

Isolating the Sound of Dark Matter: Our HELIOS Suspension

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There are several candidates in the broad search for dark matter. Prevalent among them is an ultralight particle interacting via some scalar field, which would induce an isotropic strain on all condensed bodies. Our dark matter detector (HELIOS) aims to measure this effect in the 2 kHz frequency range, and thus requires strong vibration isolation in that range. We have created a new kind of vibration isolation suspension, which uses circular catherine-wheel springs cut out of oxygen-free copper sheets. These springs utilize significantly less vertical height, meaning more isolation stages can fit above the shell of our dilution refrigerator. This increases the overall attenuation. Since stainless-steel coil springs also have very poor thermal conduction, similar suspensions are generally thermally bypassed using copper wires or rods. This implementation is unnecessary with this new design, as the entire suspension is made out of copper. Strong attenuation was measured in the desired frequency range, as well as clear improvement in overall attenuation as more stages were added.

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