

NIST A 960-pixel X-ray-TES readout platform for Athena X-IFU development



Randy Doriese (doriese@nist.gov), Jim Beall, Dan Becker, Doug Bennett, Ed Denison, Shannon Duff, Malcolm Durkin, Joe Fowler, John Gard, Gene Hilton, Jozsef Imrek, Young Il Joe, Vince Kotsubo, Ben Mates, Kelsey Morgan, Galen O'Neil, Nate Ortiz, Christine Pappas, Carl Reintsema, Dave Rudman, Dan Schmidt, Robbie Stevens, Dan Swetz, Paul Szypryt, Joel Ullom, Leila Vale, Joel Weber, Abby Wessels

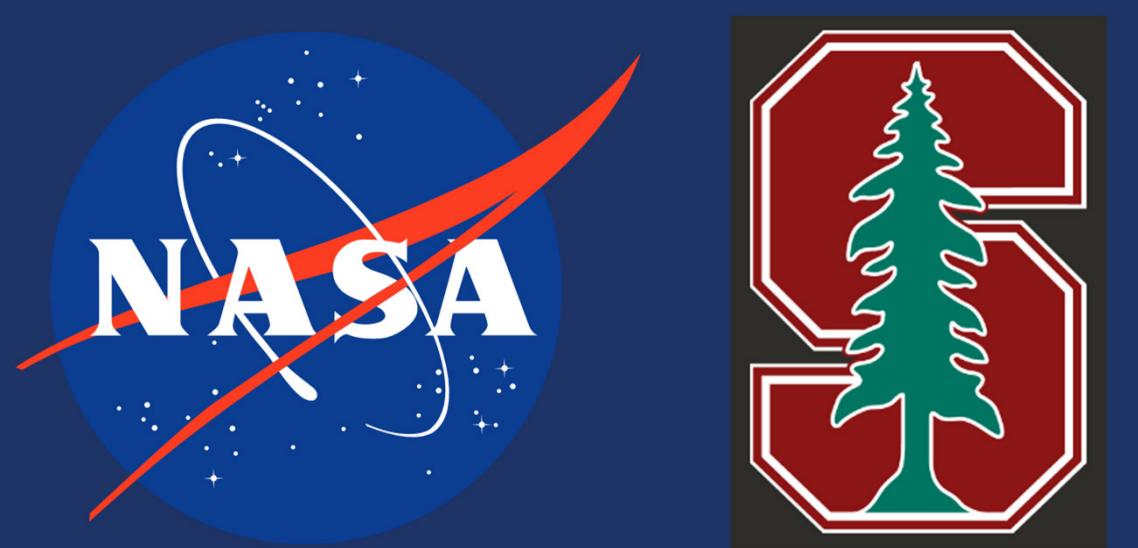
NIST, Boulder, Colorado, USA

Antoine Miniussi, Joe Adams, Simon Bandler, Jay Chervenak, Sam Moseley, Scott Porter, Jack Sadleir, Kazu Sakai, Steve Smith, Nick Wakeham

