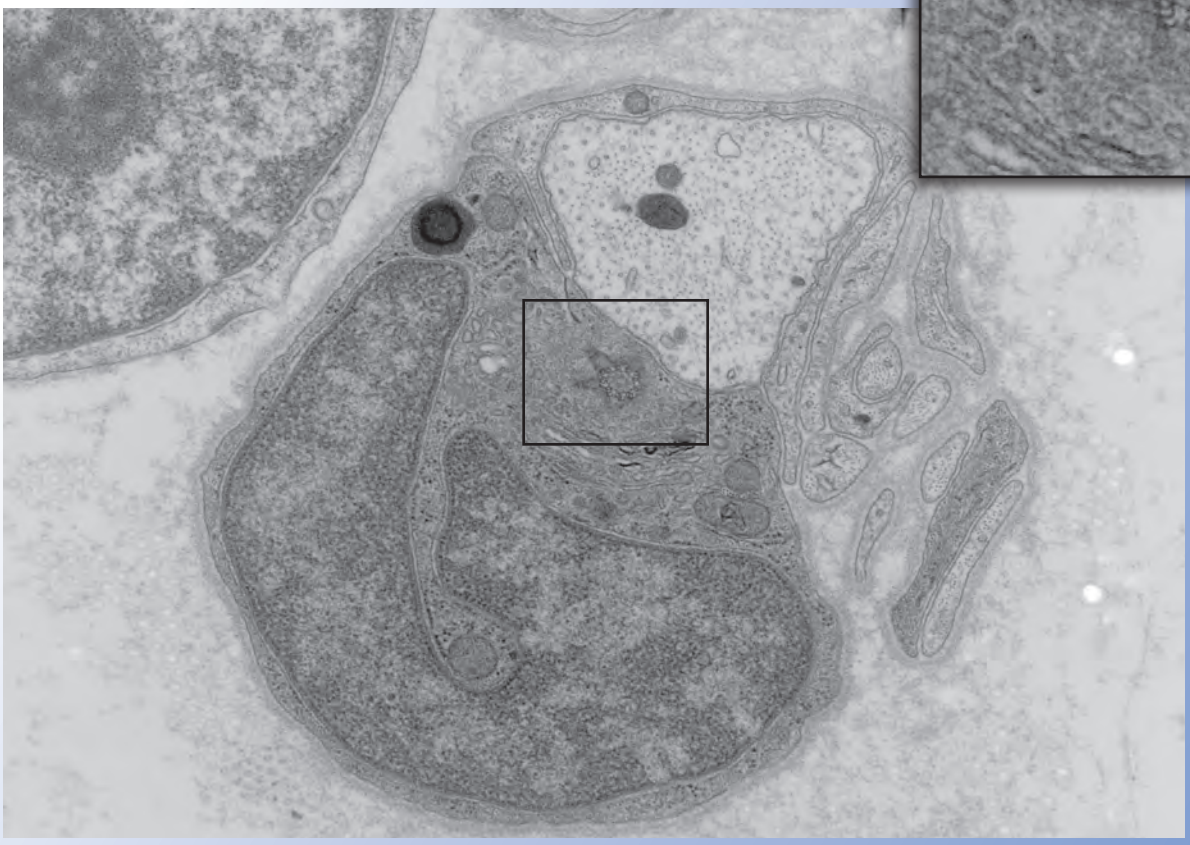
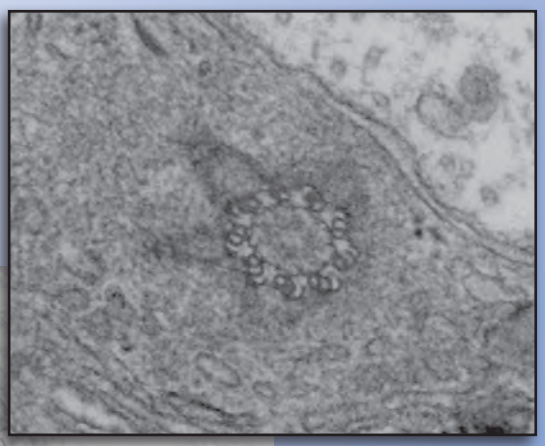
XR16 TEM CCD CAMERA



