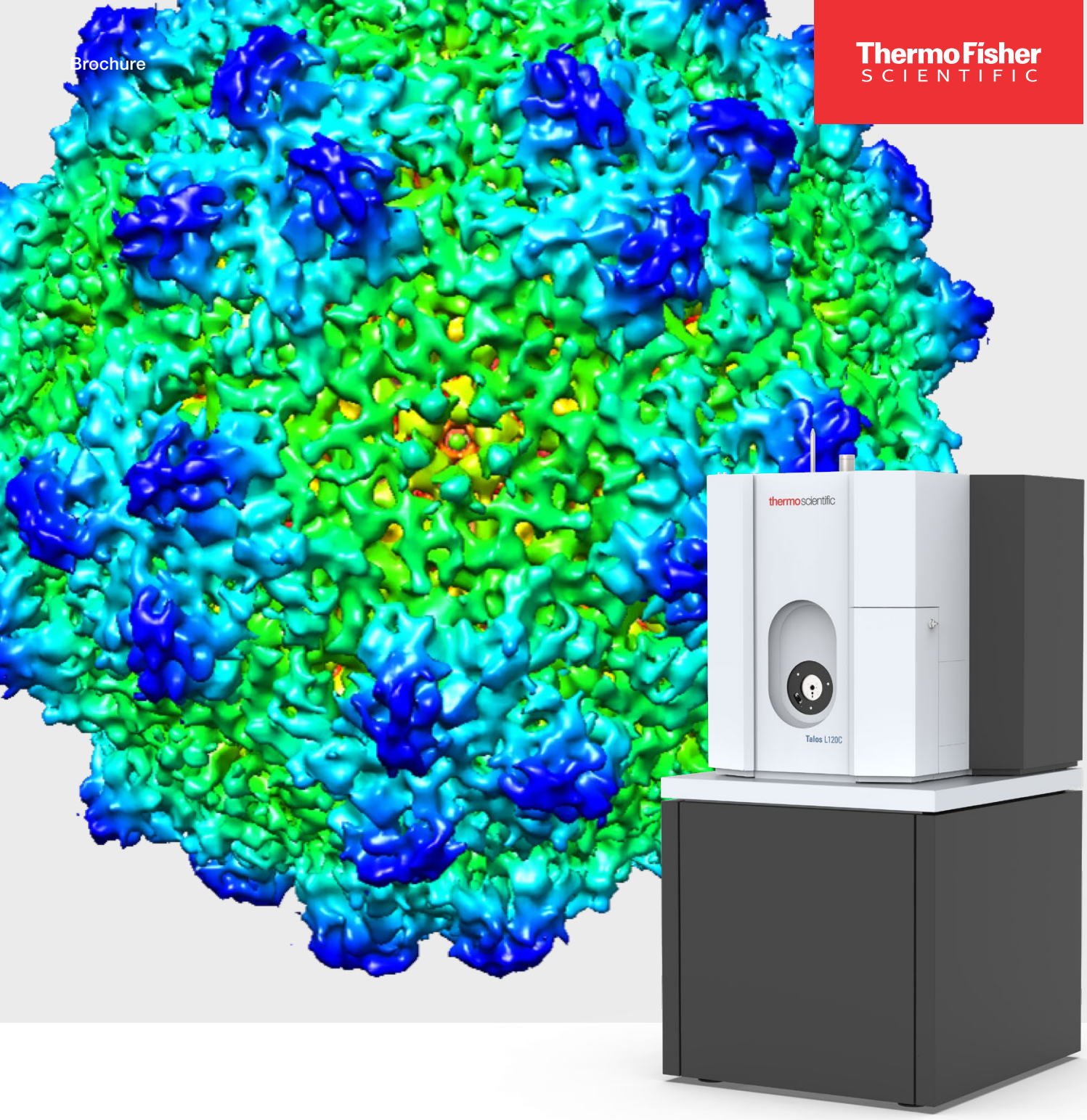
Brochure

ThermoFisher SCIENTIFIC



Talos L120C G2 (S)TEM

Powerful and flexible microscope for multi-disciplinary 2D and 3D imaging

thermo scientific

What biology will you reveal at the nanoscale range?