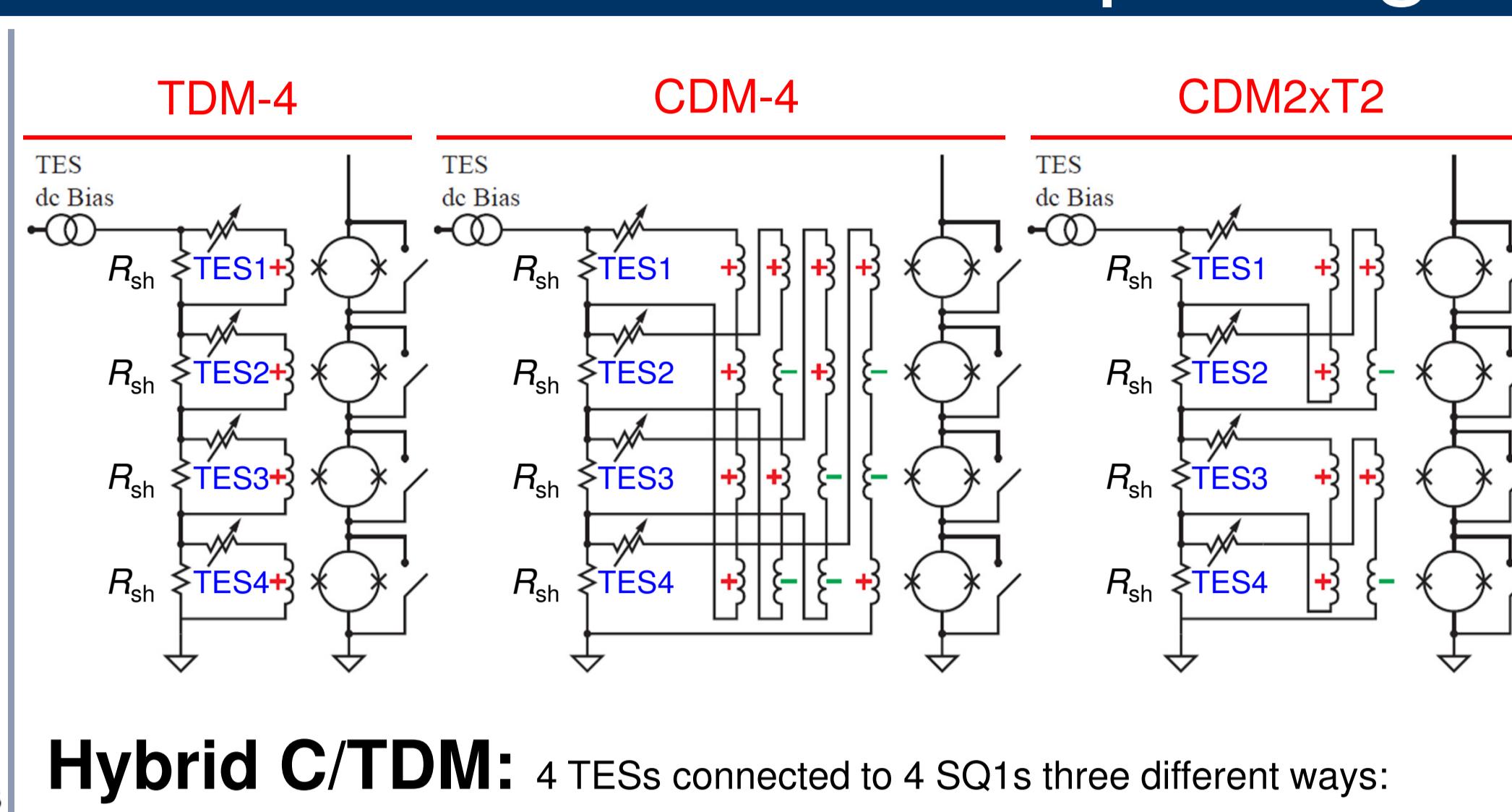
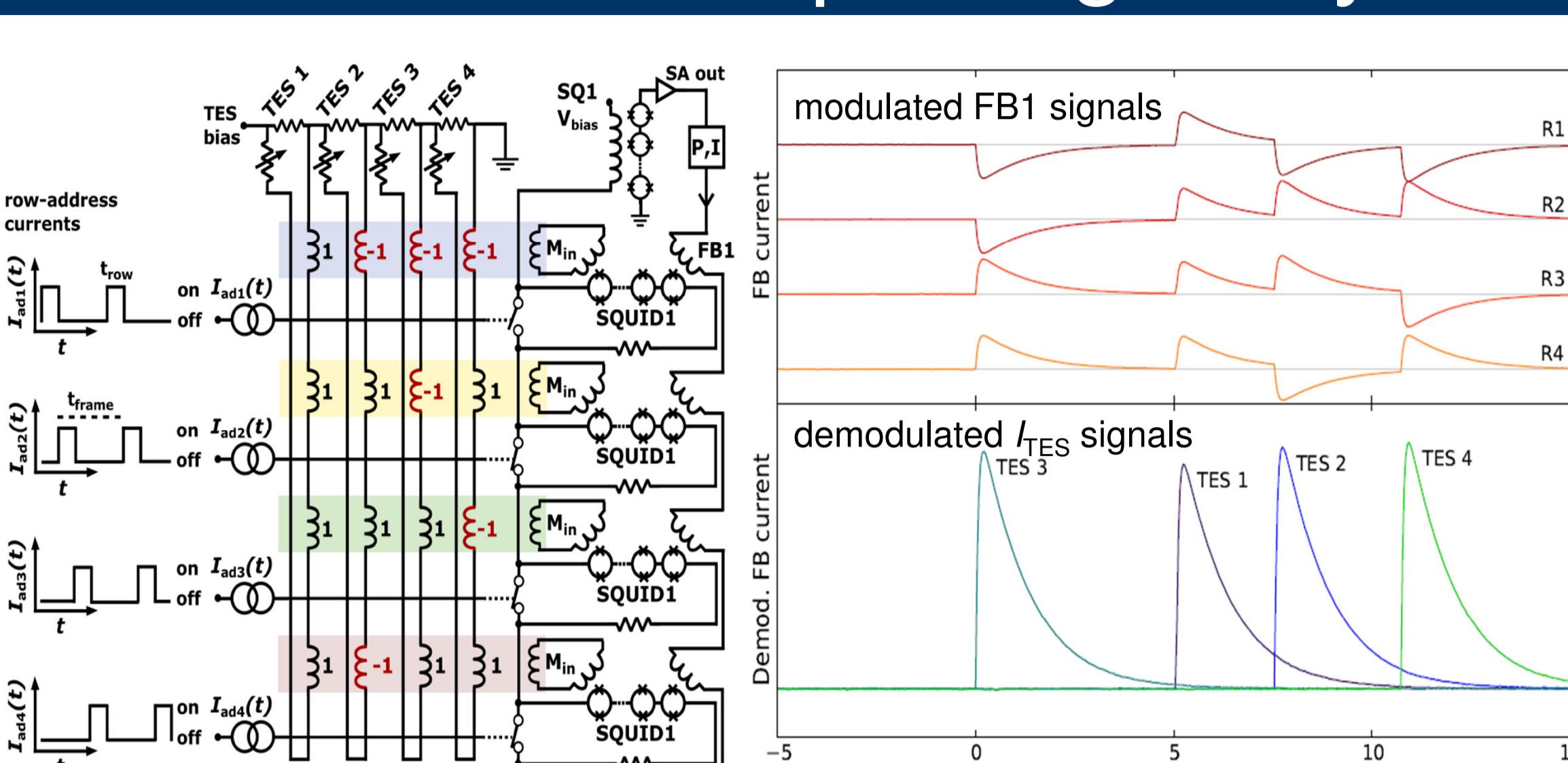
