The DEPFET Sensor with Signal Compression (DSSC) will be a 2d 1Mpx imaging detector for the European X-ray Free Electron Laser Facility (XFEL). The DSSC is foreseen as an imaging detector for soft X-radiation from 0.5 keV up to 6 keV. Driven by its scientific requirements, the design goals of the detector system are single photon detection, a high dynamic range and a high frame rate of up to 4.5 MHz. Signal compression, amplification and digitization will be performed in the focal plane. Utilizing an in-pixel active filtering stage and an 8/9-bit ADC, the detector will provide parallel readout of all pixels.

Here we present the results of studies on the stability and performance of a parameterized model for determining gain and offset in DSSC prototype calibration line spectra will be presented.

### Motivation

- A calibration strategy for the DSSC detector has been proposed and a first experimental validation has been given. An update on this can be found on poster N1CP-59 in this session. A key element of the strategy is the determination of the system gain and offset based on peak energies of X-ray calibration line sources such as $^{56}$Fe.
- DSSC prototypes currently available for calibration experiments only provide single pixel read-out functionality. Mainly due to charge sharing between neighboring pixels, calibration spectra recorded with DSSC prototypes show a continuum between noise peak and signal peaks, a so-called “trough” that aggrivates determining the peak positions.

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**$^{56}$Fe spectrum of a DSSC DEPFET pixel read out by an external 14-bit ADC.**

A continuous, global spectral response model (red) takes into account the trough between noise peak and calibration lines (see equation). By characterizing the spectral response of the DEPFET with the continuous fit function, the calibration of offset and gain in the 8-bit resolution of the DSSC can be facilitated. System simulation (above) is used to test the fit function in various environments.

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**Effects of DNL and INL (differential and integral non-linearity) of the ADC are critical for the gain and offset calibration.** Their influence on the goodness and stability of the fit is studied with the help of Monte-Carlo resampling of the fit function, system simulation and various models for possible ADC distortions.

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**Summary & Outlook**

- The proposed global fit-function for the DSSC prototype is a promising approach to facilitate the calibration of offset and gain with the desired accuracy.
- As through is the main source of systematic uncertainty, methods for reducing it are currently investigated. Hardware (e.g. a pin-hole mask) or software solutions could be applied for this task.

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