



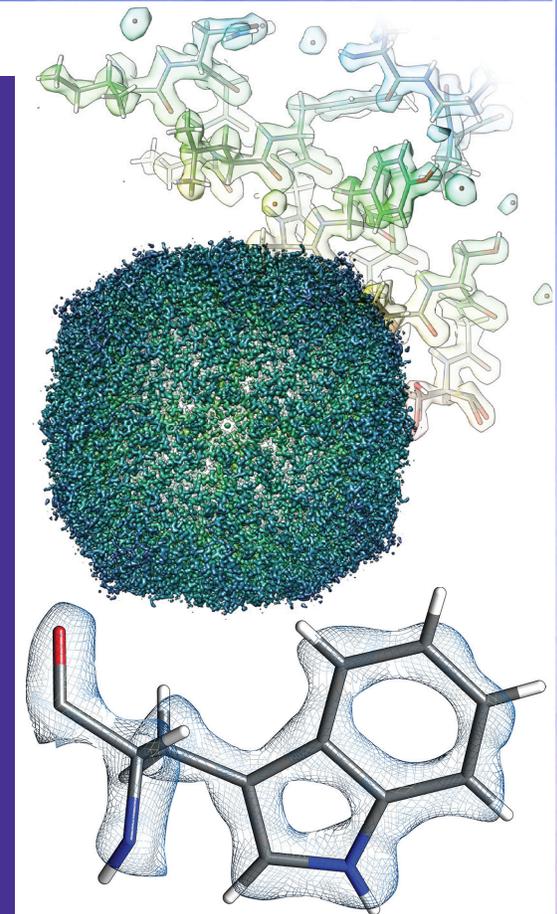
# APOLLO CAMERA

Ultra-Fast Electron Counting For Cryo-EM

Delivering Bigger | Better | Faster | Cameras For Electron Microscopy

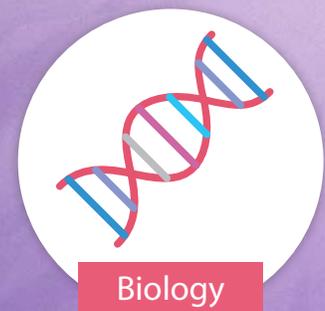
## NEXT-GENERATION DIRECT DETECTOR FOR ELECTRON COUNTING

- Our novel direct detection device (DDD<sup>®</sup>) 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.
- Change the paradigm for cryo-EM by removing camera limitations.
- On-chip CDS and digital output of detected events minimizes noise.
- 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, Leginon, etc., for automated acquisition.
- Generate better results than you've ever achieved before.



1.46 Å resolution cryo-EM structure of apoferritin (EMD-33707) from Apollo on a JEOL CRYO ARM 300 II, acquired at 12 e-/physical pixel/s (eps).

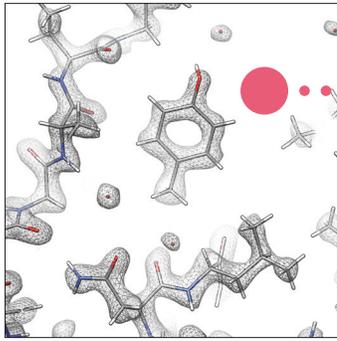
### DETECTOR APPLICATION:



