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Skipper CCDs: From Dark Matter Searches to Next Generation Ultra-Low-Noise Imaging

Skipper CCD technology has recently unlocked unprecedented sensitivity to ionization signals as faint as a single electron, enabling new frontiers in direct dark matter searches. As a result, the DAMIC-M experiment at the Modane Underground Laboratory, based on Skipper CCDs, has delivered the most stringent constraints to date on sub-MeV dark matter interacting with electrons—probing both freeze-out and freeze-in scenarios in the dark sector for the first time.
Skipper CCDs represent a technological breakthrough. By overcoming the readout noise floor of conventional sensors, they provide ultra-low noise, high stability, and quantized charge measurements, at the cost of readout time.
New recent improvements, including MAS-CCD, SiSeRO, and CMOS Skipper architectures, combine faster readout with Skipper-level performance. Looking ahead, we propose to evaluate the feasibility of advancing this technology using the INFN ARCADIA fully-depleted MAPS CMOS sensor platform, opening the path toward a new generation of ultra-low-noise silicon imagers.

Title

Topic

Solid state sensors

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