



APOLLO CAMERA

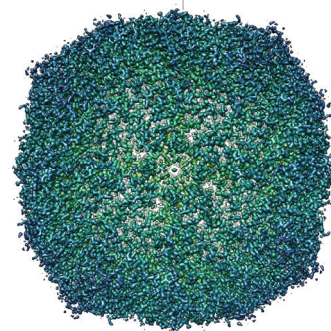
Ultra-Fast Electron Counting For Cryo-EM

Delivering Bigger | Better | Faster | Cameras For Electron Microscopy

NEXT-GENERATION DIRECT DETECTOR FOR ELECTRON COUNTING

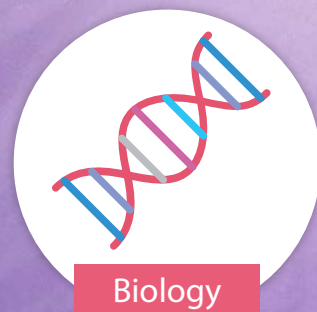
- Our novel direct detection device (DDD®) delivers ultra-low noise and extraordinary resolution for nearly any beam current for cryo-EM.
- Electron counting *in hardware* is elegant, fast, easy-to-use, and more cost effective.
- Decrease movie exposure time 5x to multiply SPA throughput.
- On-chip CDS and digital output of detected events minimizes noise and increases DQE.
- 4k × 4k (16.8 million) physical pixels with larger 8 μm pixel size to maximize resolution.
- Super-resolution 8k × 8k (67.1 MP) counted movies saved to the computer for motion correction, dose filtering, etc.
- Integrated with SerialEM, Smart Scope, JEOL VTC., for automated acquisition.
- Generate better results than you've ever achieved before.

Average throughput	1,820 [movies/hour]
Average throughput	44k [movies/24 hours]
Max throughput	2,904 [movies/hour]
Exposure time	0.47 [s]
Data collection	7x7x7 (radius 10 μm)
Acquisition time per movie	1.7 [s]
Electron dose	~30 [e-/Å ²]
Magnification	150k
Pixel size	0.572 [Å/pix]
Defocus range	0.5-1.0 [μm]
Microscope	CRYO ARM 300 II
Automation software	Virtual TEM Controller



High-throughput acquisition parameters for single-particle-analysis cryo-EM using the Apollo detector. *Data courtesy of Makino Fumiaki (JEOL Ltd), Bartosz Marzec (JEOL Europe), & Takayuki Kato (University of Osaka).*

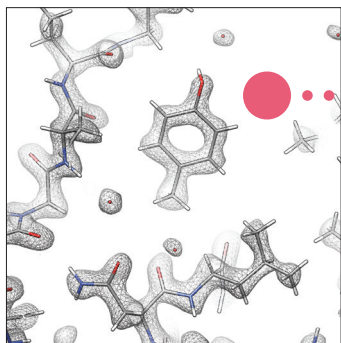
DETECTOR APPLICATION:



Direct Electron
INNOVATION PROPELLING DISCOVERY®

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OPTIMIZED FOR DEMANDING TEM APPLICATIONS

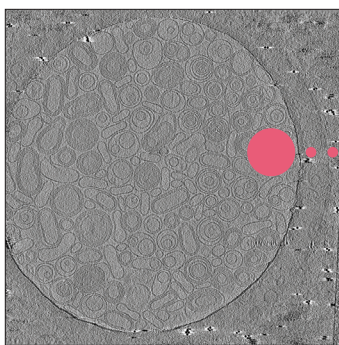


High-Resolution Single-Particle

Faster counting means better resolution with less particles

High-Throughput Automation

Shorter exposure times allow >1800 SPA movies/hour

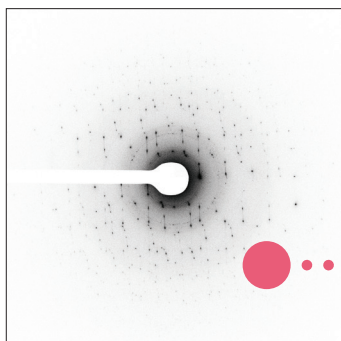


Cryo-Tomography

Large field-of-view and high contrast

Continuous Rotation & *in situ*

Real-time counting enables dynamic applications



MicroED (Diffraction)

