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UFERI –hybrid photon-counting pixel detector for diffraction experiments at synchrotrons

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A new single photon-counting ASIC called UFERI (Ultra-Fast Energy Resolved Imager [1]) is under development by the ASIC design group of AGH University and the detector group of the SOLEIL synchrotron. The detector is dedicated to pseudo-Laue diffraction applications in intense, pink beams at synchrotrons. The prototype consists of 42×42 pixels with a pitch of 75 µm, each containing a charge-sensitive amplifier with gain control, three discriminators, and corresponding counters. With its three thresholds, UFERI can discriminate multiple energy levels, and its short dead time ensures a high count rate capability of up to 23 Mcps/pixel (30% dead time loss). In addition, UFERI has a zero-dead time readout mode, and three independent gates for the three discriminators which, combined with a short gating time, allow for ultra-fast pump-probe-probe experiments. In low-noise operation mode, a capacitor discharge technique [2] implemented on-chip allows to alleviate the trade-off between noise and count rate performance, enabling operation with an ENC much below 100 e- rms, while accepting a moderate photon flux above 1 Mcps/pixel.
This proposed poster will describe the architecture of the ASIC (see Fig. 1) and present the main results of the characterization. We will show the energy calibrations, threshold dispersions, and gain spread, as well as the count rate and timing performance of the UFERI (see Fig. 2).

[1] F. Orsini, A. Dawiec, B. Kanoute, P. Grybos, R. Kleczek, P. Kmon and P. Otfinowski, "Ultra-Fast Energy Resolved Imager for 'Pseudo' Laue diffraction experiments at synchrotron facilities", Journal of Instrumentation, vol. 19, no. 02, p. C02055, 2 2024.
[2] R. Kleczek, P. Kmon, P. Maj, R. Szczygiel, M. Zoladz and P. Grybos, "Single Photon Counting Readout IC with 44 e-rms ENC and 5.5 e-rms Offset Spread with Charge Sensitive Amplifier Active Feedback Discharge" , IEEE Transactions on Circuits and Systems I: Regular Papers, vol. 70, no. 5, pp. 1882-1892, 5 2023.

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