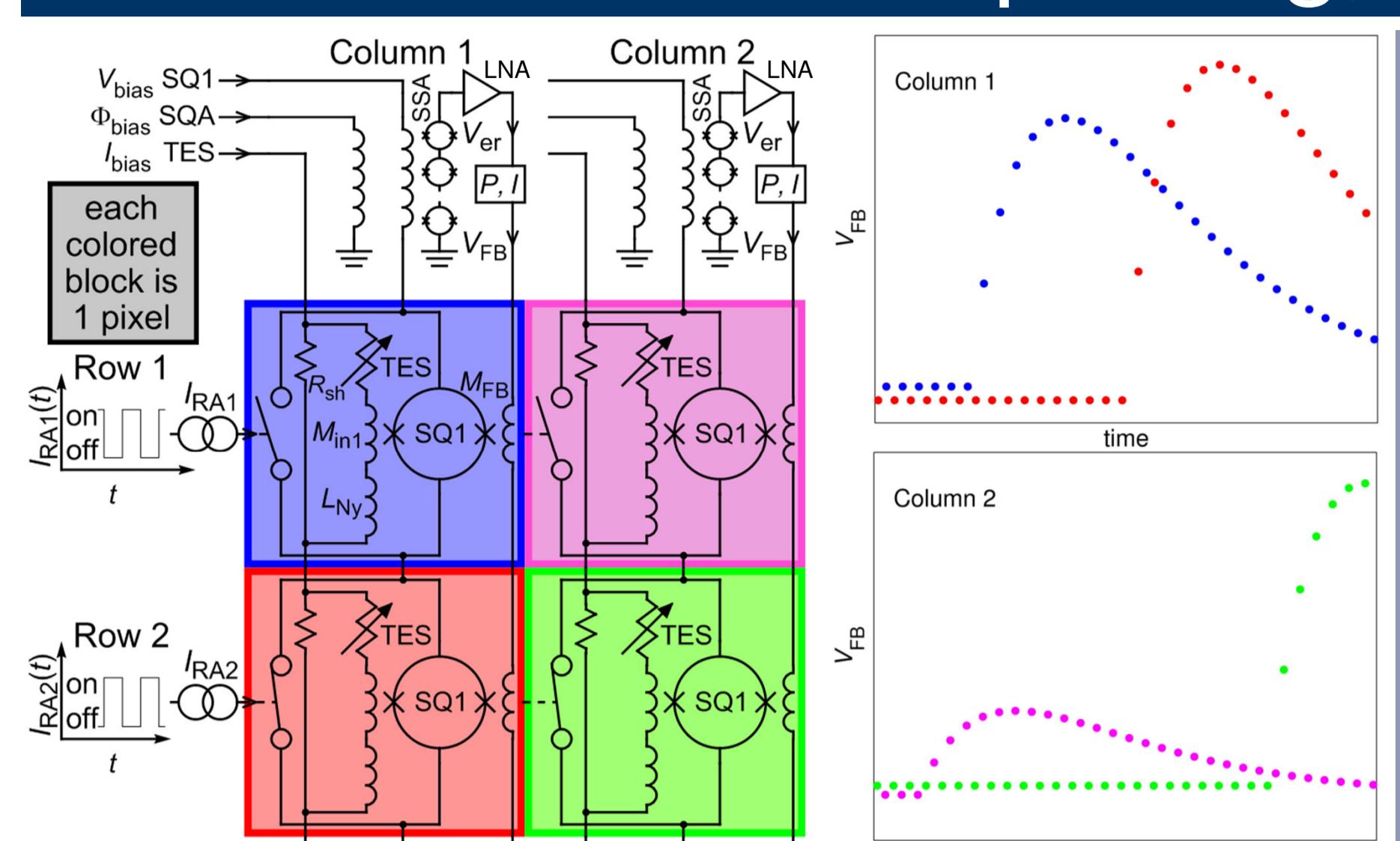
NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