**Direct Electron**  
INNOVATION PROPELLING DISCOVERY<sup>®</sup>

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# OPTIMIZED FOR DEMANDING TEM APPLICATIONS

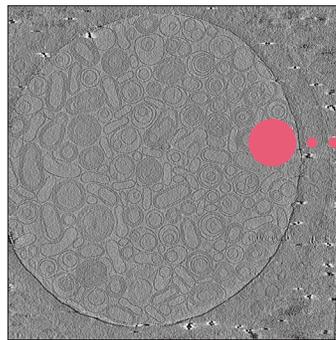


## High-Resolution Single-Particle

Ultra-large search mode images without montage

## High-Throughput Automation

Ultra-fast electron counting enables short exposure times

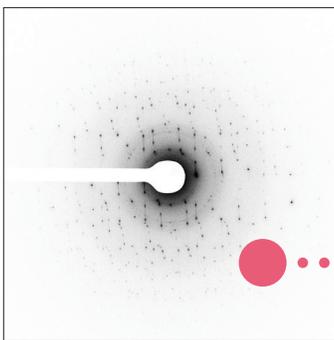


## Cryo-Tomography

Large field-of-view and high contrast

## Continuous Rotation & *in situ*

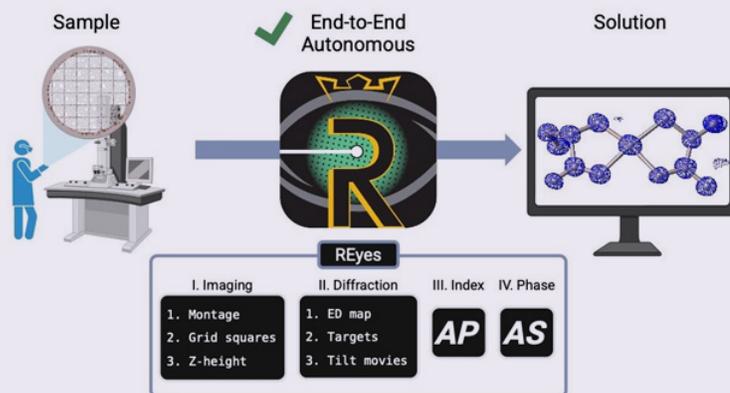
Real-time counting enables dynamic applications



## MicroED (Diffraction)

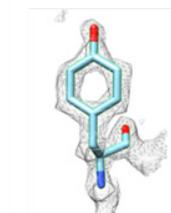
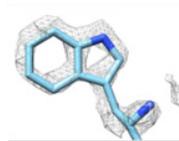
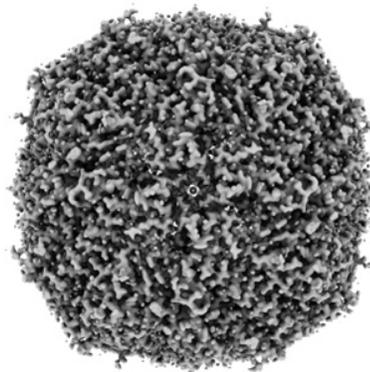
High dynamic range & large area for crystallography

## IMPACTFUL RESULTS



Researchers from Caltech have recently developed 'Reciprocal Eyes', a program that works with Serial EM to survey a TEM grid, acquire Micro-ED data and calculate the structure. It is not a screening tool, or a rough estimate. It provides the high resolution structure completely autonomously. The program is free for academic use, and compatible with all major TEMs. The developers found that Apollo produced the best resolution and highest 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 [2].



