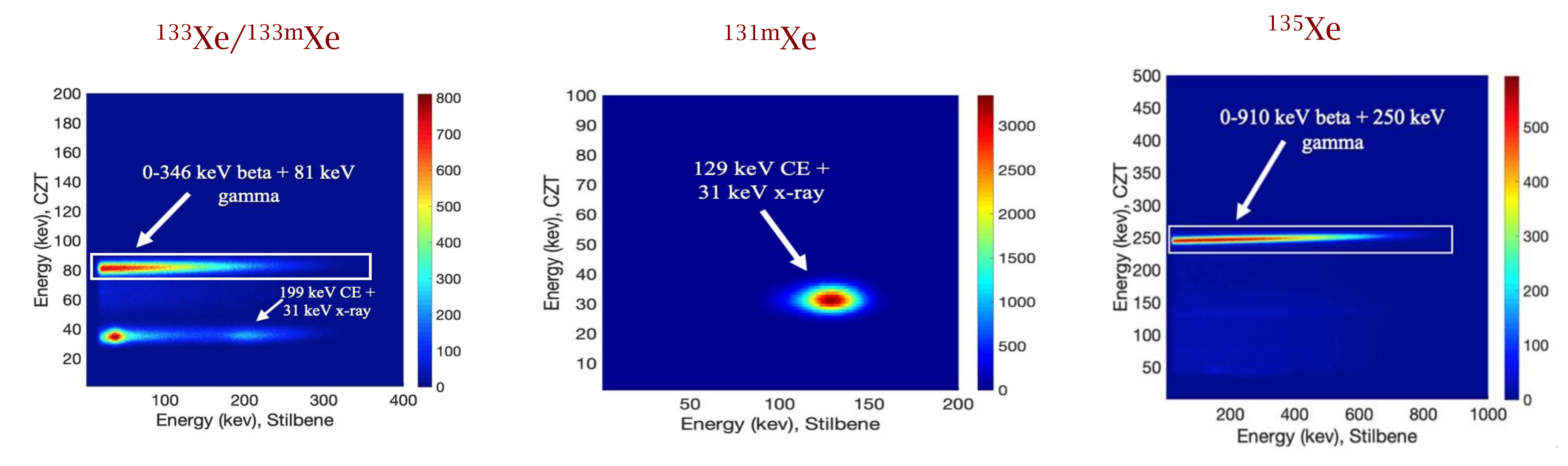
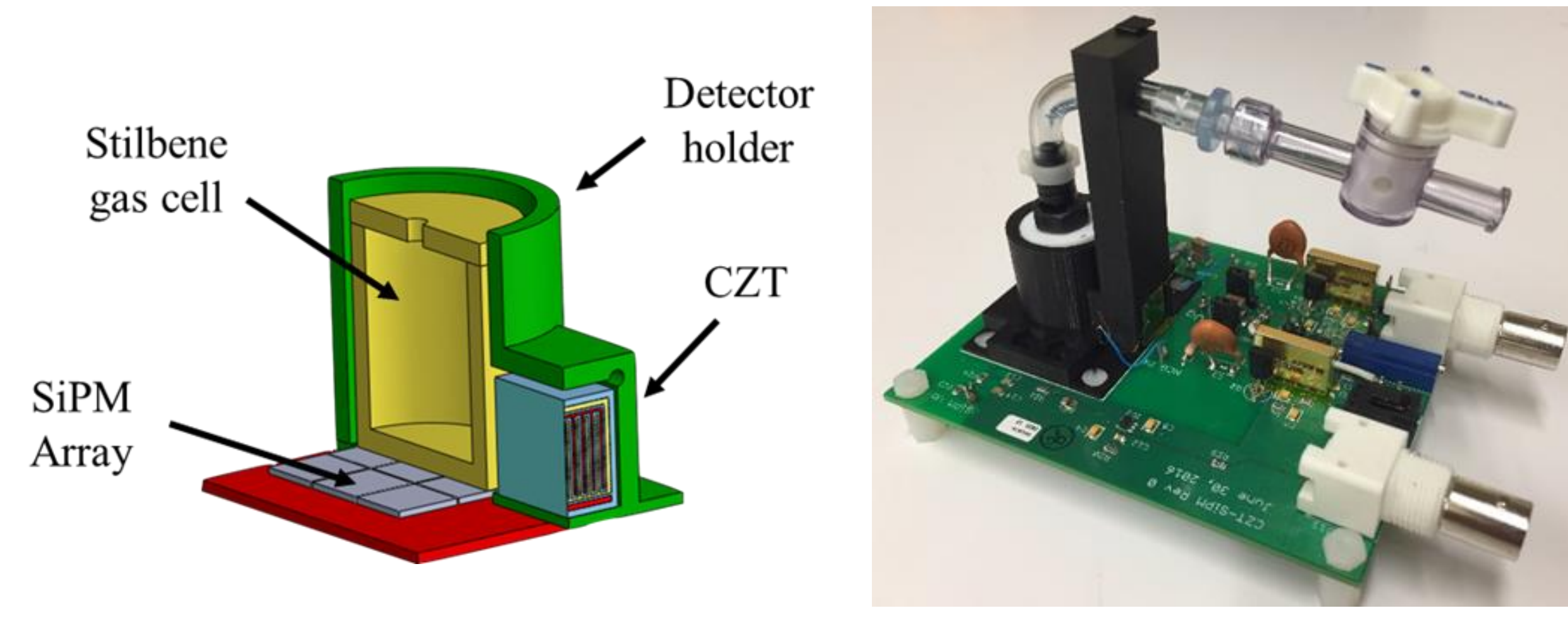