The Thermo Scientific™ Talos™ L120C G2 (S)TEM enables the visualization of biological samples including sections of resin-embedded cells and tissues or isolated particles of protein complexes and viral assemblies as well, as other materials down to subnanometer resolutions.

With a flexible base configuration, the system can be adapted for multiple applications, using different imaging and detection techniques, to meet a wide variety of user and departmental needs.

The availability of new and existing system upgrades provides opportunities to implement new applications and access to new technologies. Continuous software updates facilitate improvements in ease-of-use and the addition of new features and improved automation.

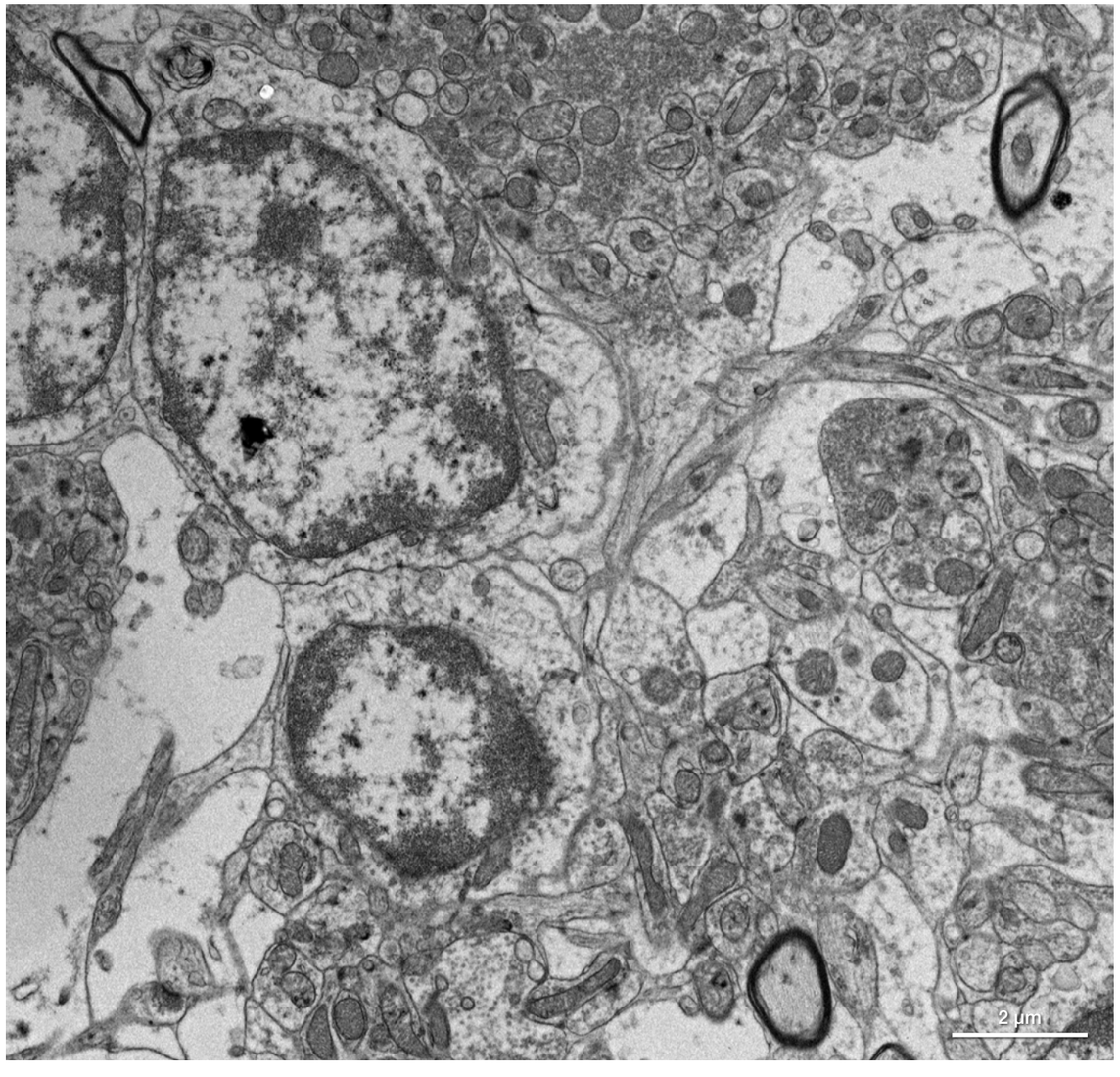


Figure 1: TEM Image of resin-embedded brain tissue (sample curtesy of Benjamin H. Cooper, MPI Gottingen, Germany).