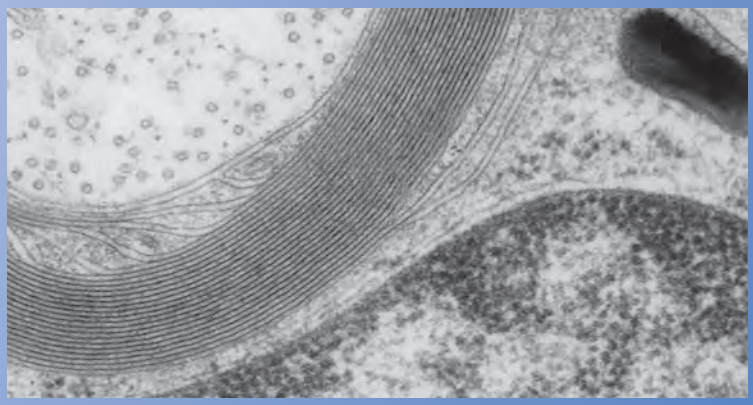


Human Schwann cell
sciatic nerve
80 keV

Image courtesy of
Kenneth L. Tiekotter
Adjunct Professor
University of Portland
Portland, OR USA

INSERT ELECTRONICALLY ENLARGED 3 TIMES

The AMT ***XR16*** *CCD camera* represents the latest in larger format CCD sensors. It is an excellent choice for clinical pathology and other applications routinely running at microscope magnifications below 50,000x. This camera is positioned directly beneath the fluorescent screen of the TEM, thus affording a wide field-of-view.
The Mid-Mount configuration encounters virtually no projector distortion and its high definition, finite-conjugate lens provides sharp images with excellent sensitivity. With fixed camera and lens assembly, there is no need for pneumatic insertion.
The simplest diffraction patterns are very difficult to acquire using CCD cameras. The nature of diffraction patterns demand the ability to provide full fidelity of weak and extremely intense spots or rings. For user convenience, the majority of modern CCD cameras provide anti-blooming properties. This is a built-in feature of the AMT ***XR16***.



Myelinated nerve fiber/Schwann cell, courtesy of K.L. Tiekotter

Diffraction rings from carbon grating replica

Mid-Mount Position Provides Optimum Viewing

Wide Field-Of-View Without 'S' Distortion

AMT's Mid-Mount configuration maintains a wide field-of-view without distortions that hinder quantitative imaging, montaging, and tomography.

This is a significant advantage relative to Side-Mount cameras, which exhibit 'S' distortion due to the corners being too far from the electron beam axis.

As seen in this grating replica (RIGHT), the x-y axes are aligned without distortion.