Kent Irwin

Stanford University Dept. of Physics, Stanford, California, USA

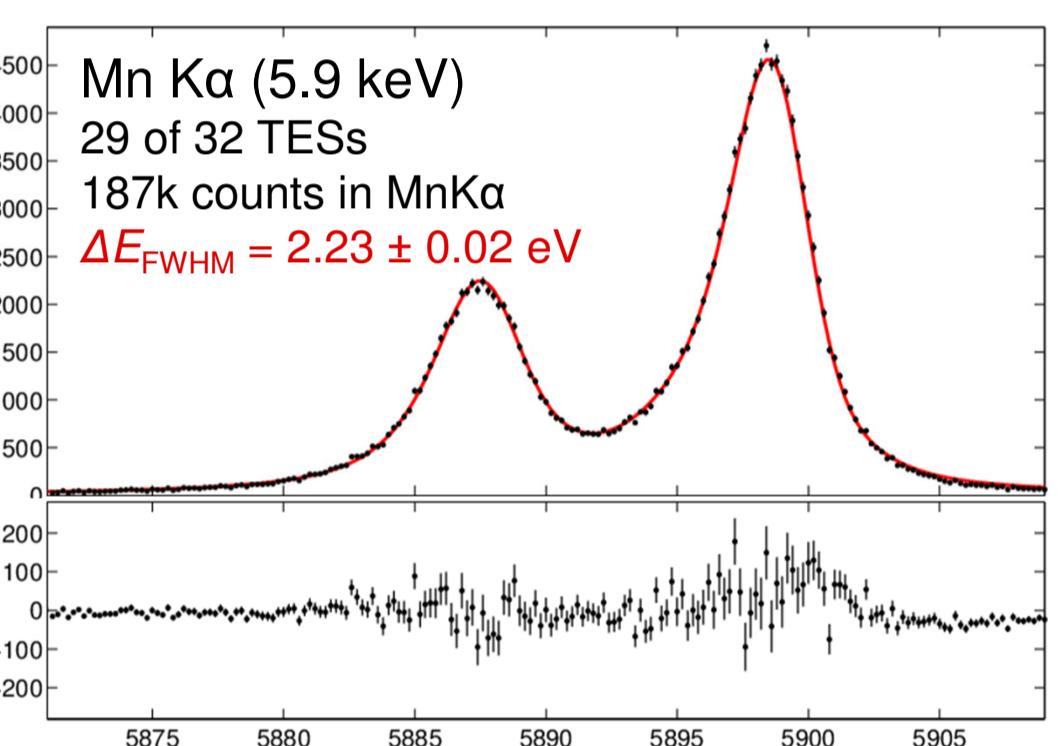


time-division multiplexing, code-division multiplexing, & hybrid code/time-division multiplexing