Explore cellular ultrastructure

The integrated digital search-and-view camera provides convenient examination of samples at ambient light conditions with optimal image contrast on a large computer screen. For pathology samples, regions of interest can be quickly identified and 2D images recorded at high resolution using the simple and intuitive user interface.

More advanced application software facilitates imaging of large sample areas at different image resolutions, using the tiling and stitching functionality and automated batch data collection. Cellular ultrastructure can then be studied thoroughly in the context of dissected tissues.

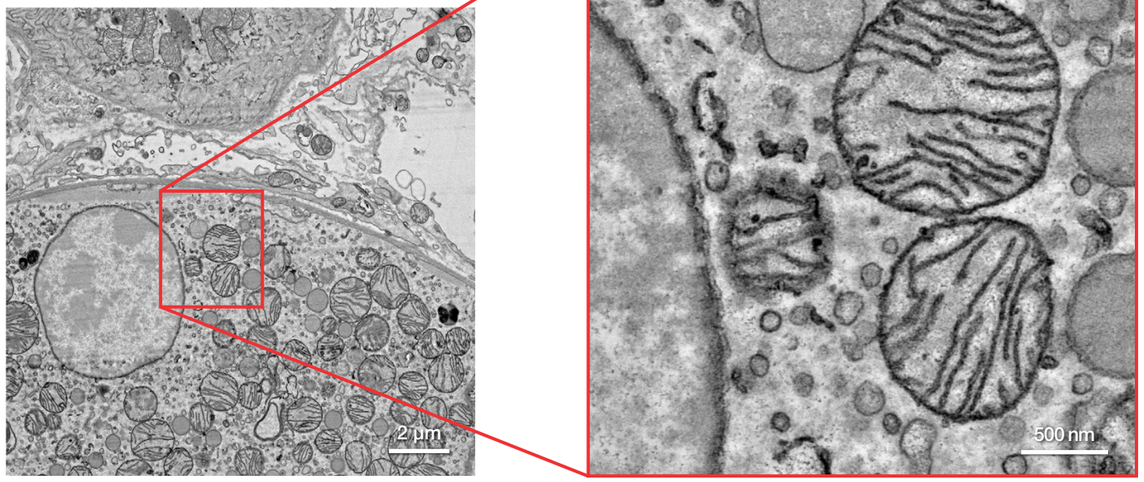


Figure 2: Examination of a 100-nm resin-embedded mouse liver tissue section at low magnification and quick zoom-in to a potential region of interest.

