A 960 x 960 Fast Frame Store CCD Detector for X-ray Photon Correlation Spectroscopy

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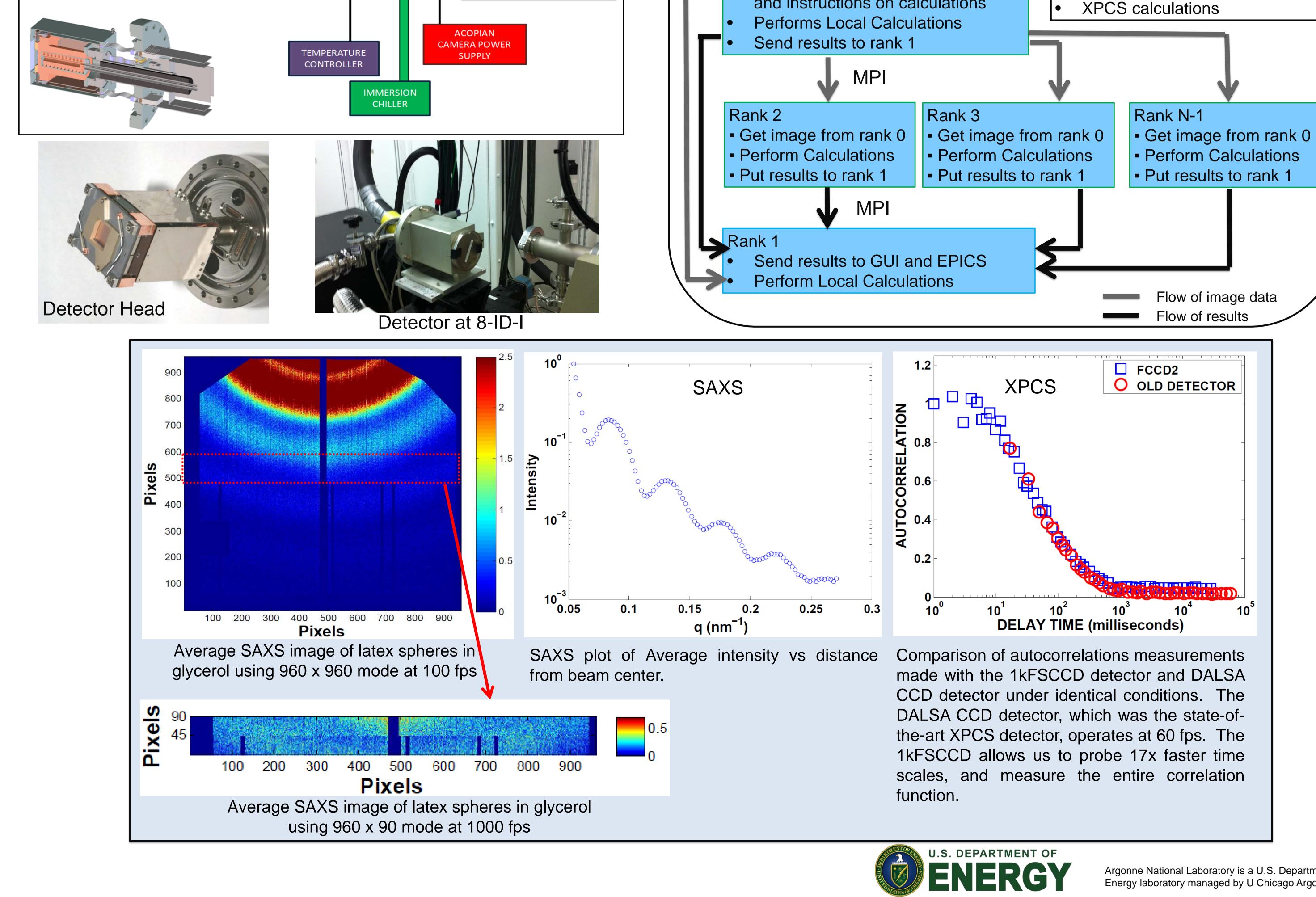
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A 960x960 Frame Store Fast Charge-Coupled Device (CCD) x-ray detector is being used for x-ray photon correlation spectroscopy (XPCS) at the Advanced Photon Source (APS) on the 8-ID-I beam line. The detector is typically operated in either the 960 x 960 pixel mode at 100 frames per second (fps) or in the 960x90 pixel mode at 1000 fps. The vacuum subsystems consist of a top board with a custom CCD sensor, two digitizer boards with 12 custom readout chips, and a CCD clock driver board. The digitized data from the detector head is sent to a Camera Interface Node **Iocated inside an Advanced Telecommunication Computing Architecture (ATCA) chassis.** One or more processor blades in the ATCA chassis use the Message Passing Interface (MPI) protocol to perform real time parallel processing on the incoming data. When the image processing is complete, the data is stored where it is available for further processing.

Features	1kFSCCD		
Area	Full mode: 1920 x 960 (58 mm x 29 mm) Frame Store modes: 960 x 960 (29 mm x 29 mm) 960 x 90 (29 mm x 2.7 mm)	AOI Without a Pipeline Slits block X-rays to all but the center of the CCD 487 480 480 487 Left Right	readout methods With a Pipeline 487 59 59 59 59 59 48 48 48 48 Left
Sensor Thickness	250 µm – 350 µm	Slit Slit	Slit
Pixel Size	30 µm x 30 µm		
Current Readout Modes at 8-ID-I	1920 x 960 @ 50 fps 960 x 960 @ 100 fps	Center of CCD exposed to X-rays	Center of CCD exposed to X-rays Colored bars show previously exposed sections.
	: 960 x 90 @ 1000 fps	Left Slit	Left Slit
QE	Near 1 at 8keV		\leftarrow
Full Well	~900k e ⁻ per pixel	Exposed image shifted to edge for readout Storage and center regions shifted together	The exposed AOI along with the rest of the pipeline is shifted 48 pixels from the center
Gain	6 eV/ADU for 8x 24 eV/ADU for 2x	Left Slit	Left Slit
Custom Readout IC (fCRIC)	15 bits = 13 bits data, 2bits gain		
ADC rate of fCRICs	1 – 2 MHz	Start Readout while center is being exposed to X-Rays Only storage region is shifted during readout	Start readout of AOI while center is exposure to x-rays. During readout there are 59 parallel shifts of the storage area, which opens a blank area between the center region and storage region
	Store Fast CCD Detector		MPI Flow Chart
In Vacuum Camera Head Muliti-pin UHV Connectors Image: Strain	100 pin UHV cable 100 pin UHV cable 100 pin UHV cable 100 pin UHV cable Clock & Control Clock & Control	CAMERA Camera Inter	UDP Packets Image Descrambling Dark Subtraction Image Compression with
	Spares	• Retrieves input St	

and instructions on calculations



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Droplet analysis