Yes, There is a Future for Discrete Electronics for Synchrotron High-Rate Spectroscopy

Peter Grudberg
XIA LLC
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Discrete versus Integrated Solutions

- As application demands increase, there has been a general trend towards an integrated solution (e.g. Pilatus/Eiger/etc).
- However, synchrotron spectroscopy does not lend itself to a one size fits all solution – there is just too much variation (energy range, detector type, wide ranging and conflicting application demands, etc etc).
- Discrete electronics offer several advantages:
  - **Flexibility: can tune the hardware/firmware to a specific solution**
  - **Higher performance**
  - **Field upgrades/updates**
  - **Hybrid solutions are possible – integrated front-end electronics combined with powerful discrete back-end readout and post-processing solutions (eg MAIA)**
- XIA offers a wide range of discrete solutions applicable to the full range of spectroscopy applications.

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The Standard: DXP-xMAP and Mercury

- High-throughput conventional digital pulse processing – approaching 1 Mcps output rate per channel
- Wide range of high-speed mapping features to support advanced applications
- Mature design: current and especially future applications demand higher throughput while maintaining (or improving) mapping capabilities.
- So – what's next?

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SITORO® Technology: The FalconX/X8

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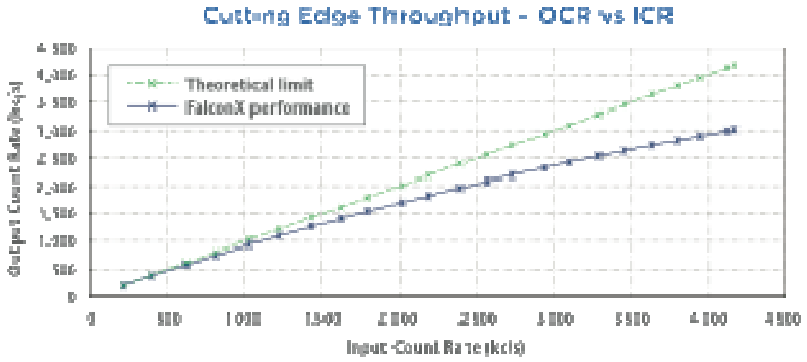