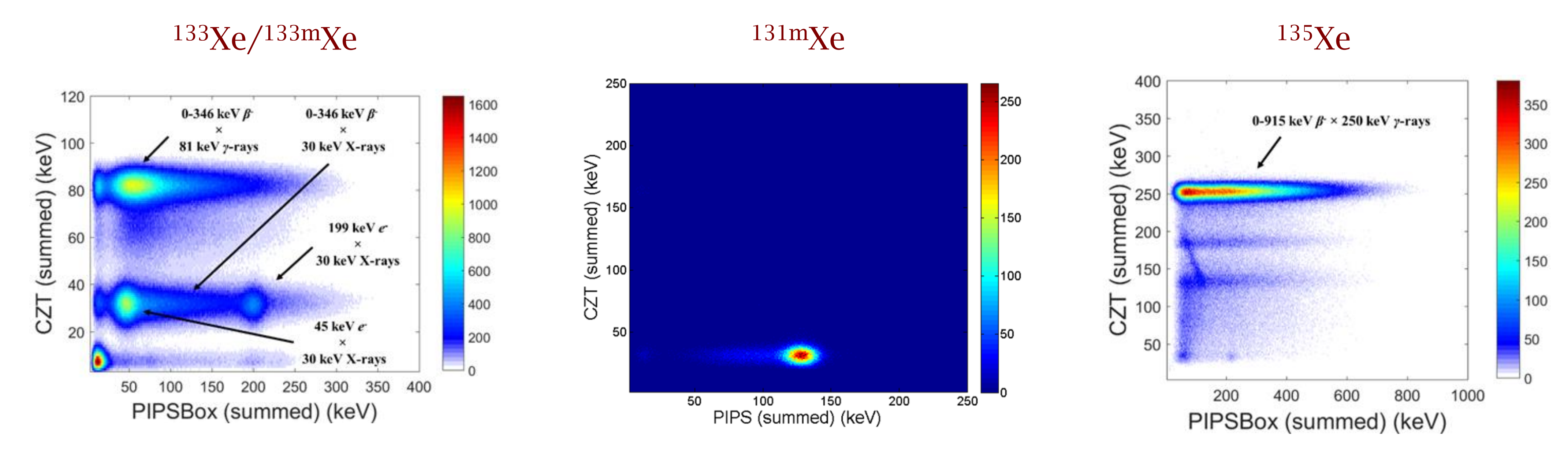
