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High energy resolution metallic magnetic calorimeters for the IAXO experiment

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The International Axion Observatory (IAXO) will be a fourth generation axion helioscope, for the search of axions generated at the core of the Sun. The detection principle used for the IAXO experiment is based on the Primakoff effect. Solar axions reaching the Earth could be converted into photons while passing through a volume under high and static magnetic field. The expected photon spectrum has a continuum shape which is peaked at about 4 keV.
IAXO is therefore characterized by three main components: a long and strong magnet pointing towards the Sun, x-ray optics and high resolution and low background x-ray detectors.
Low temperature metallic magnetic calorimeters (MMCs) are one of the detector technologies selected for IAXO. MMCs are energy dispersive detectors operated at temperatures below 0.1 K. In MMCs, the magnetization of the sensor is used to monitor the temperature change of the detector upon the interaction of a particle. This temperature change is proportional to the absorbed energy. Low-noise high-bandwidth dc-SQUIDs read out small changes in magnetization. The resolving power approaching 5000, the intrinsic response time well below 1 μs and the excellent linearity make MMCs very attractive for IAXO. In particular, the very good energy resolution of MMCs will increase the sensitivity of the experiment on the axion-electron coupling.
We present the development of a 64×64-pixel array covering a relatively large surface, 45×45 mm^2 and characterized by a moderate energy resolution of about 200 eV which is suitable for the search of solar axion signals. A second design, a 64-pixel array covering a surface of about 4 mm^2, optimized for high resolution x-ray spectroscopy and able to reach energy resolution smaller than 2 eV will be discussed for investigating axion-electron coupling. Both proposed arrays will be read out by 32 double stage SQUID channels, allowing for the development of a common detector platform for the operation of the detectors in a movable cryostat.

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