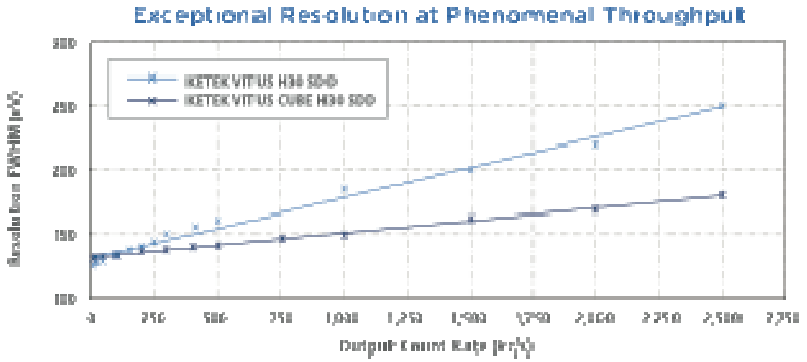

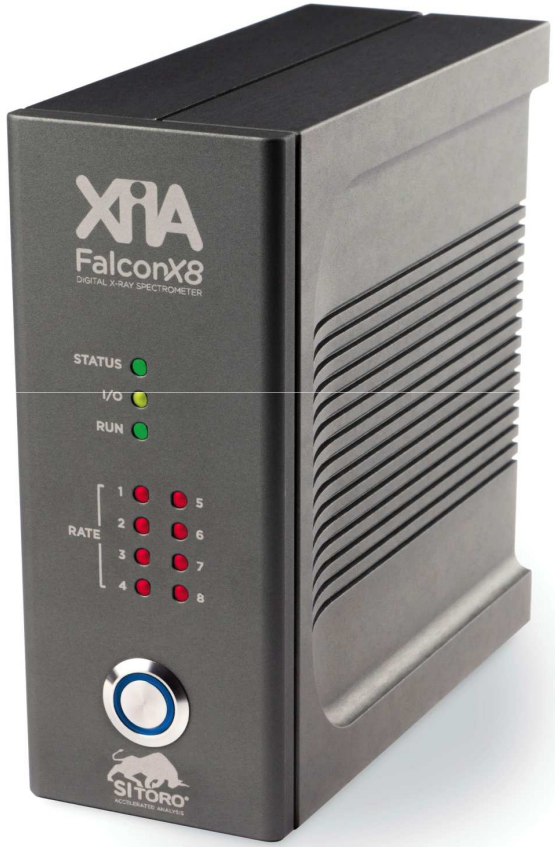

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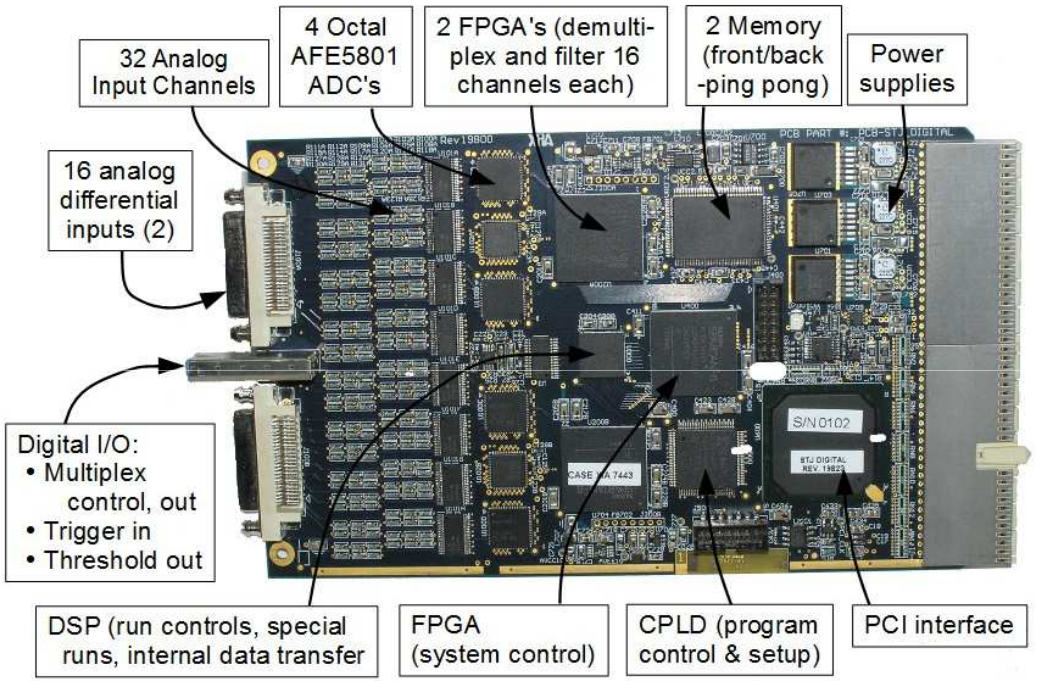
SITORO® Advantages

- Offered by XIA LLC under license from and in collaboration with Southern Innovation
- New FalconX8/X4/X1 release: Spring 2015
- Much higher throughput than conventional digital pulse processing: output rates exceeding 3 Mcps with fast detectors
- Excellent pulse-pair resolution (<30 ns) keeps pileup effects to a minimum
- Every pulse measured with optimal resolution – no more need to choose between high throughput and good resolution. Better than 200 eV FWHM resolution achieved at 2.5 Mcps OCR with CUBE-based detector
- High-speed mapping support similar to xMAP (MCA mapping as well as flexible list-mode operation)
- Highly accurate input rate measurement allows for excellent pileup correction, even up to the highest rates (well past 5 Mcps)
- Easy and flexible setup: works with virtually every X-ray detector, completely under computer control. Compact size allows for easy sharing between beam lines – perfect for a detector pool
- Gigabit Ethernet interface allows for flexible control. Built-in web server supports field firmware updates as well as online monitoring of system performance

An Alternate Approach to High Throughput: Higher Channel Count. Enter the MPX-32D.