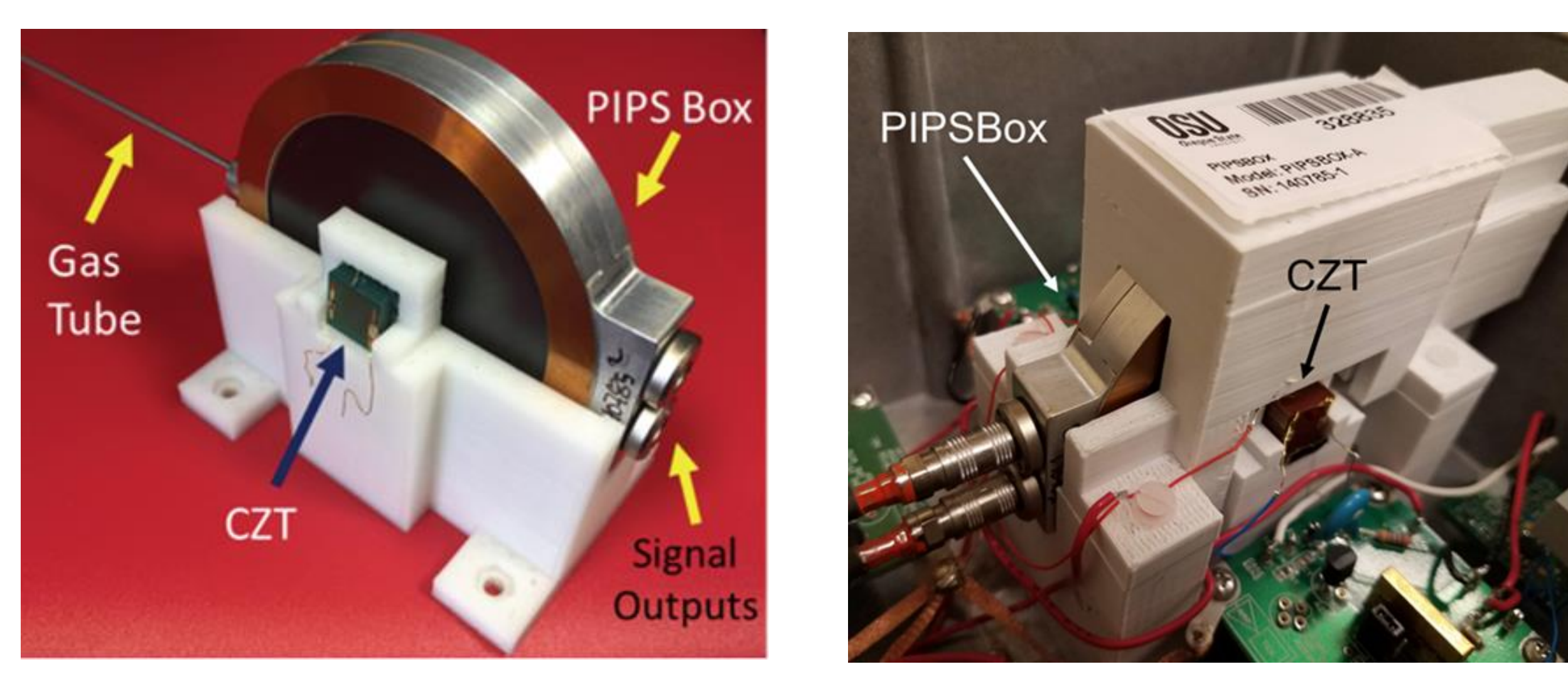
(Stilbene + SiPM) - CZT Detector