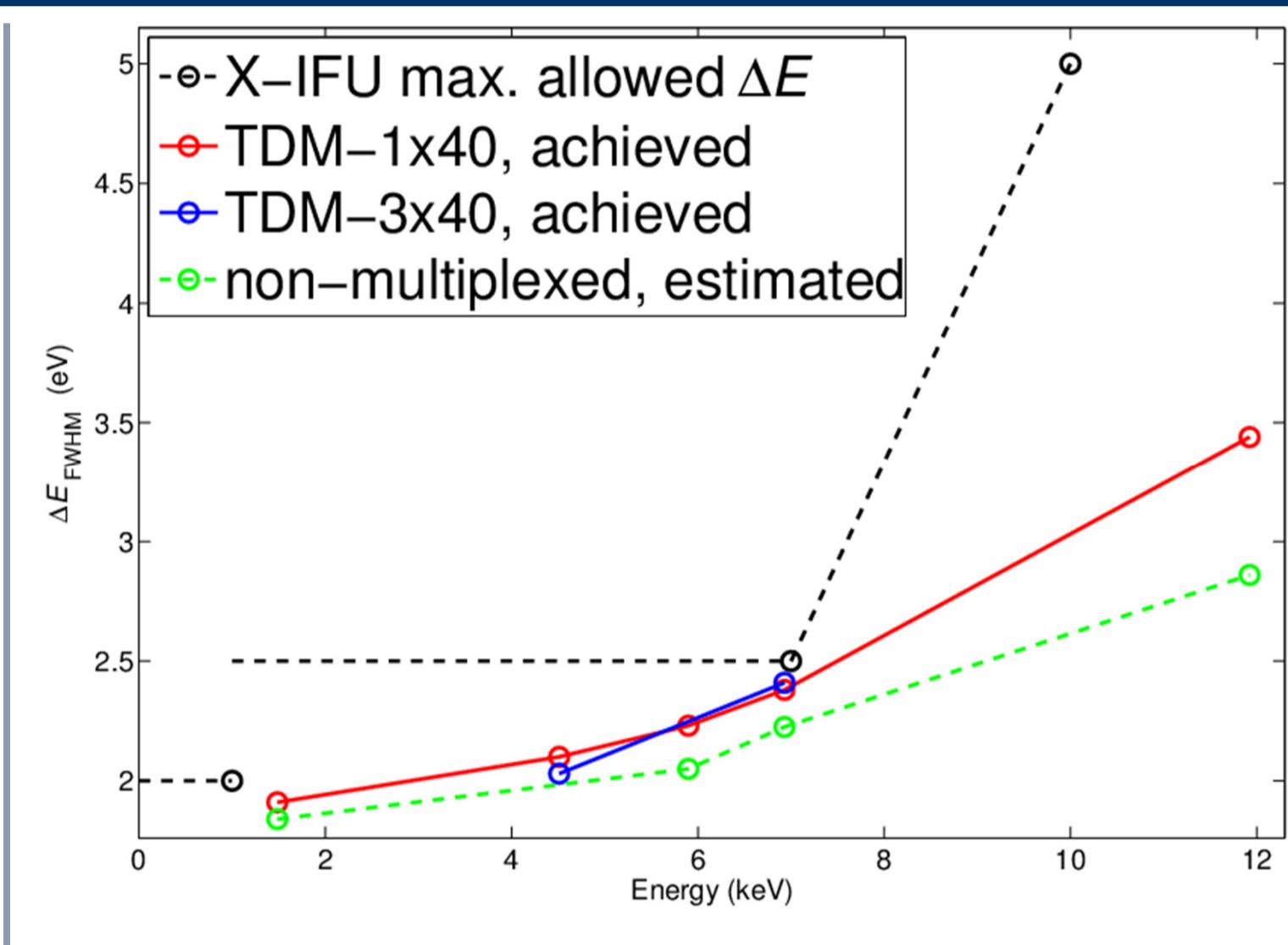
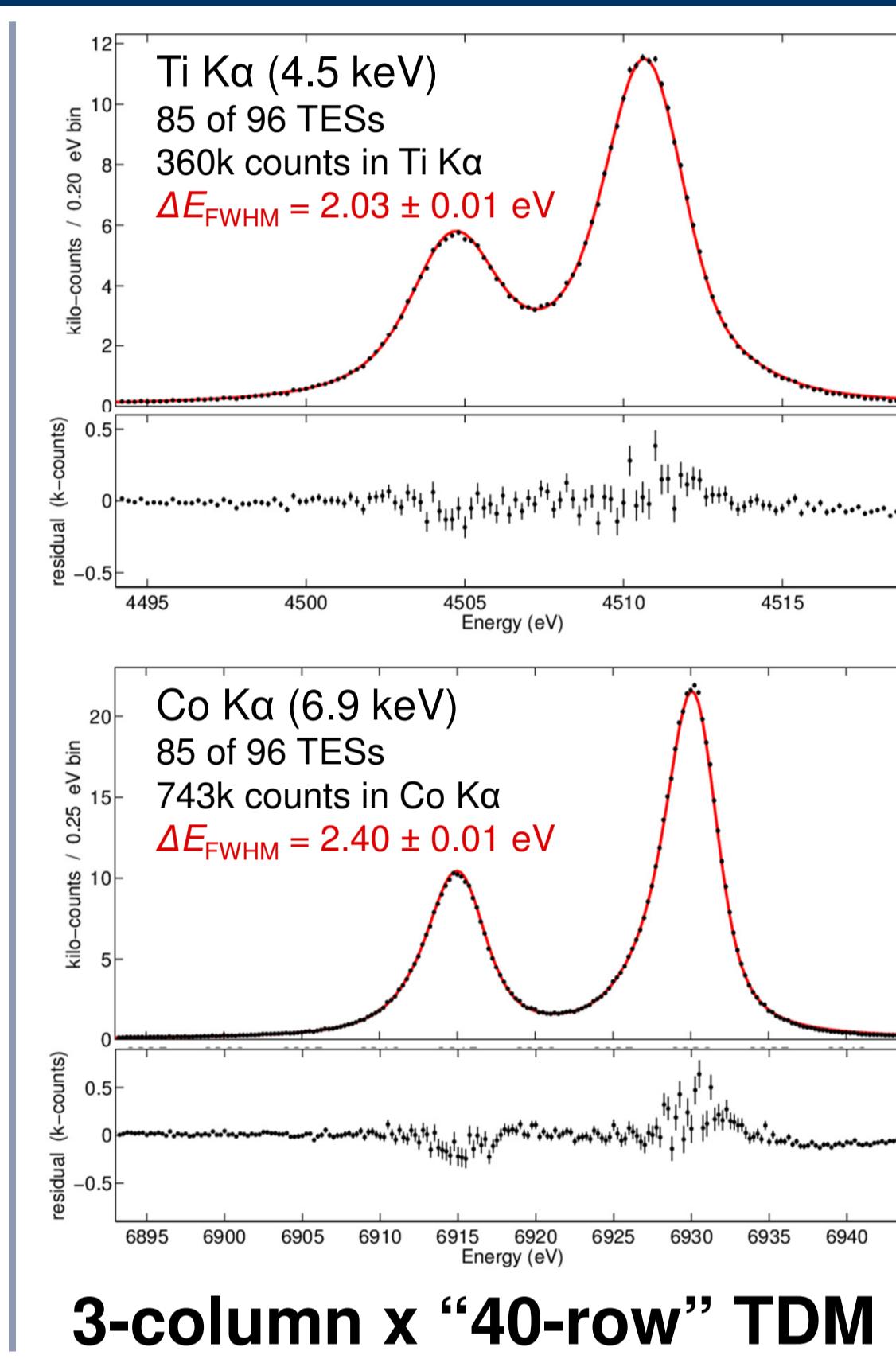