- 32 Channels (50 MHz), with xMAP architecture (dual-buffer PCI readout)
- Modular system – connects to and controls custom front-end (differential analog cabling, digital output lines, analog pulser output signal for test)
- >1 Mcps OCR per channel. Combine with 32-channel, CUBE-based SDD to get > 30 Mcps throughput at well below 200 eV FWHM (hint, hint)

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Best of Both Worlds Possible? Sure, why not!

You can network together a stack of FalconX8 modules, or …

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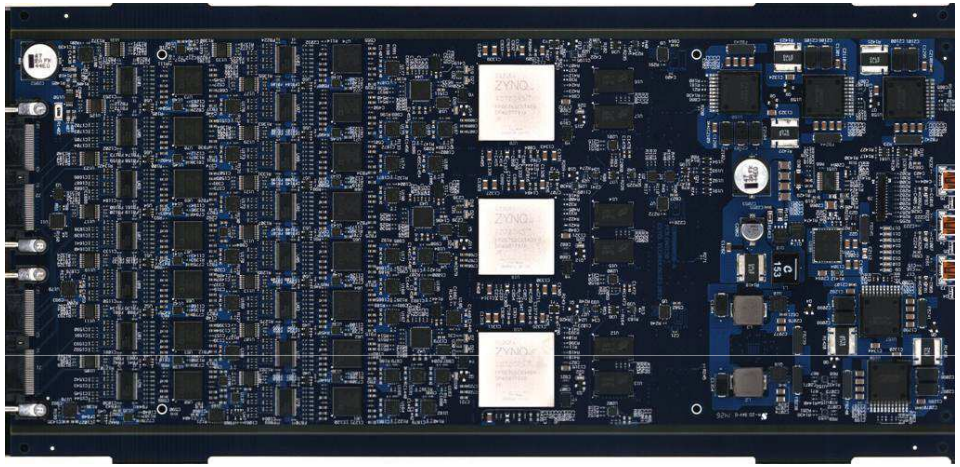
How about 120 SITORO® Channels on a card? Or 4,000 in a rack?



- Large Eurocard with 120 High-speed digitizing channel, each with full SITORO performance
- Custom backplane allows for 13 cards per crate
- Development work done by Southern Innovation for commercial high-speed X-ray imaging application – shows what can be done with their algorithm on commercial hardware

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Etcetera:

- Mercury Upgrade in progress
  - Higher throughput: 2 Mcps OCR with fast rise-time detector
  - Lower noise, better resolution
  - Use of patented intermediate baseline filter allows for very stable spectra with rate down to the shortest peaking times
  - Patented multi-spectral algorithm allows for time-variant filtering without peak broadening with rate (sort events into constant resolution spectra)
- microDXP Upgrade
  - Low-power, small card typically used for OEM applications – technology can be built into detector packaging to allow for 'digital detector'
  - Excellent resolution, OCR of high-speed version > 1.5 Mcps with excellent spectrum stability with rate