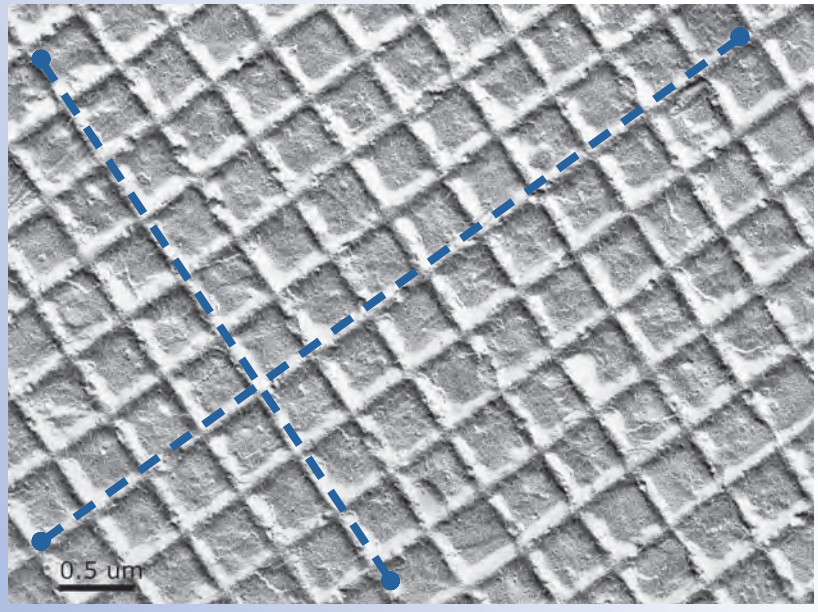
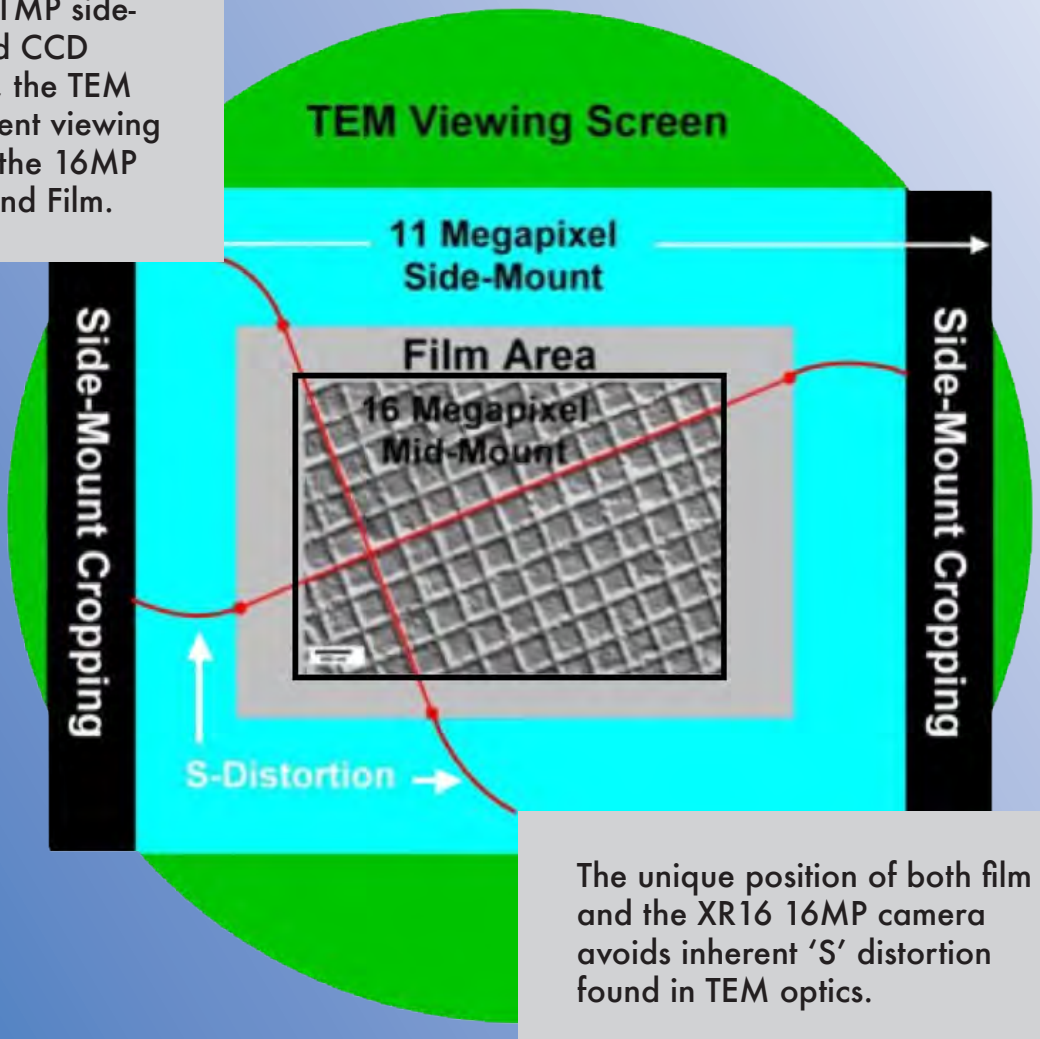


