Solution Mining Research Institute Spring 2016 Technical Conference

Galveston, Texas, USA, 25 – 26 April 2016

OPPORTUNITIES FOR PARTICLE PHYSICS EXPERIMENTS IN SOLUTION MINED CAVERNS

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Abstract

Thousands of physicists today work in a field called "particle astrophysics", whose concerns include the study of neutrinos and dark matter. Our work often requires us to build large, ultrasensitive particle detectors deep underground; examples include Super-Kamiokande, a 50 kiloton ultrapure water system in Japan, and DUNE, a 30 kiloton liquid argon experiment planned for the Sanford Underground Research Facility in South Dakota. Our needs for more and larger detectors have been stymied by the constraints of working in conventionally-excavated underground spaces. I have been studying the possibility of installing detectors in solution-mined salt caverns, which appear to offer different constraints and opportunities. Some fairly conventional detector technologies might benefit from large roof spans, low radioactivity, site flexibility, and potentially low cost. Other technologies might benefit from the access to high pressure. In this talk I will briefly introduce the field of experimental particle astrophysics, including today's key science goals and the large detector technologies now in use in mines, underwater, and in Antarctic ice. I'll show some early concepts for salt-cavern-compatible detectors, ranging from "easy" experiments previously designed for deep ice drill holes, and the more speculative ideas for high-pressure gas ionization counters (limited to about 100 kg in conventional labs) scaled up to tons or kilotons. I'll highlight what I see as the key cavern- and detector-engineering challenges which I hope can be met via future collaborations.

Key words: cavern instrumentation, cavern utilization, physics, astrophysics