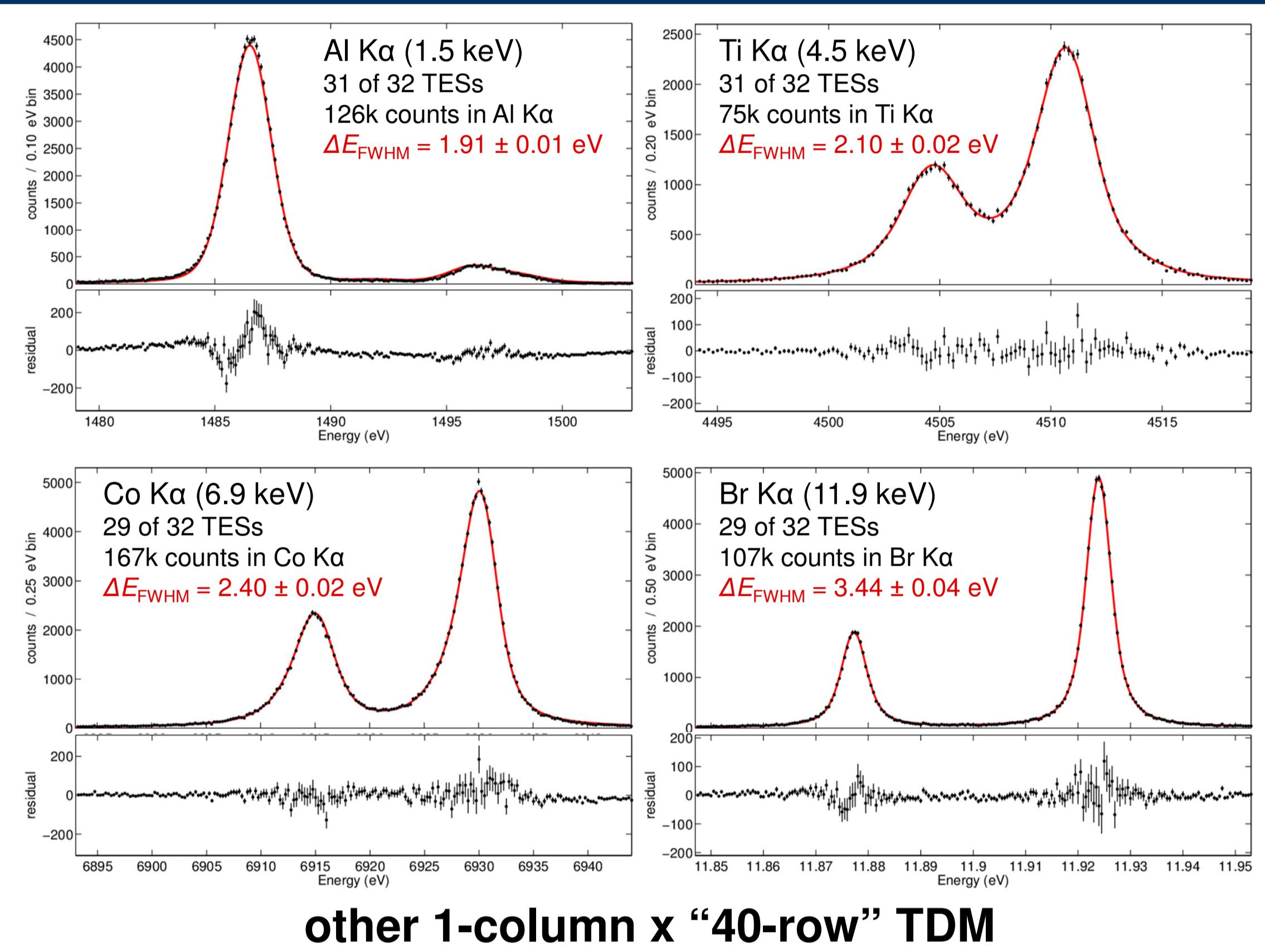


