Effect of Surface Resolution on Ray-Tracing Optical Simulations

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The nEXO collaboration proposes to detect neutrino-less double beta decay of xenon-136 with a Time Projection Chamber filled with 5000 kg of 90%-enriched liquid xenon. As part of the nEXO R&D, our group studies the optical properties of materials when immersed in LXe and illuminated by its 178 nm scintillation light. We use Chroma, a GPU-based ray-tracing software, to study the photon transport efficiency (PTE) of scintillation light in our test cell, in various geometrical and optical configurations. Chroma can import detector configurations generated using CAD software, but care needs to be put in defining the parameters of the CAD models as the details of surface tessellation could artificially impact the results of optical simulations. To study the magnitude of these effects, we compared the results from Chroma simulations of our LXe cell, obtained with a range of resolution settings of the CAD-generated geometry, while keeping all other parameters unchanged. We find that the degree of tessellation correlates with the amount of light the simulations predict to be collected on a silicon photomultiplier used as a light detector. The effect is most notable when modeling curved surfaces. We present quantitative result of this study and provide details on the CAD-to-Chroma process.