

Effect on Dark Matter Exclusion Limits from New Silicon Photoelectric Absorption Measurements **Supplemental Material**

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November 18, 2020

This document accompanies the article titled "Effect on Dark Matter Exclusion Limits from New Silicon Photoelectric Absorption Measurements" [1], and describes the photoelectric absorption cross section data used to produce its results. The photoelectric absorption cross section data used in Ref. [1] are contained in four files:

- `pexsec_Si_nominal_keV_cm2g.txt`,
- `pexsec_Si_fitted_keV_cm2g.txt`,
- `sig1_Si_nominal_keV_eV.txt`,
- `sig1_Si_fitted_keV_eV.txt`.

In each file, the first column is the photon energy in units of keV, and the second column is the absorption data at each photon energy. The files starting with `pexsec` correspond to the photoelectric absorption cross section data ($\sigma_{\text{p.e.}}$) used in the light dark matter scattering and axion-like particle absorption dark matter models. The files starting with `sig1` correspond to the real part of the complex conductivity (σ_1 , proportional to $\sigma_{\text{p.e.}}$) used in the dark photon absorption dark matter model. The absorption units are indicated by the last segment of the file name: cm^2/g for $\sigma_{\text{p.e.}}$ and eV for σ_1 .

The files containing `fitted` correspond to new precise measurements of the photoelectric absorption cross section described in Ref. [2]. These curves are generated by first fitting the absorption model in Ref. [3] to the measurements in Ref. [2], and then evaluating the fitted model at 50 mK. The absorption model in Ref. [3] and thus these fitted curves are valid up to a photon energy of 4 eV.

The files containing `nominal` correspond to the photoelectric absorption cross section curve using nominal, commonly used data sources. The nominal dataset is defined as the $\sigma_{\text{p.e.}}$ data from Ref. [4] for energies ≤ 1 keV, Ref. [5] for energies > 1 keV and ≤ 20 keV, and Ref. [6] for energies > 20 keV. To generate the curves used in this analysis [1], the nominal data was aggregated and linearly interpolated for energies below 0.2 keV. Above 0.2 keV, the data was interpolated using an inverse cubic dependence.

The analysis in Ref. [1] compares the effect on dark matter exclusion limit between using the fitted or nominal photoelectric absorption curves. Although the fitted curve is only valid up to a photon energy of

4 eV, the photoelectric absorption is needed over a wide range of energies. Thus, for energies larger than 4 eV, previously existing data is used starting at 4.02 eV (the closest data point in the nominal dataset), interpolating in the region in between. The corresponding photoelectric absorption curves above 4.02 eV. are identical to the nominal curves.

References

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