**Apollo**  
1.6 Å  
65,516 ptcls

**DE-64**  
2.5 Å  
197,315 ptcls

**K3 + GIF**  
2.5 Å  
440,421 ptcls

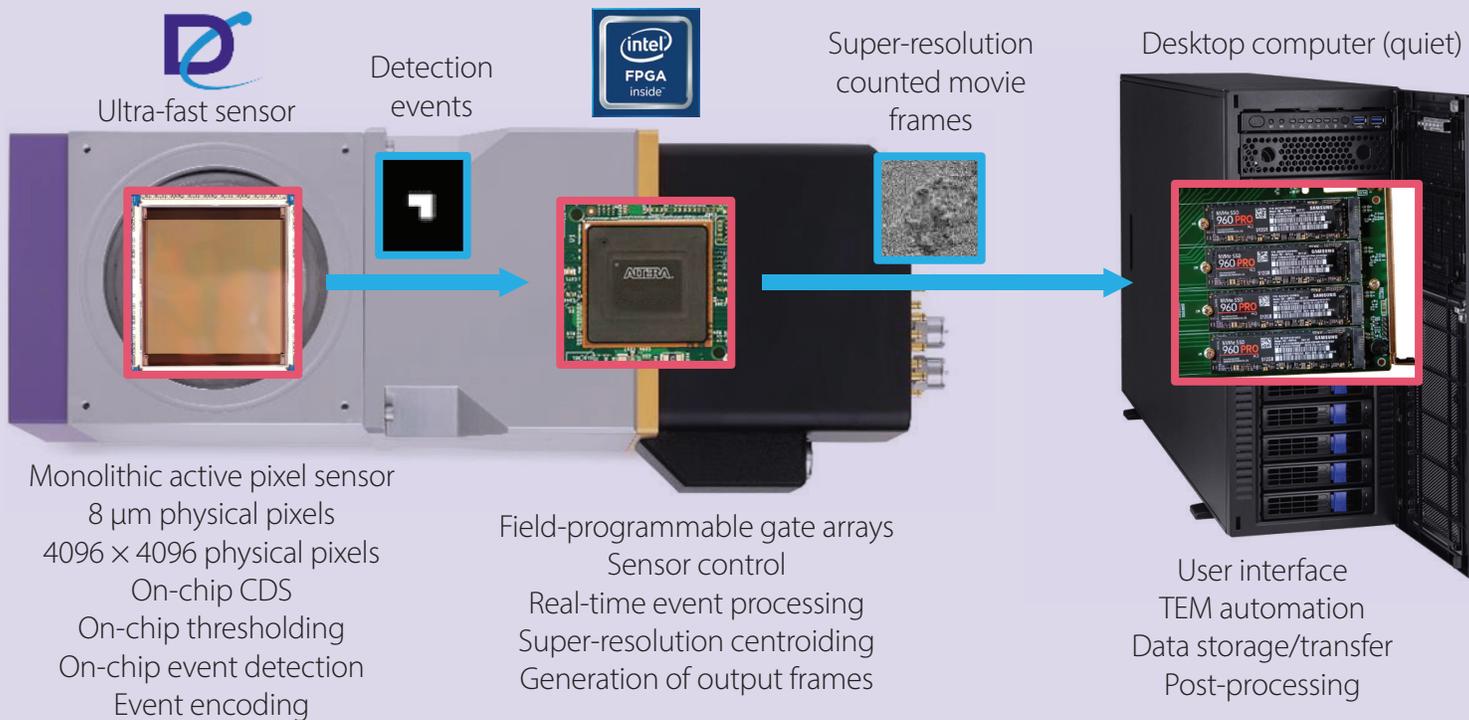
300 kV  
Titan Krios G1

1. Nakane, T. et al. Single-particle cryo-EM at atomic resolution. *Nature* 587, 152–156 (2020).

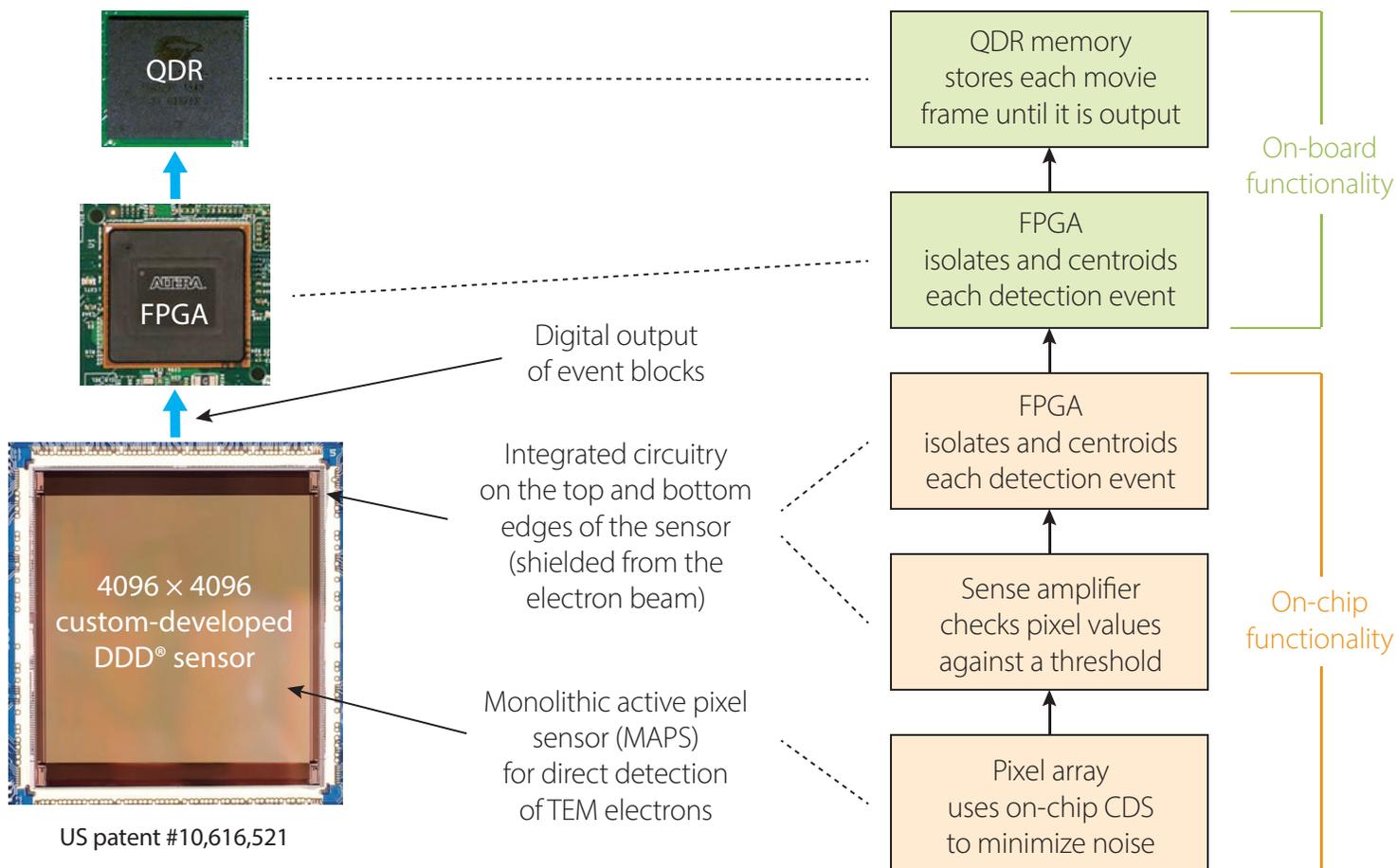
2. Peng, R. et al. Characterizing the resolution and throughput of the Apollo direct electron detector. *Journal of Structural Biology*: X 7, 100080 (2023).