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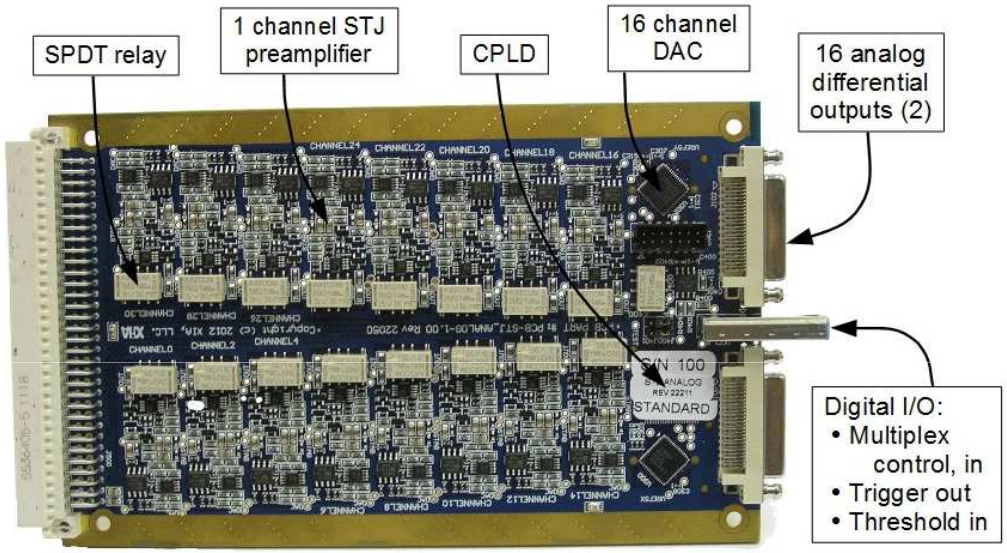
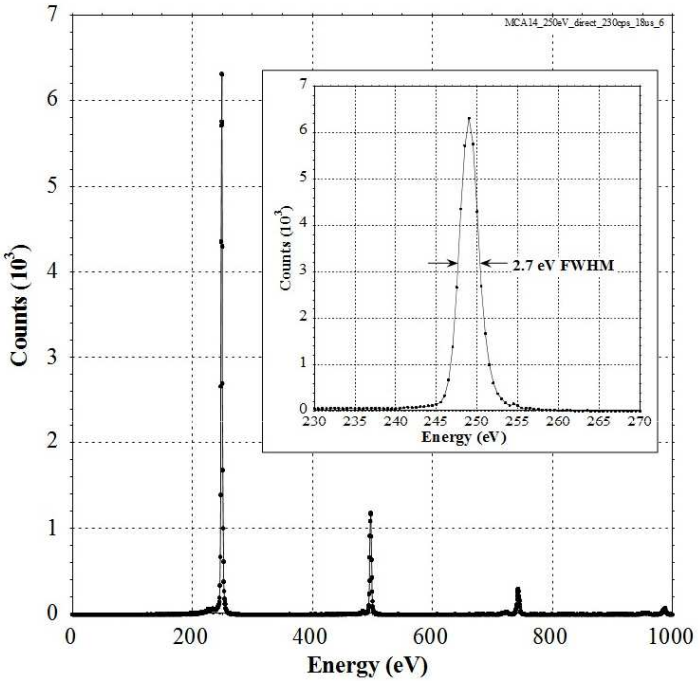
High Channel Count System Example: Superconducting Tunnel Junction (STJ) Readout





- Combine MPX-32D Digitizer/Processor card with custom ultra-low noise 32-channel preamplifier card
- Analog card controlled through digital card, including analog pulser signal used for testing
- Individually shielded twisted pair differential analog connections maintain signal performance for excellent results
- Better than 3 eV intrinsic resolution at 250 eV input energy

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The STJ System:

Low noise power supply, preamplifier chassis mounted on detector, PXI crate with MPX-32D digital cards, all connected using well-shielded cabling.