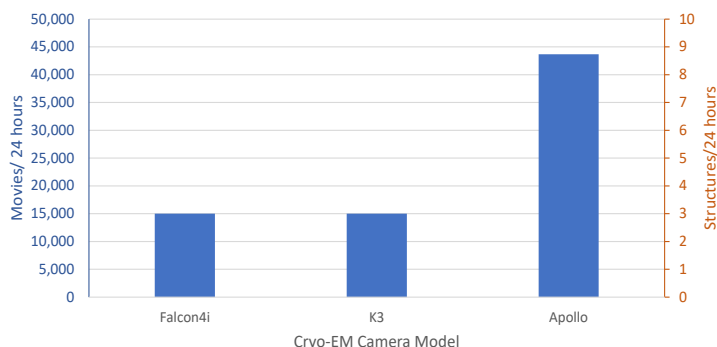
Integrated with REyes autonomous micro-ED system from Caltech

HIGH THROUGHPUT

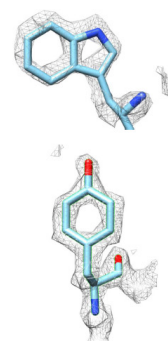
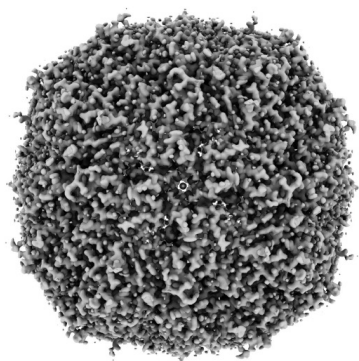
Apollo's faster electron counting means it can handle much higher dose rates than other cryo-EM cameras, with equivalent coincidence loss. Leveraging the higher dose rates to use shorter exposure times <0.5s, single-particle throughput with Apollo can reach up to 43k movies/24 hours. There is scope to increase this further with higher dose rates, lower exposure times and better dose fractionation.

IMPACTFUL RESULTS

Effect of Cameras on Single-Particle Cryo-EM Throughput



When single particle data was collected from the same apoferritin sample by different cameras on the same microscope, the results were striking. Apollo's superior counting rate enabled a much higher resolution reconstruction using much less particles [1].