- Detection of beta particles and conversion electrons in a well-type Stilbene coupled to 3x3 SiPMs
- Detection of X-rays and gamma-rays in a 1x1x1 cm³ co-planar CZT detector
- Use of Stilbene to reduce Memory Effect seen in plastic scintillators
- Background Rejection Rate: 99.85%
 - Total: 1.55 cps, Coincidences: 0.0023 cps
- Memory Effect: 0.045 ± 0.017%
 - ~10² reduction vs plastic (~4-5%)



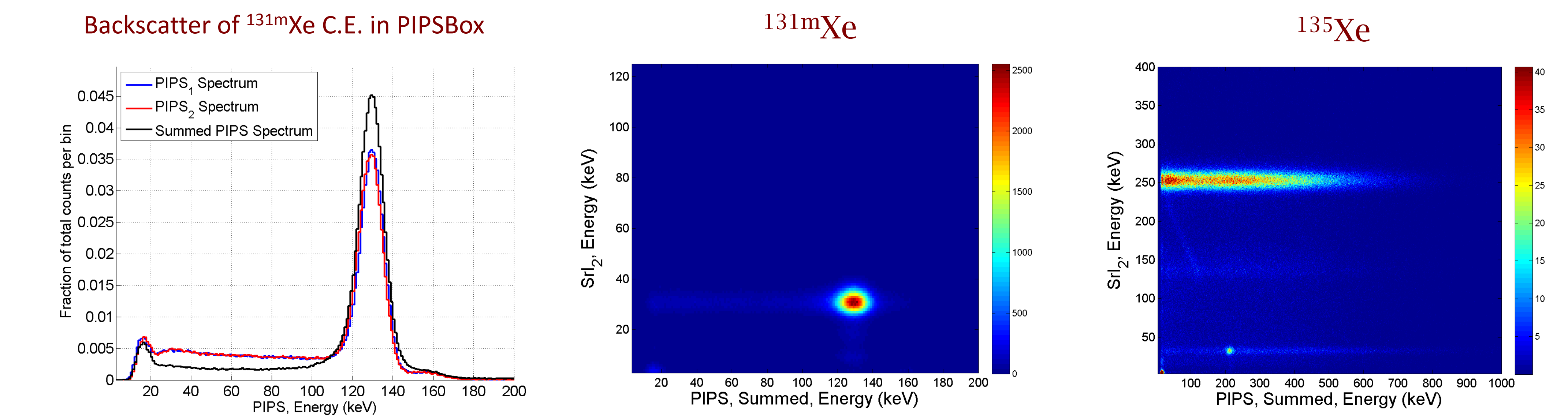
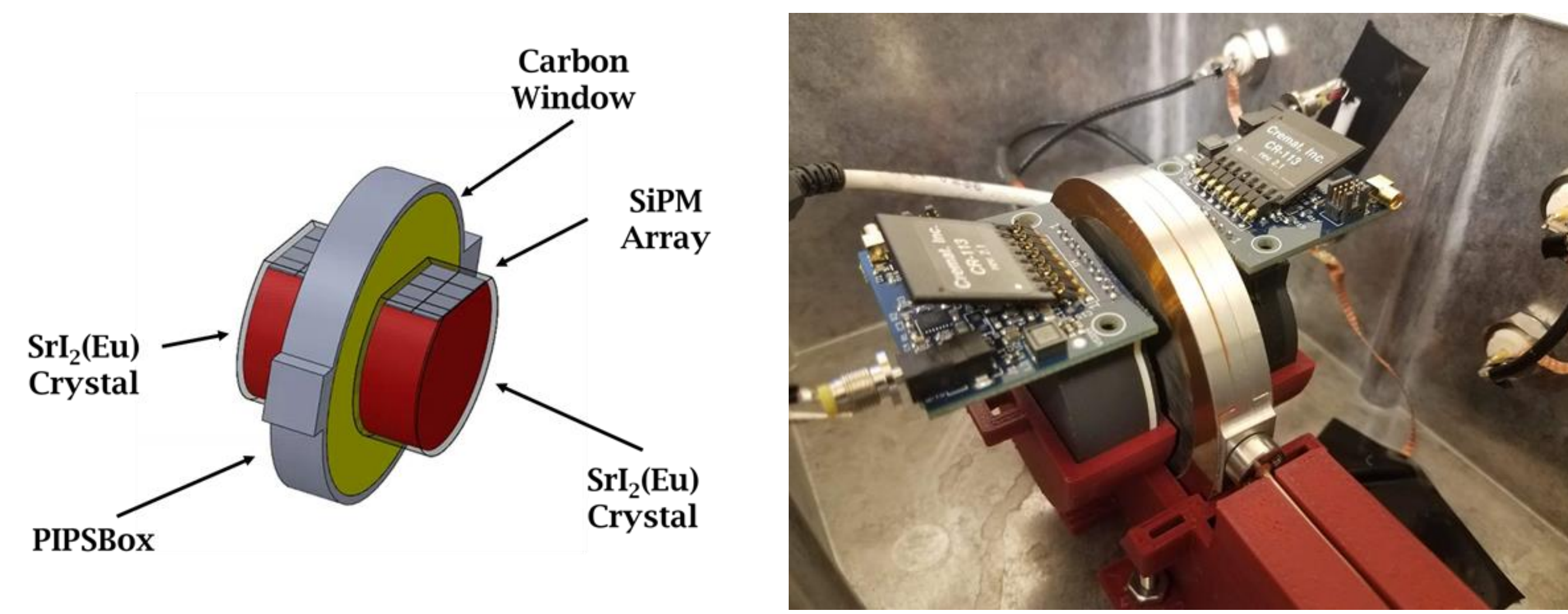
PIPS - CZT Detector

