

# ULTRA-FAST ENERGY RESOLVED IMAGER FOR 'PSEUDO' LAUE DIFFRACTION EXPERIMENTS AT SYNCHROTRON FACILITIES

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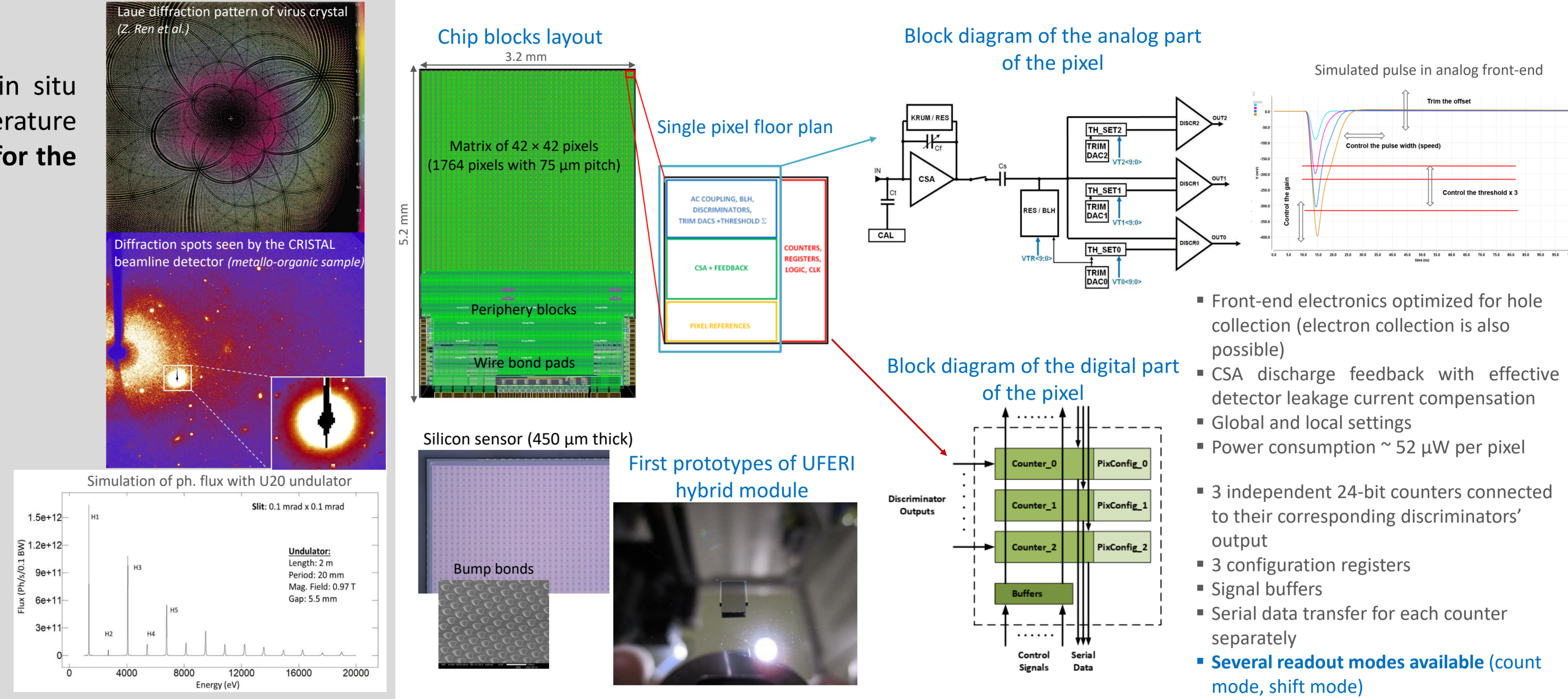
## SCIENTIFIC MOTIVATIONS AND DESCRIPTION OF THE ASIC PROTOTYPE

### Scientific motivations

- Time-resolved crystallographic applications (e.g. serial synchrotron crystallography, in situ macromolecular crystallography, in vivo crystallography and high-pressure/temperature crystallography) → using 'Pseudo' Laue diffraction technique with multi-pink beam (for the Upgrade of SOLEIL)
- Capability to measure simultaneously continuous high photon fluxes at several energies
- High count rate capability of the readout ASIC
- Pump-probe techniques can be considered