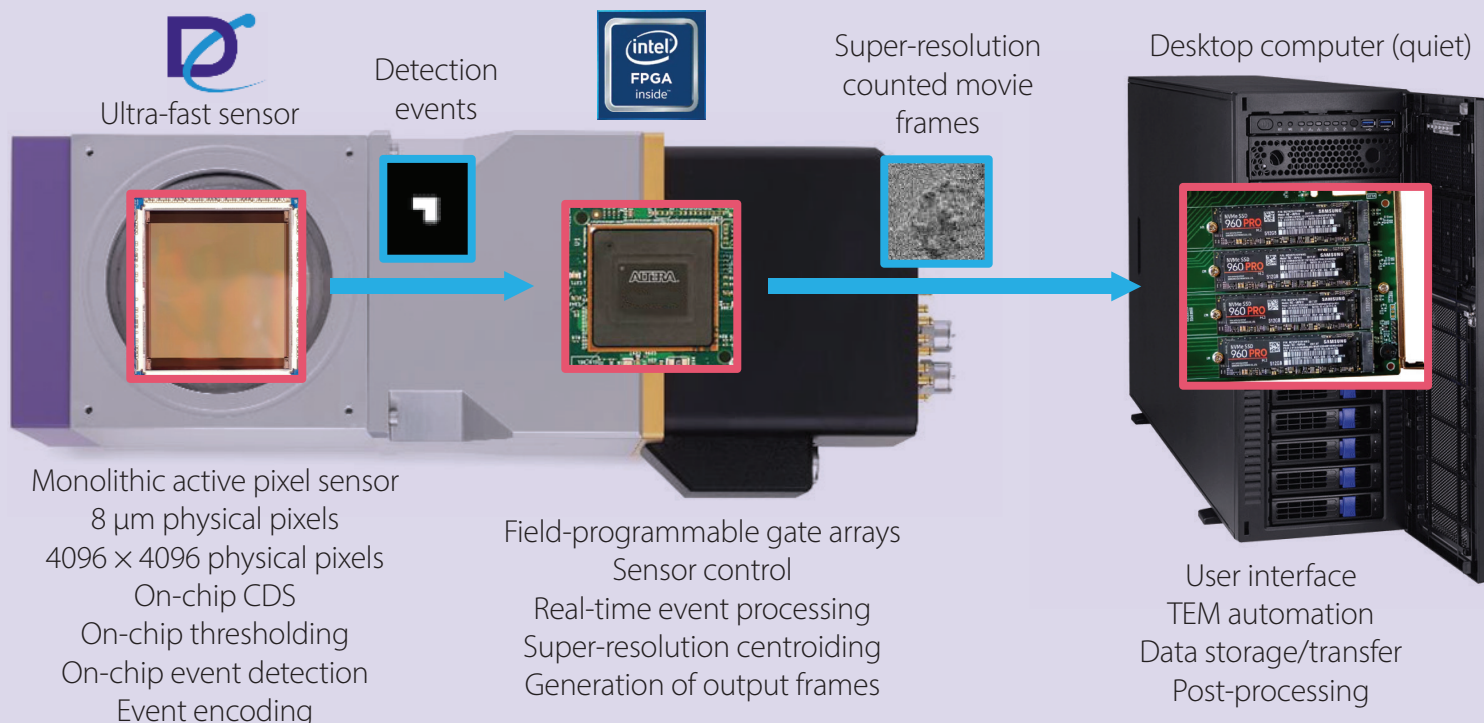


Apollo
1.6 Å
65,516 ptcls

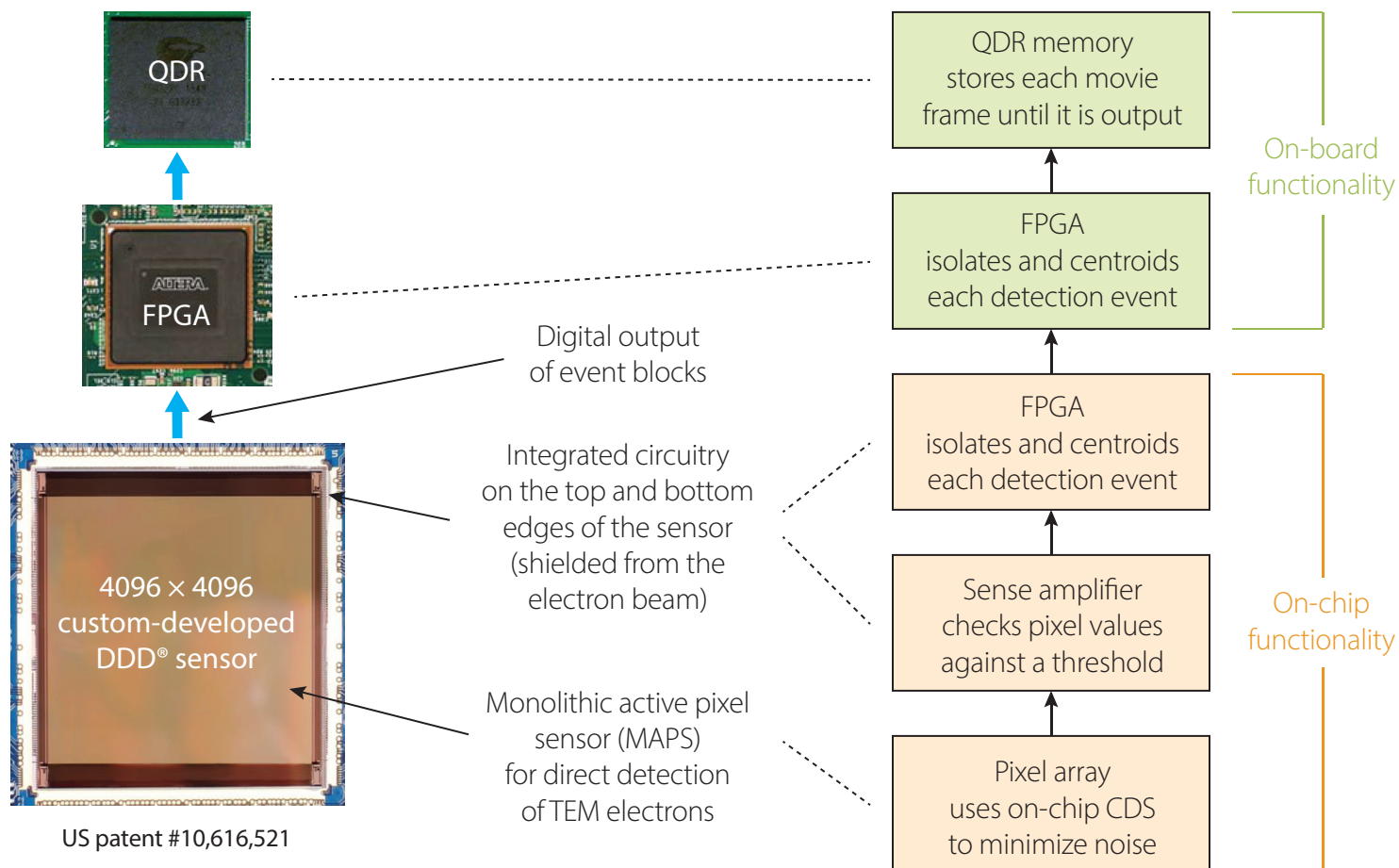
K3 + GIF
2.5 Å
440,421 ptcls

300 kV
Titan Krios G1

A NEW STRATEGY FOR ELECTRON COUNTING: EVENT DETECTION IN HARDWARE



NEXT-GENERATION REAL-TIME ELECTRON COUNTING



Tem Electron Energy

Sensitive to 80 keV – 1.25 MeV | optimized for 200 - 300 keV

Pixel Array Size

4096 × 4096 (16.8 million pixels) | 8 μm pixel pitch

Sensor Design

Novel event-based ultra-fast DDD® sensor
on-chip correlated double sampling (CDS) | on-chip thresholding | digital readout
backthinned | radiation hardened