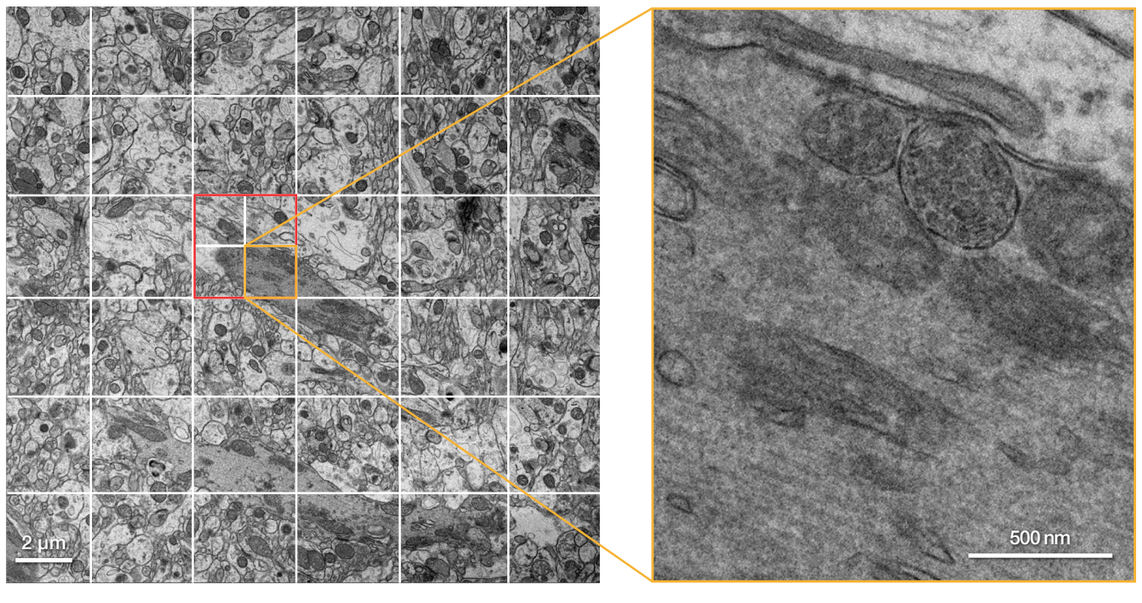


Figure 3: Imaging of a large area of brain tissue using tile stitching (left). Selected regions of interest (pink square) can be further imaged at a higher magnification to reveal intracellular structures at higher image resolution (right).

Capture and target cellular regions

The combination of electron microscopy with fluorescence light microscopy (CLEM) enables the localization of specific regions of interest within cells based on fluorescence labeling and subsequent visualization at nanometer resolution using electron microscopy.

The correlation of light microscopy and electron microscopy images is very easy and intuitive in the MAPS application software, which supports multiple image formats from different instruments. Users can focus on biological insights rather than wasting valuable time tweaking settings and handling images.