- Passivated, Implanted, Planar Silicon (PIPS) detectors in one air-sealed box
- Detection of beta particles and conversion electrons in a PIPSBox
- Detection of X-rays and gamma-rays in two 1x1x1 cm³ co-planar CZT detectors
- Background Rejection Rate: 99.9%
 - Total: 23.64 cps, Coincidences: 0.021 cps
- Memory Effect: 0.26 ± 0.03%
 - ~1/17 reduction vs plastic (~4-5%)



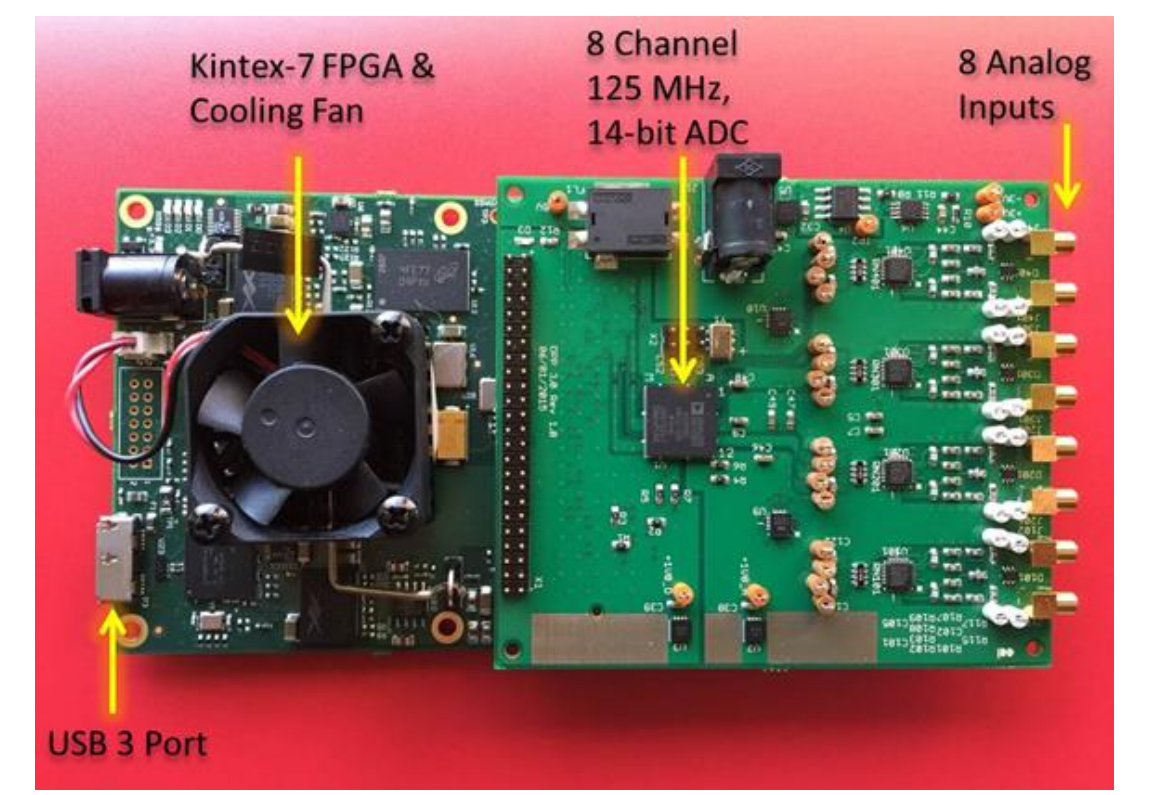
PIPS - (SrI₂(Eu) + SiPM) Detector

- Detection of beta particles and conversion electron in a PIPSBox
- Detection of X-rays and gamma-rays in two 3.81 Ø cm x 1.25 cm SrI₂(Eu) crystals coupled to 2 x 4 SiPMs
- High resolution = small ROIs
- PIPSBox signal summing
 - Backscatter reduction of 51%
 - 81.5% peak-to-total ratio



Digital Pulse Processing in FPGA

- Custom-made FPGA-based digital pulse processing board (DPP8)
- Full firmware development in our lab
- Coincidence event captured on fly in hardware (FPGA)
- All radioxenon prototype detectors were tested using this board



Performance Comparison

Radiation Detection

Energy (keV)	Resolution (%FWHM) at energy					