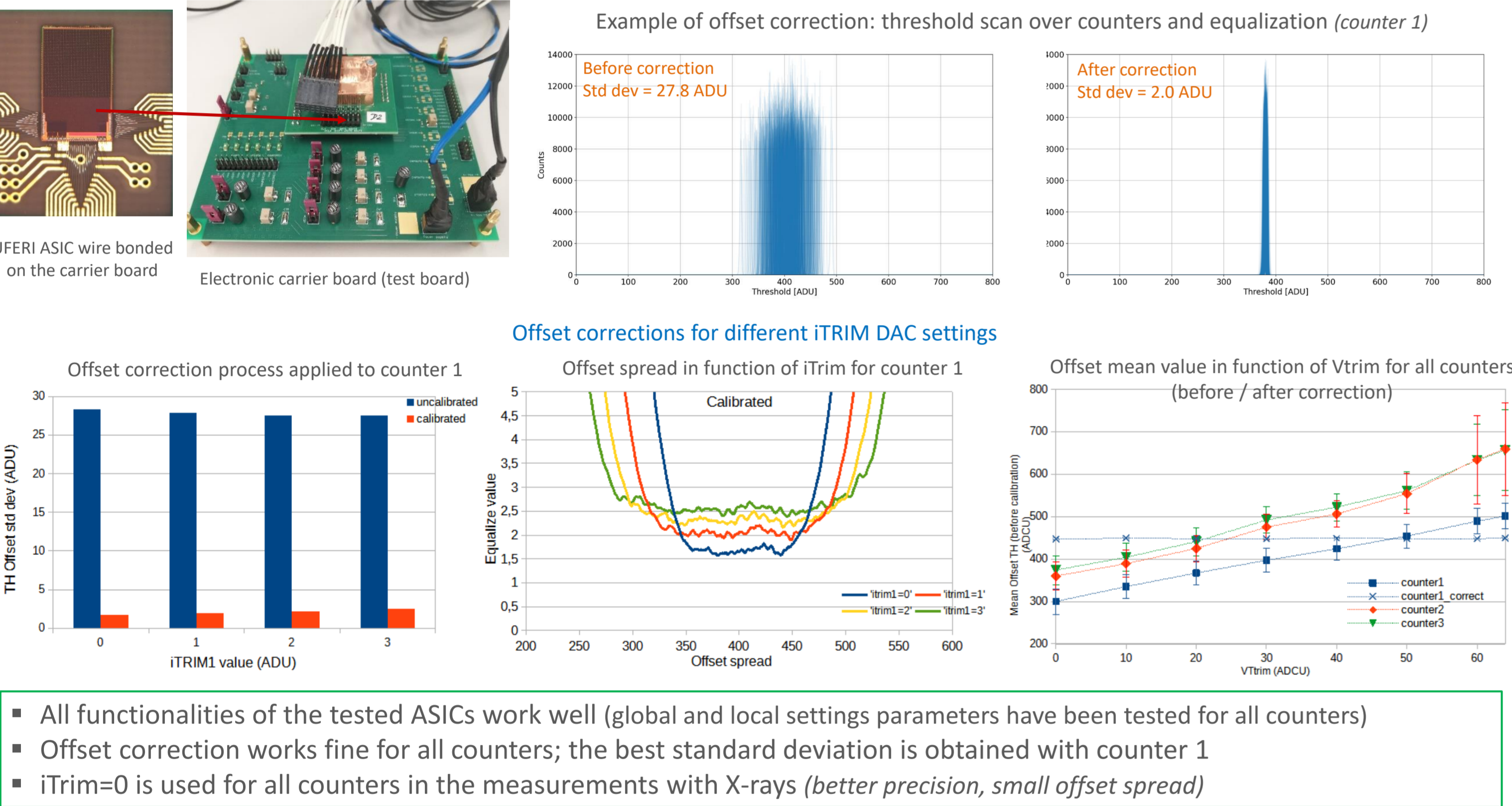
### Detector / ASIC requirements

- Photon counting detector is preferred → a new ASIC, named UFERI (Ultra-Fast Energy Resolved Imager), has been designed for this purpose
- Energy range: from 5 up to 30 keV
- Very high photon flux → an ultra-fast front-end is considered as a priority in the design of the chip → max input count rate:  $0.43 \times 10^{10}$  ph/s/mm<sup>2</sup> (30% count loss at the output)
- Multi-threshold detector → energy discrimination is required → 3 discriminators and counters per pixel are implemented
- Gating option needed