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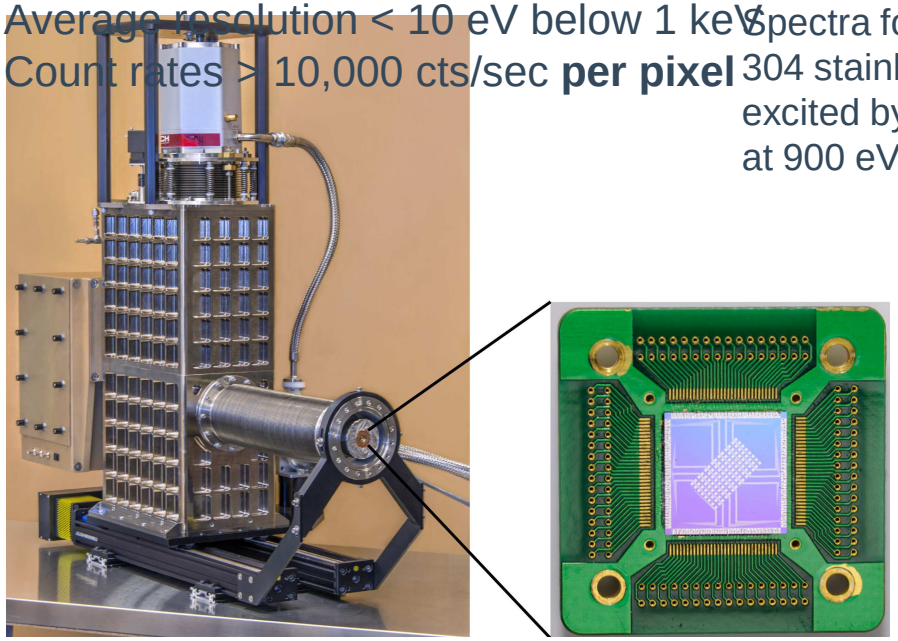
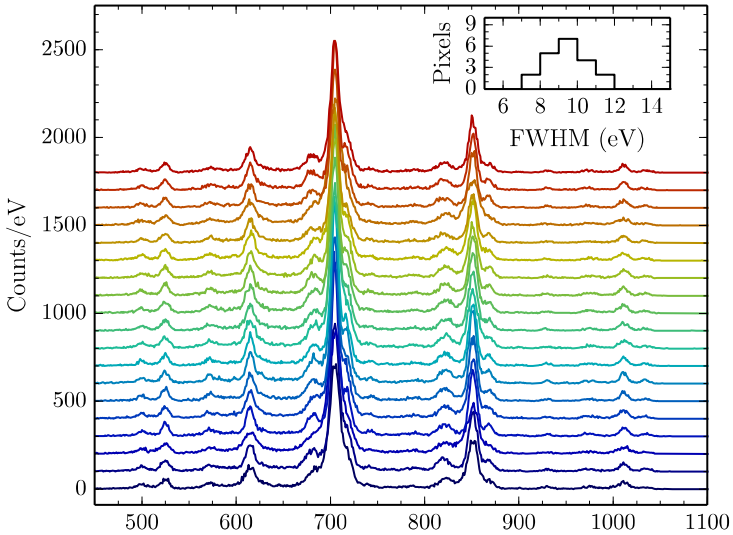
STAR Cryoelectronics

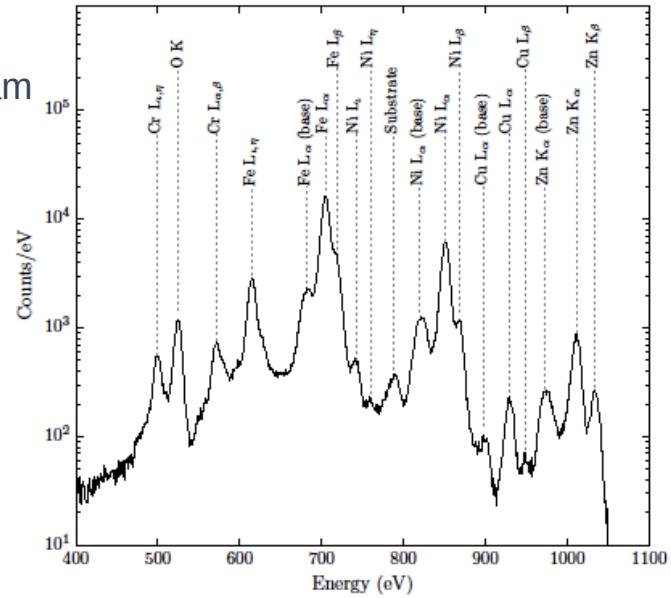
STAR Cryoelectronics STJ Spectrometer for XAS

- Cryogen-free adiabatic demagnetization refrigerator (ADR) cryostat
- Computer-controlled, fully-automated cryogenic system
- Run time up to 48 hours between ADR cycles
- 1.5 hr ADR cycle (regeneration) time
- 112-pixel full size or 36-pixel miniature detector arrays
- Average resolution < 10 eV below 1 keV
- Count rates > 10,000 cts/sec **per pixel**





Spectra for 304 stainless steel, excited by X-ray beam at 900 eV



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