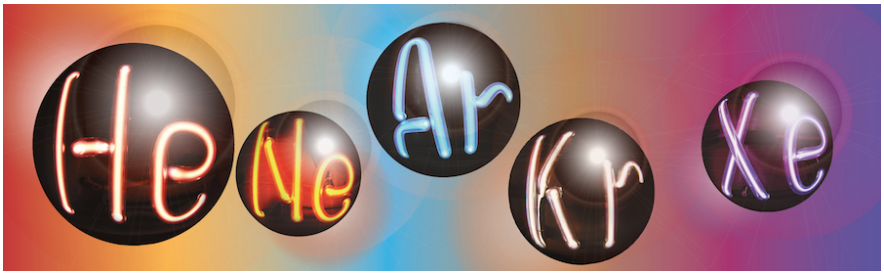

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3DΠ scanner, an application in medical physics of the DarkSide collaboration

Thursday, 22 September 2022 14:45 (15 minutes)

This project is based on the emerging technology from the field of direct dark matter searches for weakly interacting massive particles (WIMPs), in which Liquid Argon (LAr) time projection chambers are used to identify different particle interactions for WIMP detection. The Darkside Collaboration has demonstrated the true power of the advancing LAr detector technology. They are also making significant strides in low-radioactivity argon procurement and cryogenic photosensor development and fabrication. With these advances in hand, the principle of 3DΠ has been developed. It is a novel design of a Time Of Flight (TOF) Total-Body (TB) scanner for Positron Emission Tomography (PET) using Xenon-doped liquid Argon (LAr) as a scintillator. By doping the LAr with Xenon, the long-lifetime component of the LAr scintillation light can be suppressed, allowing the scanner to handle higher data rates and hence higher patient doses if required for a given application. Since the de-excitation process in the mixture can be accomplished with direct energy transfer from argon excimers to xenon and direct emission of xenon light, it will be faster than the fluorescence processes of a wavelength shifter (WLS). Additionally, it has been shown that reducing the operating temperature of SiPMs down to the temperature of LAr significantly reduces the dark count rate within the SiPM.
The preliminary results of the Monte Carlo simulation demonstrate that the scanner's system performance, according to the NEMA NU 2-2018 standardized guide, is comparable to commercial scanners.

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