	31	81	250	662	129	199
Stilbene-CZT	25.8	9.3	4.2	2.3	20.2	19.1
PIPS-CZT	34.95	12.6	5.3	3.95	13.4	9.1
PIPS-SrI ₂	22.1	---	7.7	4.4	10.3	---
ARSA	32	25	9.6	24	24.8	---
SAUNA	23	12	---	---	23	---

System	ROI for ^{131m} Xe: FWHM (30 keV) × FWHM (129 keV)				
	Stilbene-CZT	PIPS-CZT	PIPS-SrI ₂	ARSA	SAUNA
ROI (keV ²)	208	187	91	317	217

Memory Effect and Background Count Rate

Memory Effect (%) in Xe ^{131m} Region				
Stilbene	0.045 ± 0.017%			
PIPS	0.26 ± 0.03%			
Plastic	4-5%			

Background Count Rate				
	SAUNA	ARSA	PIPS-CZT	Stilbene-CZT
Total (cps)	9.75	30	23.64	1.55
Coincidence (cps)	0.03	0.1	0.021	0.002
Rejection Rate (%)	99.69	99.67	99.9	99.85

Estimate of Minimum Detectable Concentration (MDC)

Radioxenon Isotope	MDC (mBq/m ³) Estimates		
	Stilbene-CZT ε _β , ε _γ simulation	PIPS-CZT ε _β , ε _γ experimental	PIPS-CZT (simulation)
^{131m} Xe	1x1x1 cm ³ CZT	1x1x1 cm ³ CZT	4x4x1 cm ³ CZT
^{131m} Xe	0.48 ± 0.01	0.87 ± 0.66	0.35 ± 0.39
¹³³ Xe	0.84 ± 0.01	0.87 ± 0.21	0.46 ± 0.16
^{133m} Xe	0.34 ± 0.01	1.20 ± 0.78	0.51 ± 0.49
¹³⁵ Xe	3.34 ± 0.50	4.26 ± 0.89	1.40 ± 0.38