3. Sun, M. et al. Practical considerations for using K3 cameras in CDS mode for high-resolution and high-throughput single particle cryo-EM. *Journal of Structural Biology* 213, 107745 (2021).

# A NEW STRATEGY FOR ELECTRON COUNTING: EVENT DETECTION IN HARDWARE



## NEXT-GENERATION REAL-TIME ELECTRON COUNTING



Email | [info@directelectron.com](mailto:info@directelectron.com) Web | [www.directelectron.com](http://www.directelectron.com) Phone | +1 858-384-0291

**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  
flexible dose fractionation time | 16.7 ms minimum

**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 10 | Nvidia GPU(s) | up to 55 TB storage

**Image Format**

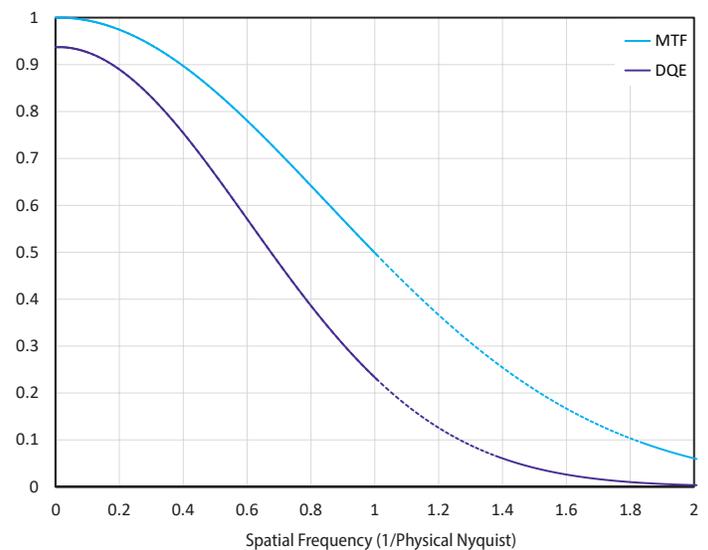
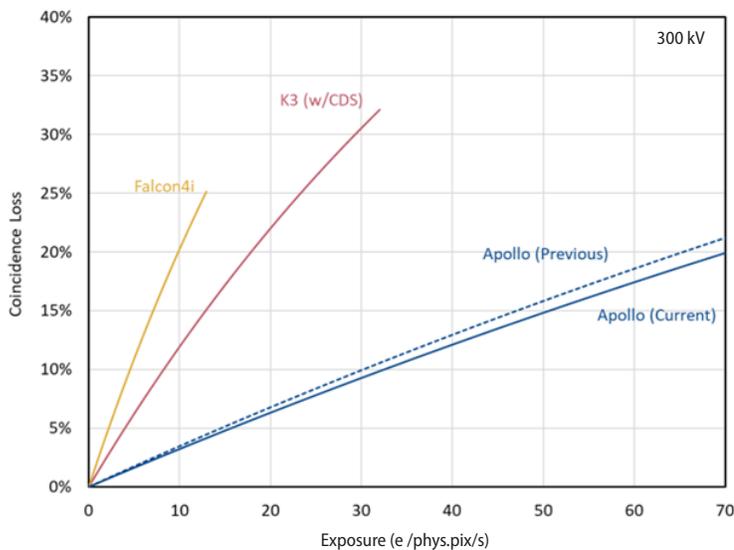
Non-proprietary | MRC, TIFF, or TIFF LZW

**Automation Software**

SerialEM | Legikon | JADAS (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.