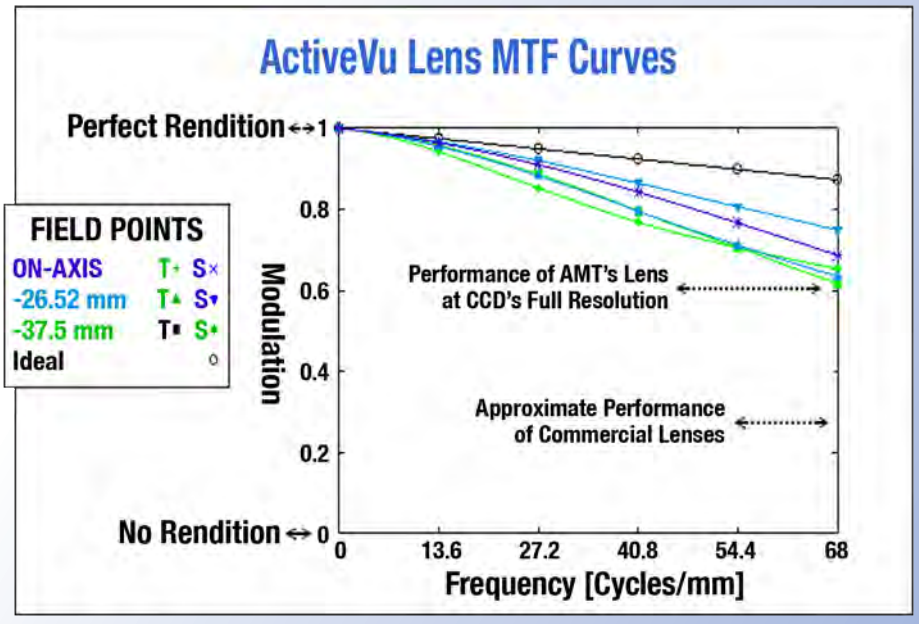
Image taken with XR16 Mid-Mount System

Note the relation of the 11MP side-mounted CCD camera, the TEM fluorescent viewing screen, the 16MP XR16, and Film.



The unique position of both film and the XR16 16MP camera avoids inherent 'S' distortion found in TEM optics.

Performance Specifications for TEM Camera Lens System



Lens System

The key elements for image resolution and sensitivity are defined by: 1) resolution is the preservation of information produced by the TEM and phosphor; and 2) sensitivity is the efficiency of the lens system to quickly gather signal. This speed is necessary to avoid damage to the specimen or force the user to work at "TEM crossover." Working at crossover results in degradation of the imaging performance of the TEM. The objective measure of resolution is the modulation transfer function (MTF), while the lens efficiency is determined by f-number or numerical aperture.

Lens Efficiency

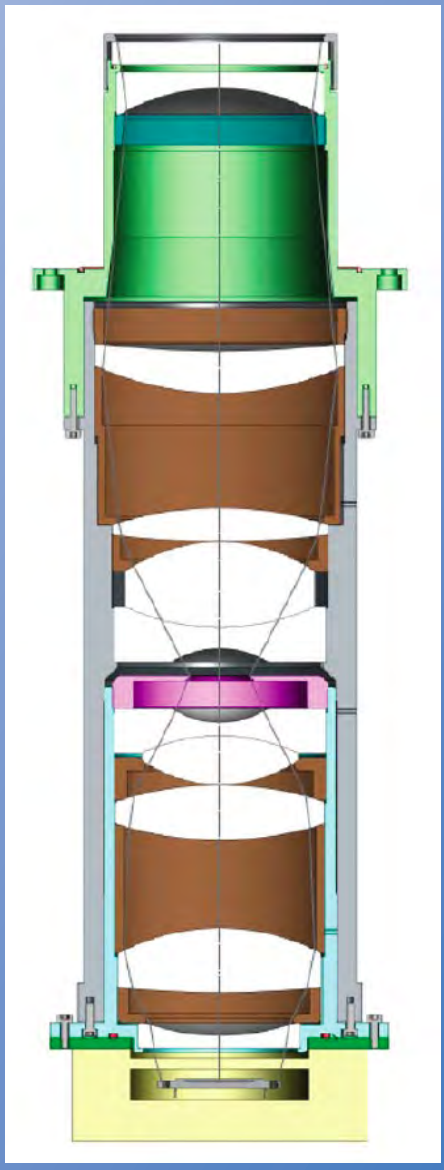
Camera speed is especially useful for focusing and adjustment. In combination with a high-speed lens, i.e., one that delivers more illuminance, high efficiency lenses allow the system to be run fast over the entire range of TEM operation. Low efficiency lenses require longer camera exposure times (i.e. slower frame rates) to collect enough signal intensity to pass the camera's noise threshold. This is an important issue for higher magnifications and beam sensitive specimens. (See diagram on the right)

To maintain system performance over the entire range of TEM operation, the lens must have a high numerical aperture (low f-number) so that light is collected efficiently. The XR16 lens has an input high numerical aperture (NA) of 0.11, which is 2x to 5x greater than the best commercial macro-lenses. Since efficiency varies as the square of NA, AMT's lenses are 4 to 25 times more efficient than commercial lenses used in conventional lens coupled cameras.

