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P2: photon and phonon detectors on a solid Si substrate for scintillating crystals at low temperature

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We present the concept and design of the P2 detector for measuring the temperature rise and scintillation light in a scintillating crystal at mK temperature. P2 is based on low temperature metallic magnetic calorimeters (MMCs) and it features both photon and phonon detectors structured on a single 3"Si wafer.
The photon sensor consists of a Nb superconducting stripline pickup coil enclosing about 50 Ag:Er paramagnetic sensor segments, each 300 nm thick and 450 μm long located on the central part of the Si wafer. This part is connected to the rest of the wafer through seven 100 μm long and 300 μm wide Si bridges structured using Si deep etching. In this way, the central part of the Si wafer acts as a photon absorber.
On the outer part of the wafer, three MMC channels based on the double meander design are located. Each of them is equipped with two Ag:Er sensors, but only one pixel is equipped with a gold cylinder. The three gold cylinders will be used both as thermal contact to the crystal and as mechanical support. We aim at demonstrating that the proposed detector design can achieve suitable performance for the AMoRE experiment.
In addition, we propose to investigate the use of the independent readout of the three MMC channels connected to the crystal for the identification of event position based on pulse shape analysis. The possibility to define a fiducial volume will be of utmost importance to reduce the contribution to the background due to surface events.

Submitted on behalf of a Collaboration?

Yes

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