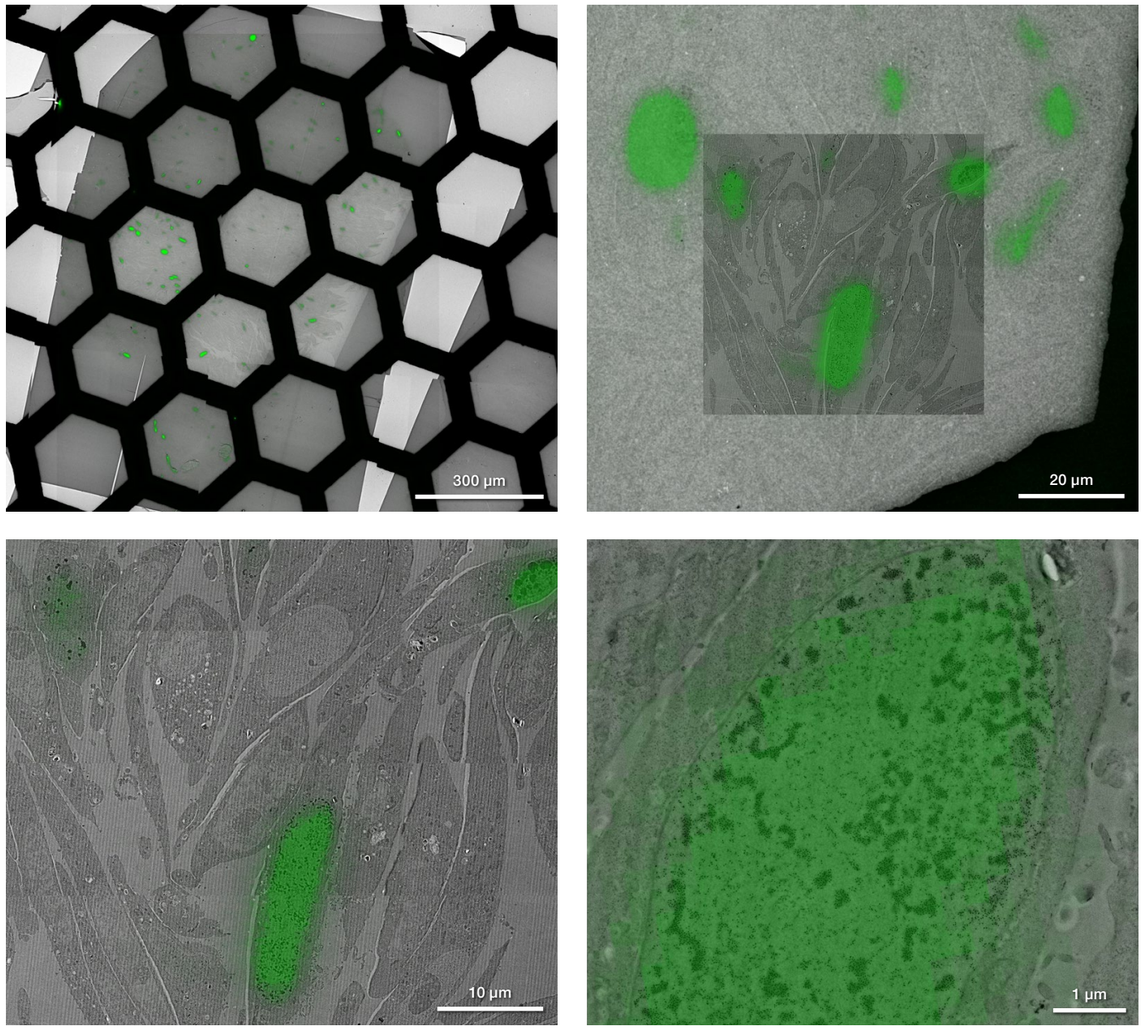


Figure 4: Identification and imaging of 2D regions of interest at different magnifications and image resolution using MAPS.

Gain insights into elemental composition

Compositional analysis using the optional energy dispersive spectroscopy (EDS) detector can reveal the elemental composition of selected regions of interest, such as different compartments and organelles within cells. The sensitivity of the EDS detector allows it to reveal elements despite the sample being embedded in plastic resin and stained with the heavy metals typically used in cell biology applications.

Additionally, elemental mapping enables the localization of specific regions with elevated concentration of selected elements, such as iron sequestered in ferritin cages, or other heavy metals in lysosomes and other compartments in the cell.