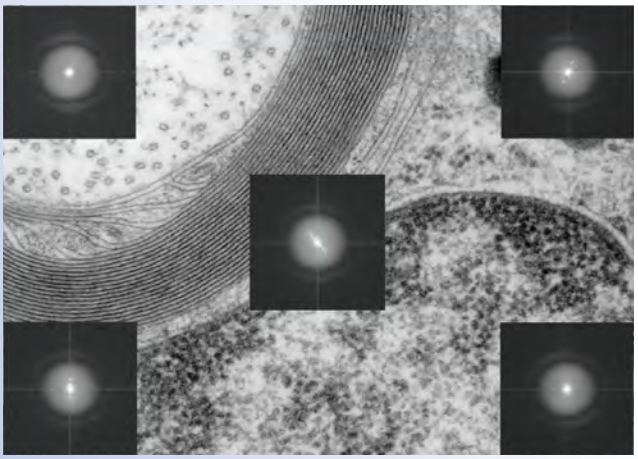
Lens Resolution (MTF)

The modulation transfer function (MTF) of the lens determines how well the digital image reproduces the detail of the electron image. For example, when the MTF is equal to 1, the fidelity of rendition is perfect. However, when the MTF is equal to 0, the fidelity of rendition equates to no information being passed. MTF varies with the size of the features being observed. For most lenses at low resolution (i.e. big features comprised of many pixels) the MTF is typically near 1 and the image is near "perfect." However, MTF decreases as the details approach the size of the CCD pixels. The graph above shows AMT's custom designed lenses maintain a high MTF level (>60%) across the entire field up to the resolution limit of the CCD (68 line-pair per mm). See graph above.

No other company uses lens systems designed or rated for the resolution limit of the CCD at full aperture and full field.



High Sensitivity with Precise Focusing Across the Entire Image



The ***XR16*** achieves high sensitivity and unmatched resolution with highly corrected finite-conjugate imaging lenses. Only AMT offers lenses with this sophistication and performance. Competitive lens-based systems suffer from poor sensitivity and defocusing at the picture corners. The *fast fourier transform* (FFT) algorithm images (RIGHT) illustrate homogeneous patterns in the four corners and middle of this image. The use of FFT pattern comparisons is one means by which lens-coupled cameras can be compared for corner-to-corner flatness-of-field correction. The ***XR16 Mid-Mount camera system*** represents another AMT advantage in a long line of first accomplishments, providing the user with innovation and excellence in high resolution, high sensitivity, and highly corrected imaging systems, as well as the standard in user-friendly software. Unique TEM column position allows for more pixels and less distortion than comparable systems in the Side-Mount port. Simple installation and operation, there is no need to cool en vacuum or insert/retract the camera assembly. In addition, the system does not require invasive connections to microscope air or water-cooling lines.

Selection / Satisfaction / Service = The AMT Advantage

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Camera, Phosphor and Geometry	Specifications	Advantage
Pixels in CCD in millions	16	Ultimate definition
Pixel Size at Phosphor Sharpness (um)	11	Large pixels for high definition
Phosphor Size	62 mm x 41 mm	Gives wide angle viewing
Camera Placement	Mid-Mount (near filmplane)	Optimum position for capture
Coverage Relative to Film	~75%	Largest in class
Dynamic range of A/D converter (dB)	72	Highest in Class
Cooling Method	Peltier with Passive Air	No vibration with high reliability
Dark Current e-/sec/pixel	<2	Allows long exposures
Max Readout Rate (fps)	8.8 @4x4 binning	Comfortable live viewing
Readout Taps	2	Allow fast readout with low noise
Computer Camera Interface	GigE	Simple, fast and reliable protocol
Signal Collection	**Specifications**	**Advantage**
Optical Coupling	Finite-Conjugate 0.57x Lens	Only AMT custom designs lens for optimum performance
Collection Numerical Aperture	0.111 at Input	Gives high quantum efficiency
Optical Resolution @Nyquist @100kV	>60% by MTF	High definition by design
Conversion Efficiency [Counts/Electron]	4	Single electrons sensitivity
Software Highlights	**Specifications**	**Advantage**
Gain and Background Correction	Full Live Correction	Fast with low CPU overhead
Photographic Processing	Automatic and Manual	Good contrast over wide range
Live Streaming Digital Video	Standard with Complete AVI Creator	AMT provides total package
Measurements	On-Image Point-to-Point	For efficient operation on-line
Advanced Image Processing	Customized for ImageJ	Extensive library of function at No charge
Native Image Format	MSA Standard TIFF8 and TIFF16	Only formats endorsed by MSA
Caption and Scale Bar	Securely attached to TIFF Image	Improves image authentication

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