustrative DUSEL Laboratory Concept





- **Scope is being driven by needs of physics experiments, E&O at/near surface.**
- **Modular design being pursued will facilitate future scope adjustments.**

The Long Baseline Experiment



The configuration of a Mega-Detector at Homestake, that is greater than 1,000 km from a high intensity beam from Fermilab, offers an opportunity for transformational discovery that is ***unique in the world***.