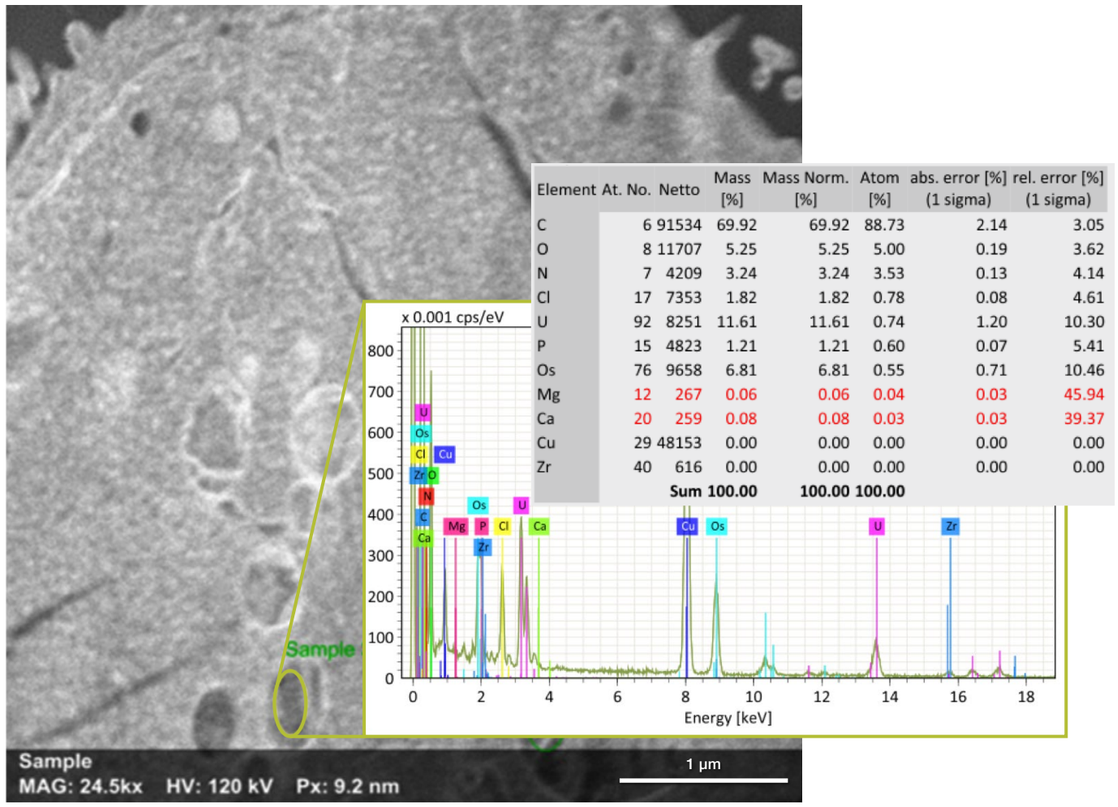


Figure 5: Elemental analysis of an organelle (mitochondrion) in a plastic embedded cell section reveals the presence of Ca and Mg despite the strong signal from the background carbon of embedding resin and heavy metals (Os, U) used for section staining.

Visualize 3D intracellular structures

Understanding of function of intracellular organelles, compartments and other structures often requires the visualization of their organization and interactions in 3D space. The Talos L120C G2 (S)TEM offers multiple software packages for the intuitive and automated collection of tilt series, tomogram reconstruction and segmentation to reveal the 3D shape and organization of imaged intracellular structures in the tomogram.