X-IFU-like TDM readout of LPA2.5a TESs with 40 timing rows (in older 8-col x 32-row system)

- 1-col x “40-row” TDM; Mn Ka:
- ΔE ranged from 1.99 eV to 2.49 eV
- ΔE_{avg} : 2.23 eV
- TDM degradation ~ 0.2 eV

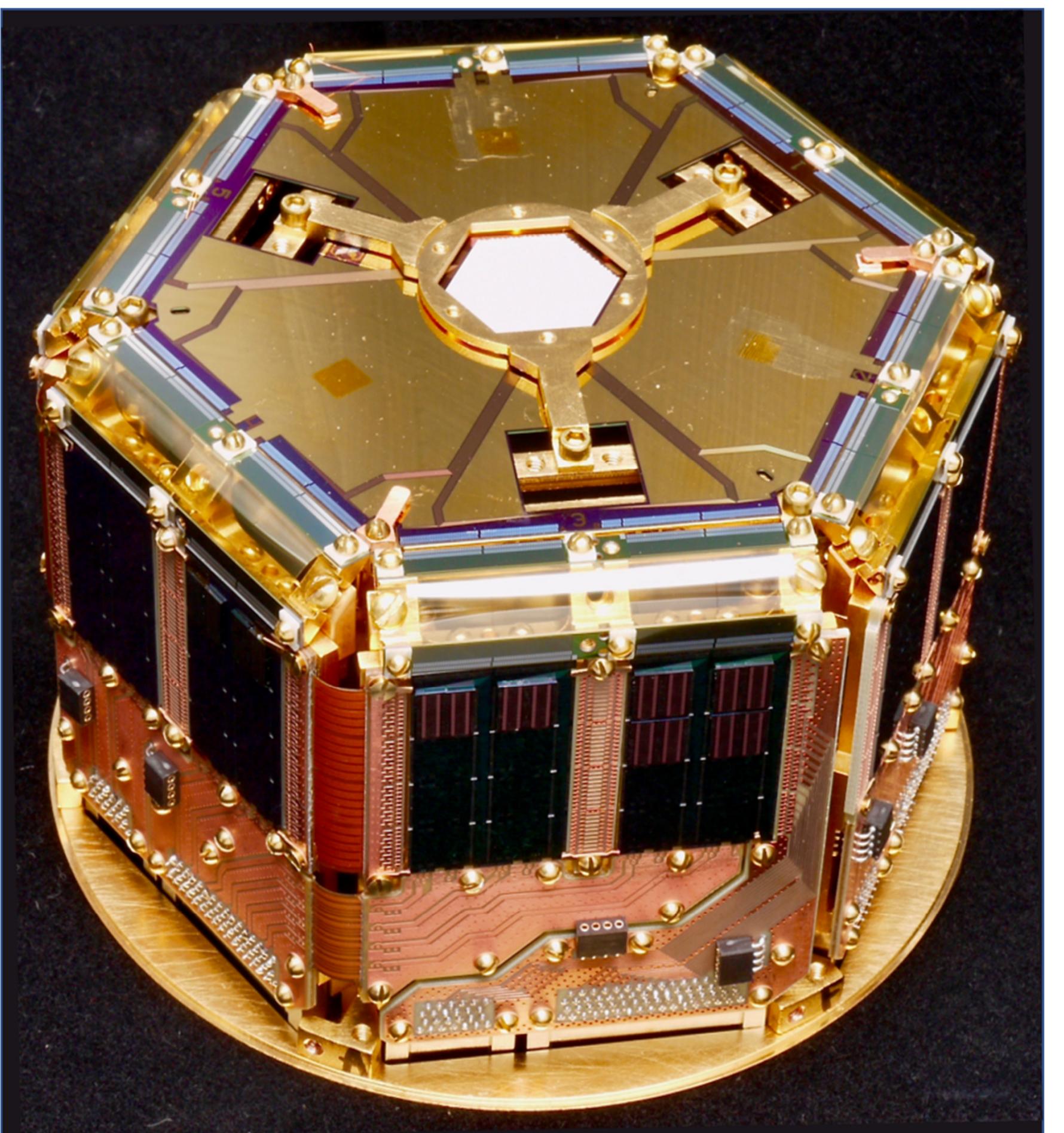
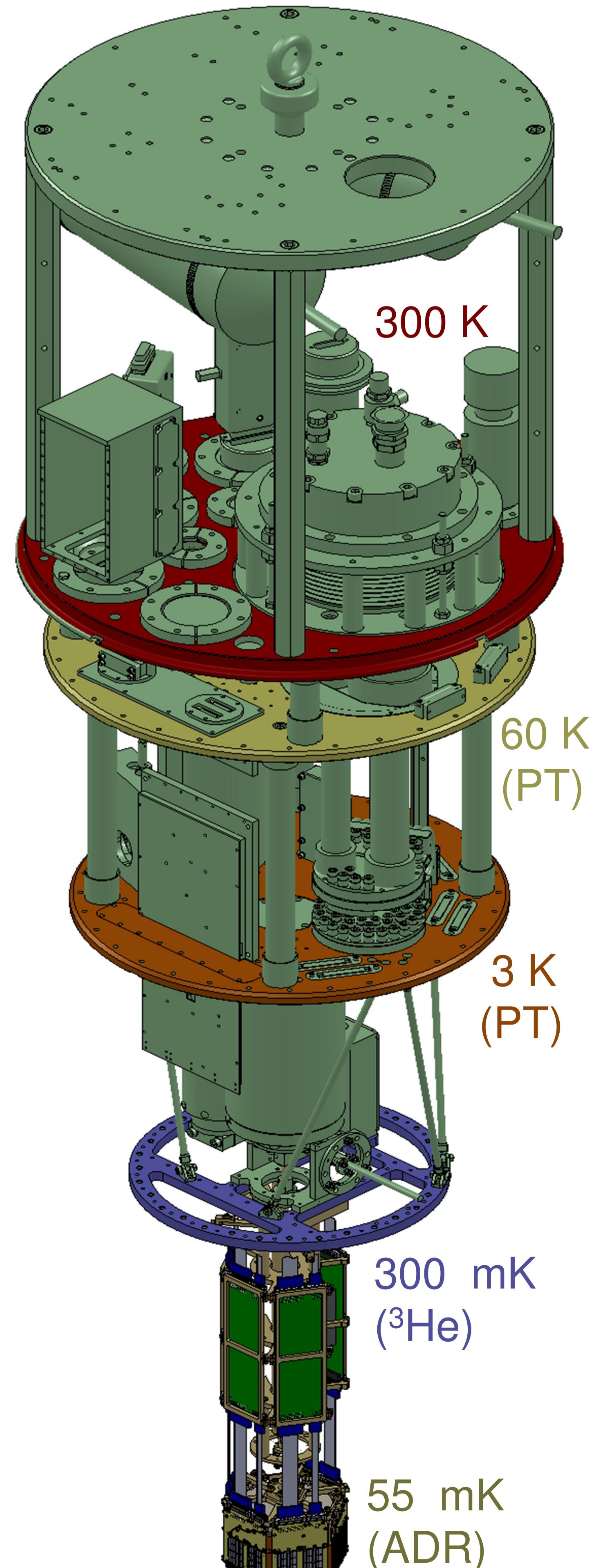


