

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)

A cosmic background image featuring a bright star with a lens flare at the top center, surrounded by a field of smaller stars and a complex, dark, textured structure resembling a galaxy or nebula. The overall color palette is dark with highlights from the stars and the bright star's glow.

Cosmic Questions for DUSEL

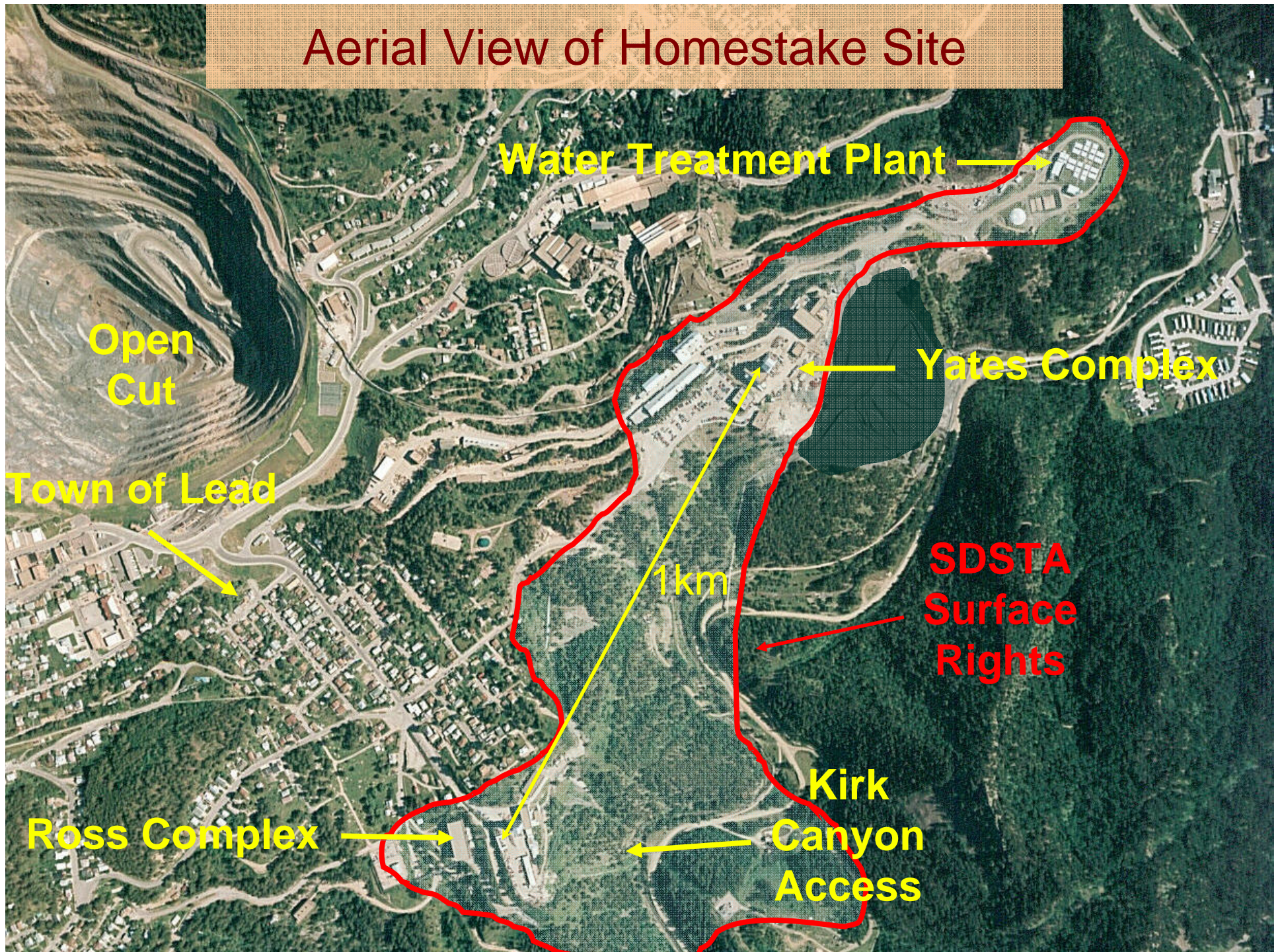
- Of what is the Universe made?
- What is Dark Matter?
- What are neutrinos telling us?
- Where did the antimatter go?
- Are protons unstable?
- How did the universe evolve?