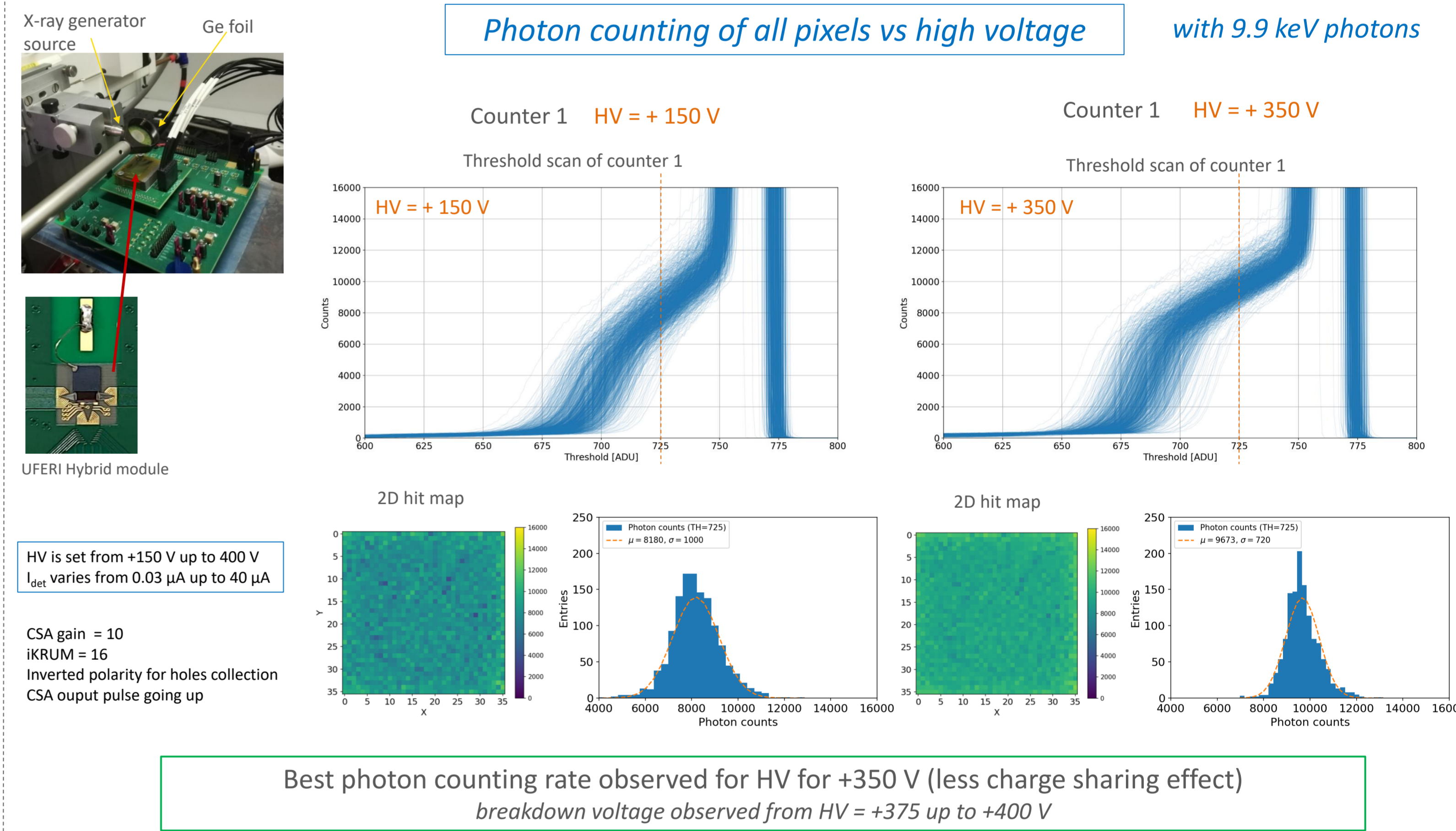
## TESTS RESULTS OF THE FIRST HYBRID PIXEL PROTOTYPES IN LABORATORY

### ASIC characterization tests (no hybrid)

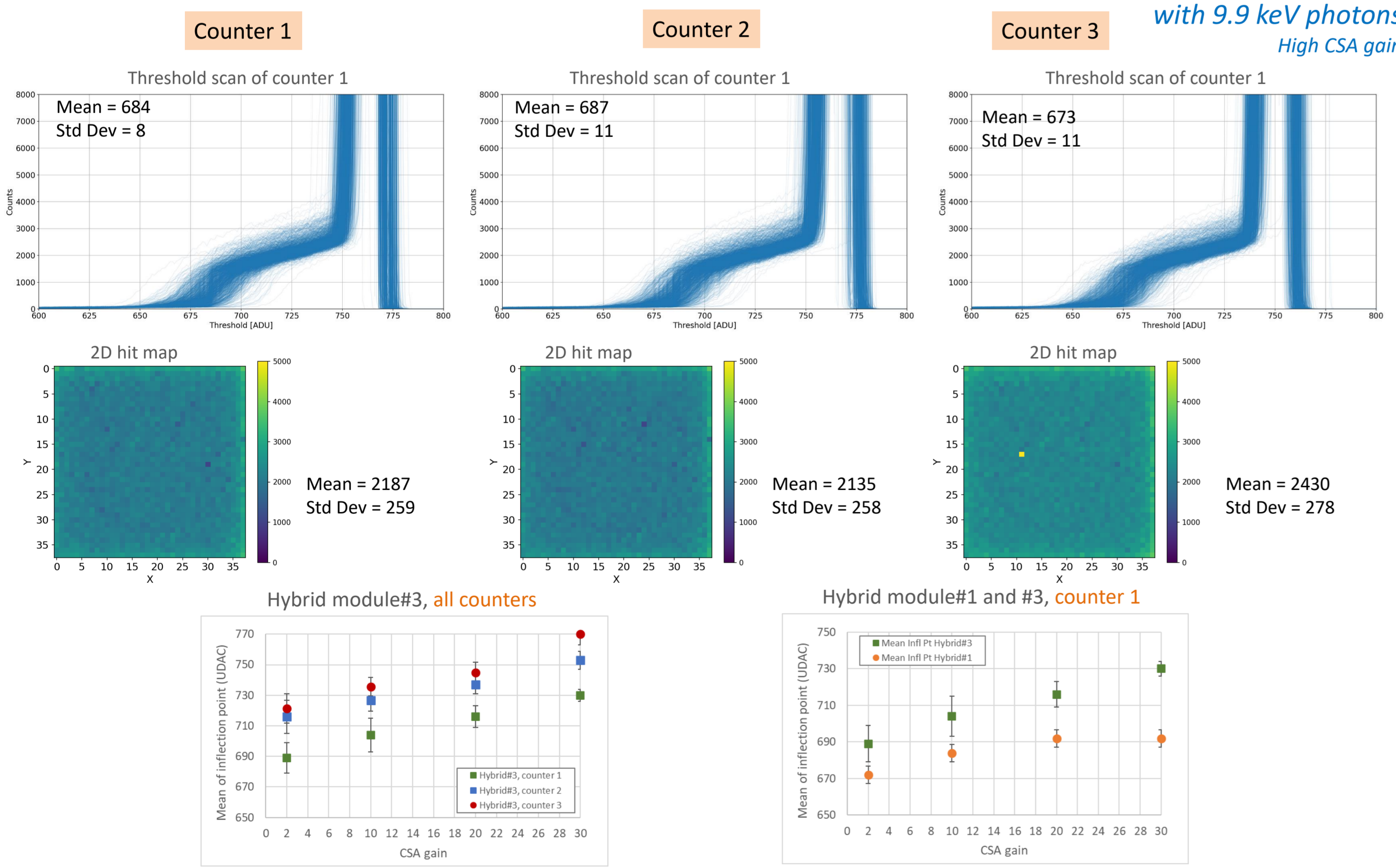


### Photon counting of all pixels vs high voltage

with 9.9 keV photons

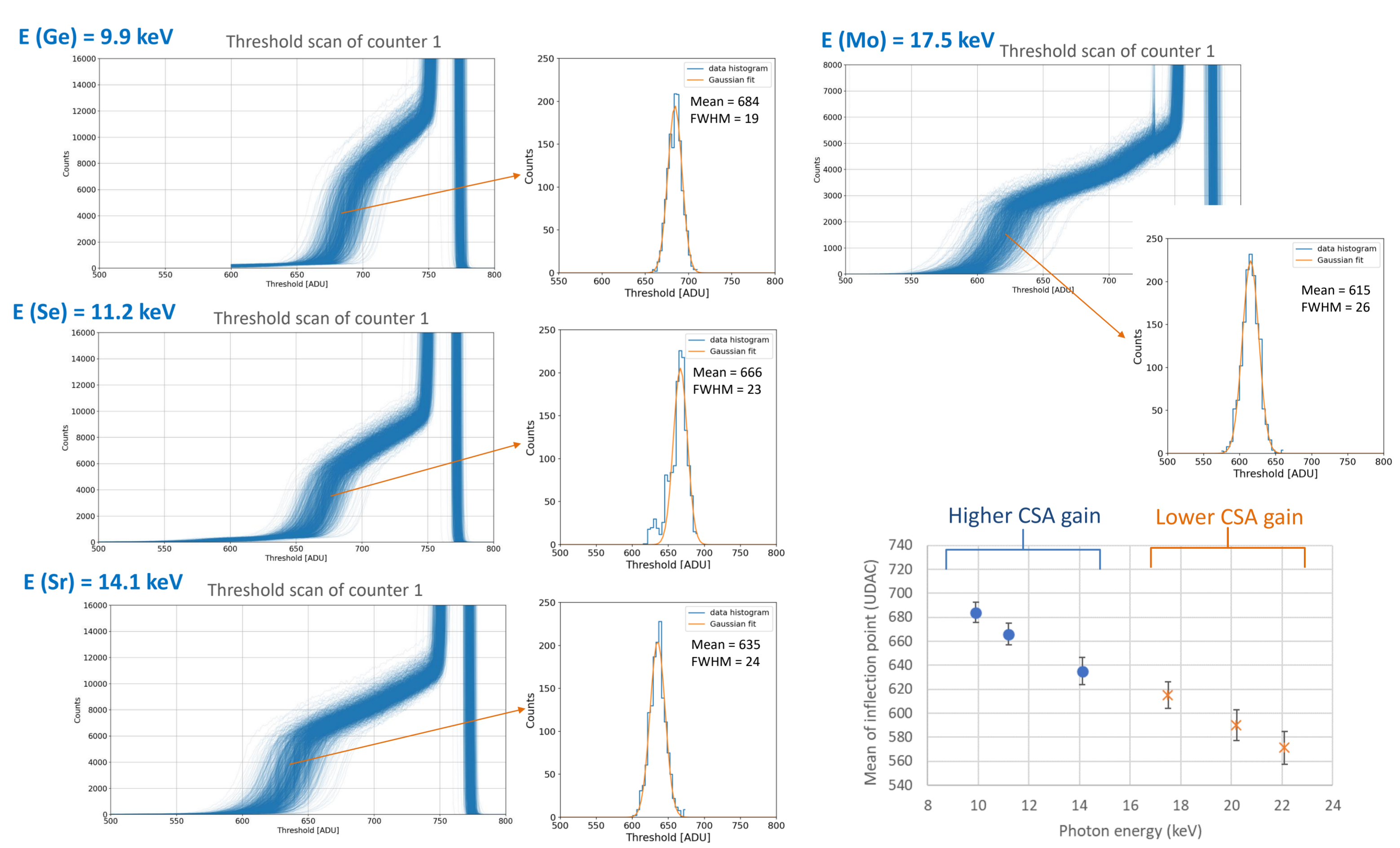


### Threshold scan of all counters simultaneously with variation of CSA gain



### Threshold scan of all counters at different energies

CSA gain varies IKRUM is fixed to medium value



## SUMMARY AND NEXT STEPS

Ultra-Fast Energy Resolved Imager (UFERI) is an ambitious R&D project of a new hybrid pixel photon counting detector designed for hard X-ray diffraction experiments, using high throughput photon fluxes from pink beam at synchrotron facilities

- A first small-size ASIC prototype was designed, and several dies were tested in laboratory showing promising results
- Other performance tests (count rate capability, energy separation, etc) with photon beam are foreseen in the coming weeks at SOLEIL synchrotron
- After a detailed review of the testbeam results with the first UFERI chip, a medium-size prototype is to be considered (collaboration is welcome)