

Abstract Submitted  
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**Study of annual modulation at Soudan Mine using a liquid scintillation detector**<sup>1</sup> CHAO ZHANG, DONGMING MEI, University of South Dakota — The phenomenon of annual modulation is believed to be one of signatures induced by Weakly Interacting Massive Particles(WIMPs) through elastic scattering off nucleus in the target for direct dark matter searches. Both DAMA and CoGeNT experiments have claimed the discovery of dark matter in terms of annual modulation while many other experiments have ruled out the entire claimed region. However, the sources that caused the annual modulation in DAMA and CoGeNT are till mysterious. A 12-liter liquid scintillation detector has been running at Soudan Mine (1.95 km.w.e) for several years. Using this detector, muon and muon-induced neutron fluxes at Soudan Mine are measured to be  $(1.65 \pm 0.02(sta.) \pm 0.1(sys.)) \times 10^{-7} \text{ cm}^{-2}\text{s}^{-1}$  ( $E_\mu > 1 \text{ GeV}$ ) and  $(2.23 \pm 0.52(sta.) \pm 0.99(sys.)) \times 10^{-9} \text{ cm}^{-2}\text{s}^{-1}$  ( $E_n > 20 \text{ MeV}$ ), respectively. Data analysis for three years shows a clear annual modulation pattern ( $E > 10 \text{ MeV}$ ) caused by cosmic-ray muons with an amplitude of  $\sim 2\%$ . The annual modulation caused by radon has also been observed in the energy region below 10 MeV. We demonstrate the sources of annual modulation in different energy region and explain how background-induced annual modulation may mimic dark matter signature.

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