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



Open Cut

Water Treatment Plant

Yates Complex

Town of Lead

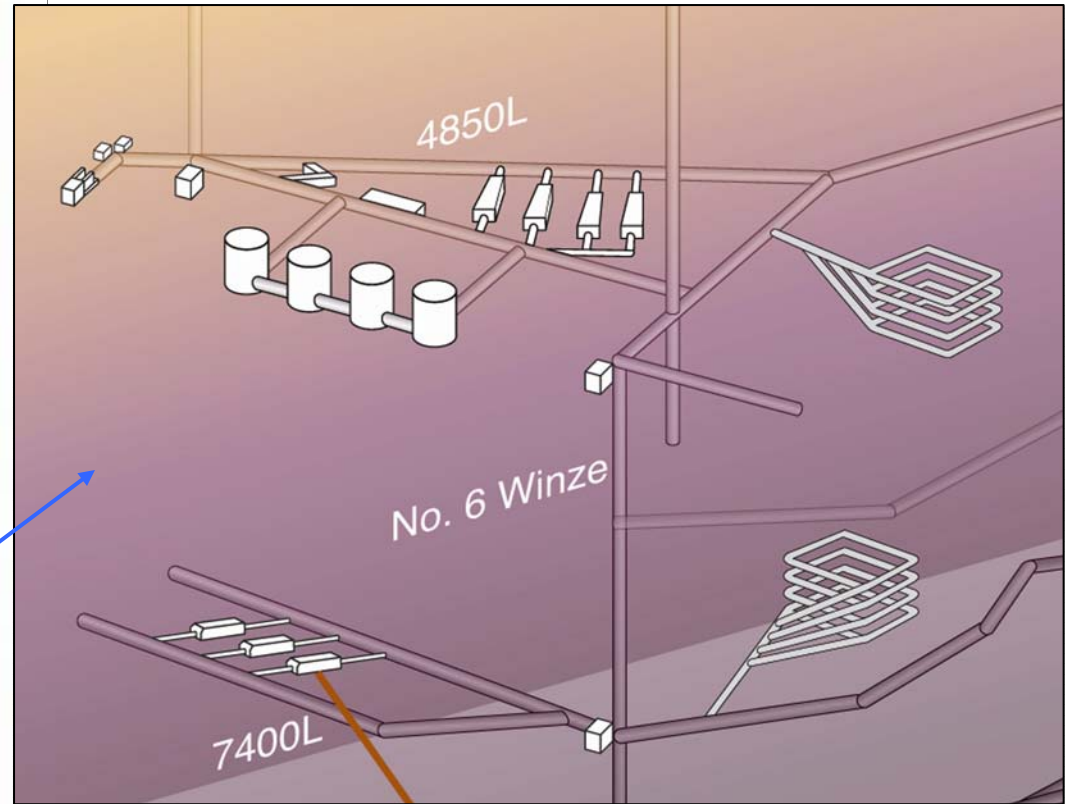
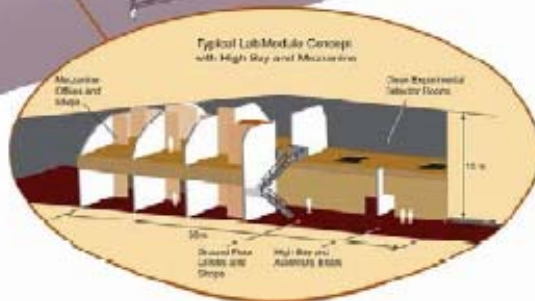
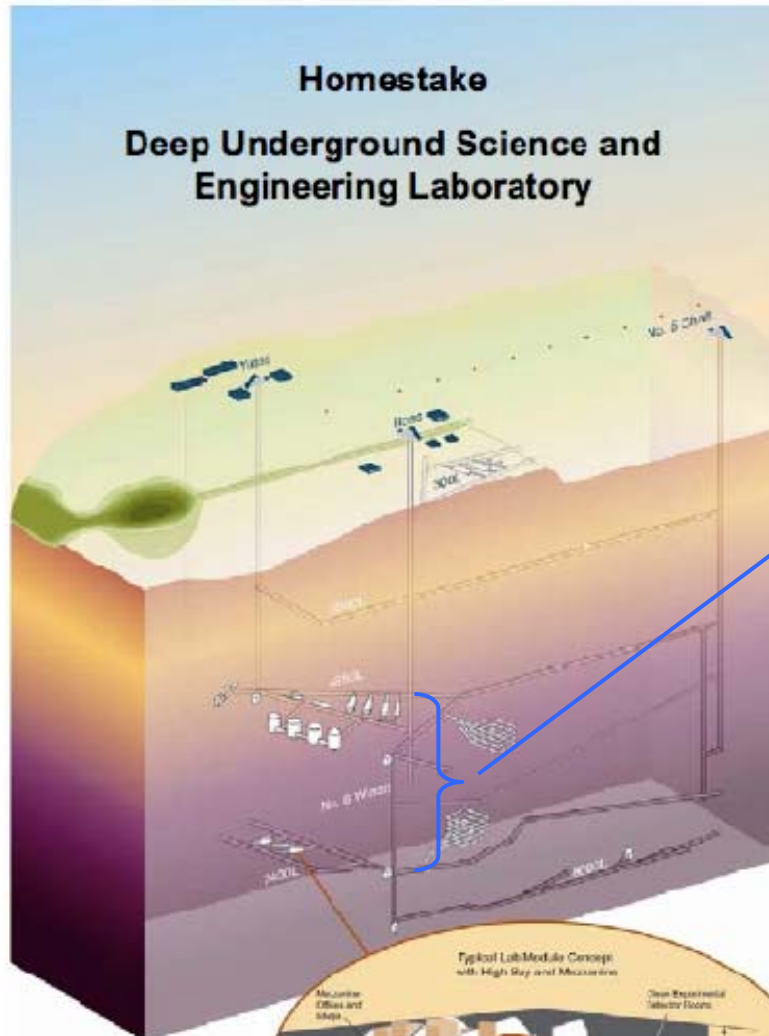
1km

SDSTA
Surface
Rights

Ross Complex

Kirk
Canyon
Access

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



Homestake
DUSEL

Mega-Detector at DUSEL:
CP violation, Proton Decay,
Supernovae

NOvA
(off-axis)

MINOS (on-axis)

735 km

High Intensity Neutrino Beam
1300 km

Fermilab

Chicago

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.*