“40-row” TDM: To simulate the timing and noise of 40-row TDM, the 32-row TDM system (32 LPA2.5a TESs and 32 SQ1s) was run with row 32 repeated 8 times. Circuit parameters ($R_{\text{TES_op}}$, $R_{\text{TES_shunt}}$, L_{loop} , and M_{in}) and operating/analysis parameters (t_{low} , t_{rec} , input X-ray rate, and the fraction of events surviving pileup and crosstalk cuts) were chosen to make the experiment faithful to X-IFU's requirements.



ΔE vs. $E_{\text{x-ray}}$ for LPA2.5a TDM-40

new 960-pixel platform: 24-col x 40-row TDM or hybrid C/TDM up to 64 rows (CDM16xT4)



Purposes of this system:

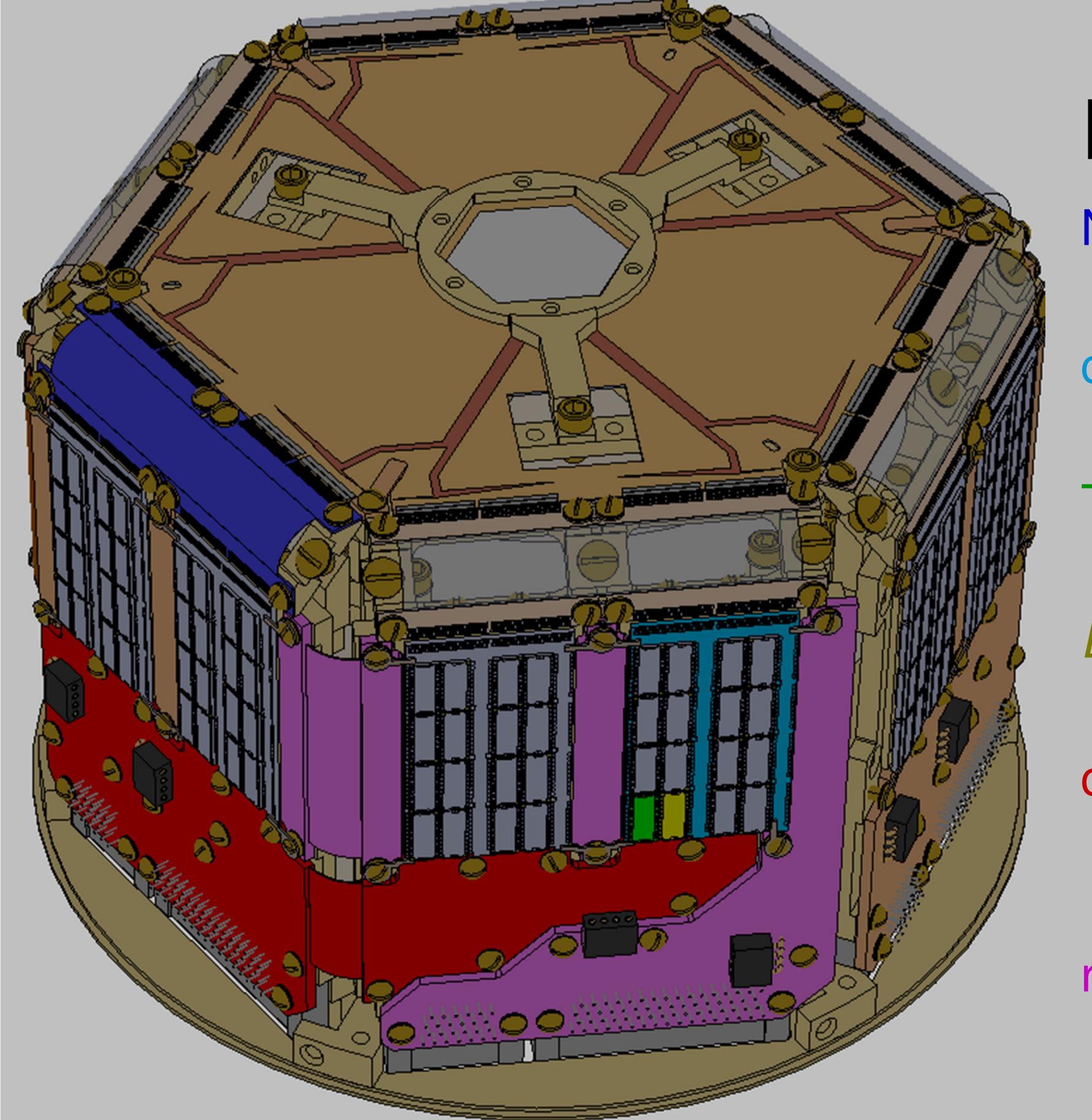
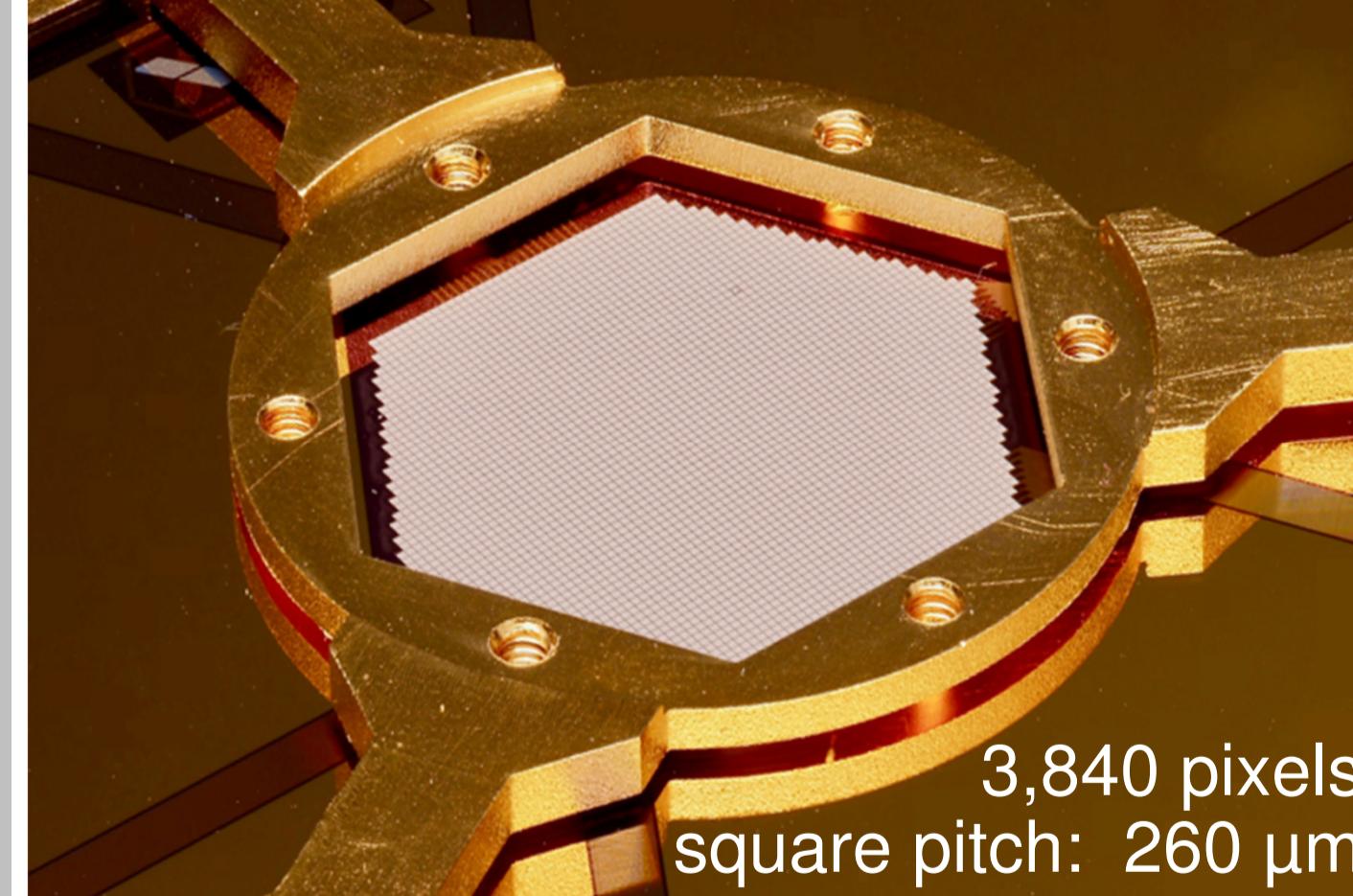
- screen X-IFU TES arrays.
- continue development of TDM and hybrid C/TDM for X-IFU.

Novel features (beyond the size):

- heatsinking of TES array via back-side Au wirebonds
- Nb-on-polyimide, round-the-corner flexible circuits (160 pairs each)
- improved capacitive isolation of signal pairs from one another

System has 176 wire pairs:

- row-address: 40 pairs for 40 rows
- each column has 5 pairs:
 - detector bias
 - FB1, FBA
 - SQ1 bias/out, SSA bias/out
- 16 utility pairs for thermometry, heaters, B-field application, etc.



FPA parts:

- Nb-on-polyimide flex (160 pairs; NASA)
- carrier chip (4 columns; NIST)
- TDM chip (10 SQ1s; NIST)
- L_{Ny} and R_{sh} chip (10 channels; NIST)
- column-wiring PCB (supplies 8 columns; commercial)
- row-address PCBs (40 RAs for all cols; commercial)