Acquisition Modes

Event-based electron counting, *always*

Detection Efficiency

>90% For 200 - 300 kV

Exposure Rate

~0.01 - 75 e-/pixel/second (ranging ~4 orders of magnitude)

Linearity

>95% linear up to ~15 e-/pixel/second

Dose Fractionation

8192 × 8192 (67.1 Million pixels) super-resolution counted movies
8.3 ms minimum per frame | 382 μs with event streaming CSB format

TEM Compatibility

All major TEM manufacturers & models

Mounting Position

Fully retractable | compatible with a wide-range of configurations typically in TEM bottom port, pre- or post-energy filter, or in JEOL film drawer

Sensor Protection

TEM blanking/shuttering | failsafe software

Computer System

High-performance computer | Windows 11 | Nvidia GPU(s) | up to 55 TB storage

Image Format

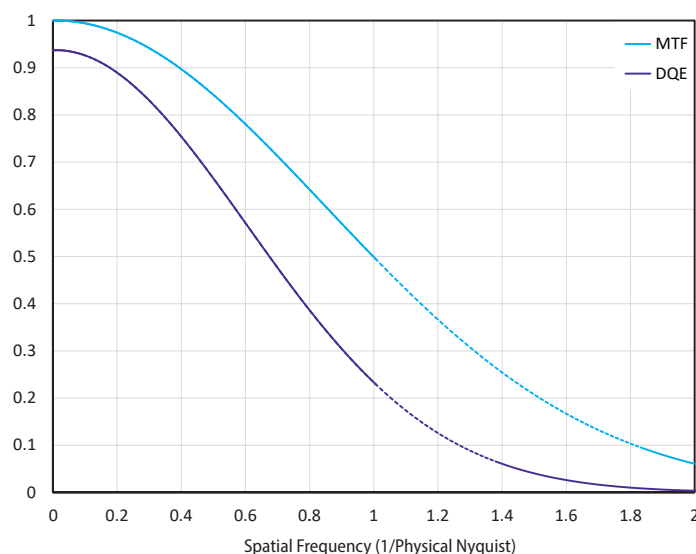
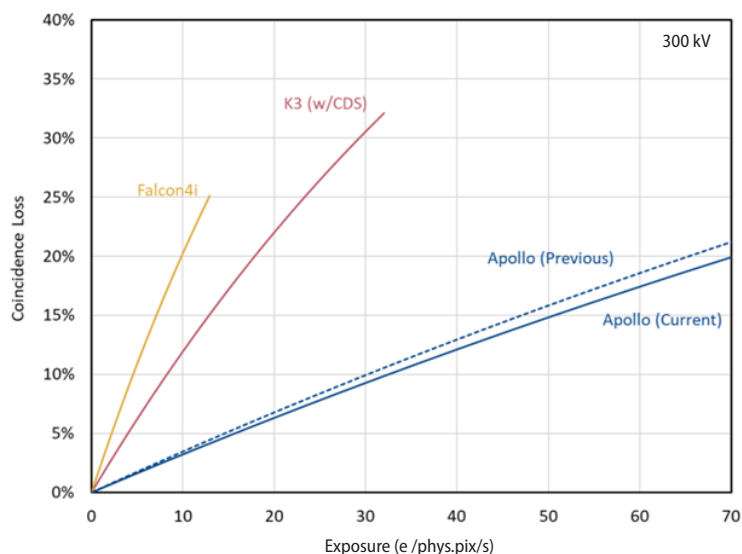
Non-proprietary | MRC, TIFF, or TIFF LZW | CSB Event Streaming

Automation Software

SerialEM | JADAS (JEOL) | VTC (JEOL) | open API (supporting Python, C, C++, C#, etc.)

Integrations

CEFID post-column energy filter (CEOS)



Left: Coincidence loss is a failure to detect electrons when the beam is too bright compared to the speed of the sensor. As you can see from the graph above, Apollo's ultra-fast counting is unmatched [1-3].
Right: DQE curves are shown for 300 kV electrons with Nyquist meaning the physical (non-super-resolution) Nyquist | Specifications and performance are subject to change.