

# Experimental results of the pFREYA16 ASIC for x-ray ptychography in continuous wave light sources

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## Abstract

The pFREYA16, prototype Fast Readout for ptychography Applications with 16 channels, ASIC is a pixellated 8-by-2 readout matrix developed for ptychography experiments based on fourth generation storage ring light sources, also known as Diffraction-Limited Storage Rings (DLSR), pushing towards continuous wave operation. The target of the experiment is to obtain a 128-by-128 matrix of pixels, working at a frame rate of 1 MHz with single-photon resolution, as well as low-noise and low-power figures, in a modest-size pixel area of  $150\ \mu\text{m} \times 150\ \mu\text{m}$ . The current prototype reports respectively a noise of  $250\ e^-$  rms and a power consumption of  $220\ \mu\text{W}$  per pixel. The readout chain is composed of a switch-reset CSA and a semi-Gaussian unipolar RC-CR shaper, and includes signal discrimination, zero-suppression capabilities, and pixel-level analog to digital conversion. The ASIC is also configurable for 5, 9, or 25 keV input photon energy, with a full well of 256 equivalent photons in each mode, and four different peaking times are available for noise optimisation. The conference presentation will focus on a full characterisation of the CSA and the shaper stage, and will provide insight into the equivalent noise charge obtained in each mode, with a comparison between post-layout simulations and actual measurements on the chip.

**Keywords** - ptychography, continuous wave, low-noise, front-end channel, pixellated readout

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