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# Quasiparticle Diffusion in CRESST Light Detectors

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The sensitivity of transition edge sensors (TES) is mainly limited by the thermalization of non-thermal phonons in the main absorber. The addition of superconducting thin films serving as phonon collectors (PC) is an elegant approach to reduce the collection time of the non-thermal signal component without increasing the heat capacity of the TES.
In a PC non-thermal phonons break Cooper pairs into free electrons, also called Quasiparticles. Those Quasiparticles diffuse thermally through the superconducting metal film and break up other Cooper pairs before they recombine or interact with the electron system of the TES. Since recombined quasiparticles are lost signal, the size of the PC have to be adapted to their diffusion length in consideration of the used TES structures and materials.
To determine the diffusion parameters of CRESST type aluminum-tungsten (Al-W) bilayer systems, a dedicated setup was simulated and realized. In this setup, quasiparticles are able to diffuse in a 2 mm long Al-W thin film system before being detected with two independently operated TES. The measurements show, that in the case of CRESST light detectors the diffusion length can reach up to 1 mm, which is much

higher than previously expected for the current detector quality. Several independent measurements confirmed these diffusion lengths.
Based on these results, new CRESST light detector structures were developed. First test with adapted light detector geometries show an improvement of the signal height of up to 50% compared to the currently used geometries.