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DArKSIDE-50: A view of the first atmospheric argon run

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Summary. — The DArKside (DS) program aims to detect the so-called WIMPs (Weakly Interactive Massive Particle) which are considered the best candidates for Dark Matter. WIMPs elastically scattering would be detected by using a two-phase Time Projection Chamber (TPC) based on argon nuclei target. Thanks to the properties of the scintillation and ionization signals detected by the TPC it is possible to discriminate a WIMP-induced signal from one induced by background. DS-50 started its data taking on November 2013 with atmospheric argon (later with underground argon depleted in ^{39}Ar.)

PACS 95.35.+d – Dark matter (stellar, interstellar, galactic, and cosmological).
PACS 29.40.-n – Radiation detectors.

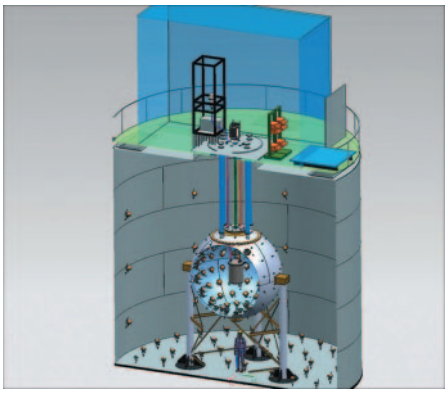
1. – The experimental apparatus

The DArKside experiment is formed by three detectors; from the outside to the center: the water Čerenkov detector (*i.e* muon veto), the liquid scintillator detector (*i.e* neutron veto) and the Liquid Argon TPC (LAr-TPC), see fig. 1.

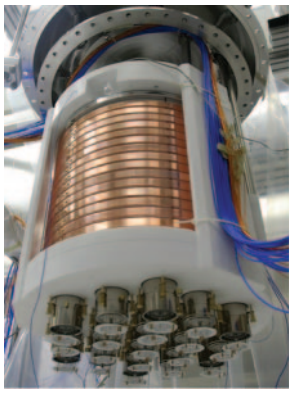
An event that deposits energy in the LAr produces excitation and ionization of the argon. The excitation results in a prompt scintillation signal called "S1". Ionization electrons, escaping recombination, are drifted by an electric field to the surface of the LAr and extracted into the argon gas above it. The electric field in the gas accelerates the electrons, which produce a second signal called "S2", proportional to the collected ionization.

2. – Measurement of scintillation light yield

The Light Yield is defined as the ratio of the number of photons emitted over full solid angle due to the amount of energy deposited into the medium by nuclear recoil or electron recoil (our case). From a first background run our measurement is dominated by the β-decay of ^{39}Ar, whose end-point is at 565 KeV$_{ee}$ (electron equivalent), see fig. 2(a). From this spectrum we obtain a value for the light yield of 8.04 photoelectrons/keV.

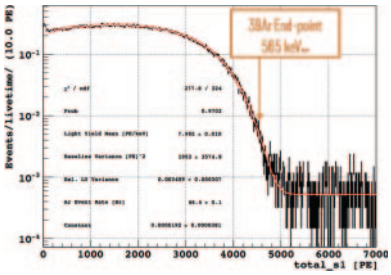


(a) Schematic view of the DS-50 detector.

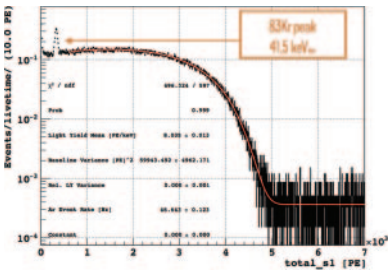


(b) Assembled TPC

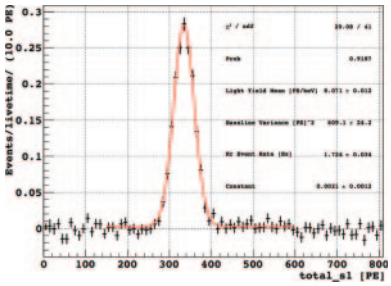
Fig. 1. – Pictures from the DArKside experiment.



(a) Background run dominated by the decay of ^{39}Ar.



(b) Run with gaseous injected ^{83m}Kr.



(c) Zoomed picture of decaying peak of ^{83m}Kr.

Fig. 2. – Measurement of the Light Yield.

To improve the measurement we took a run with a gaseous ^{83m}Kr, whose decay peak is at 41.5 keV and an half life of 1.83 hours. Thanks to this peak we are able to know exactly the value of the scintillation light yield of the detector, which results to be 8.07 pe/keV.

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I want to thank the Steering Committee of DS-50 for advice and for helping me.