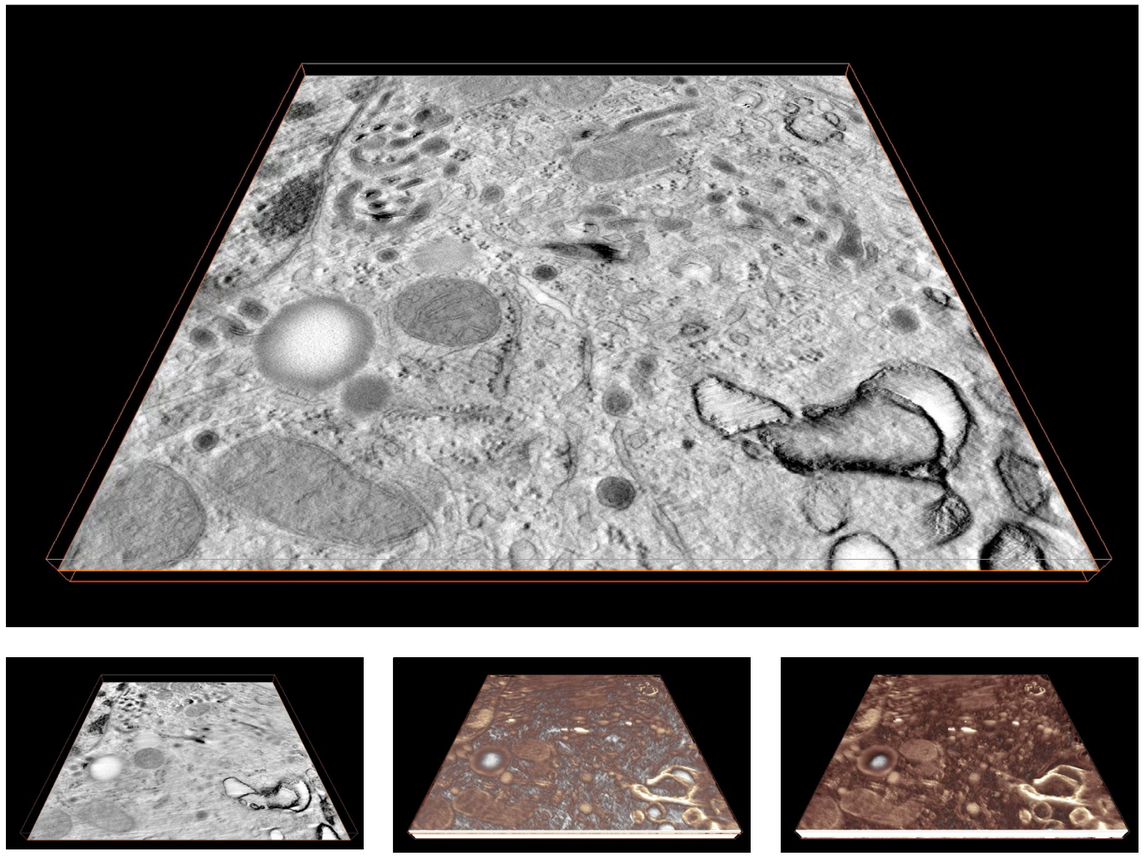


Figure 6: Reconstructed 3D tomogram of a 200-nm plastic section of a macrophage with density segmentation in Amira.

Characterize quality attributes of nanoparticles

The Talos L120C G2 (S)TEM is well suited for characterization of samples during process development in biotechnology. The imaging of individual particles at the nanoscale range enables direct determination of critical quality attributes, such as the size distribution of particles or occupancy of delivery vectors using either negative stain EM or cryo-EM techniques.

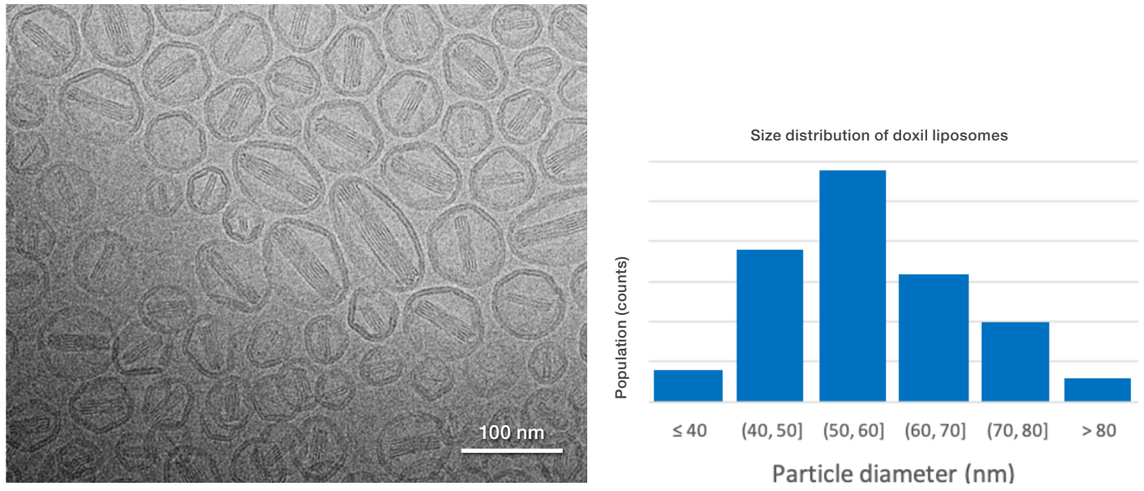
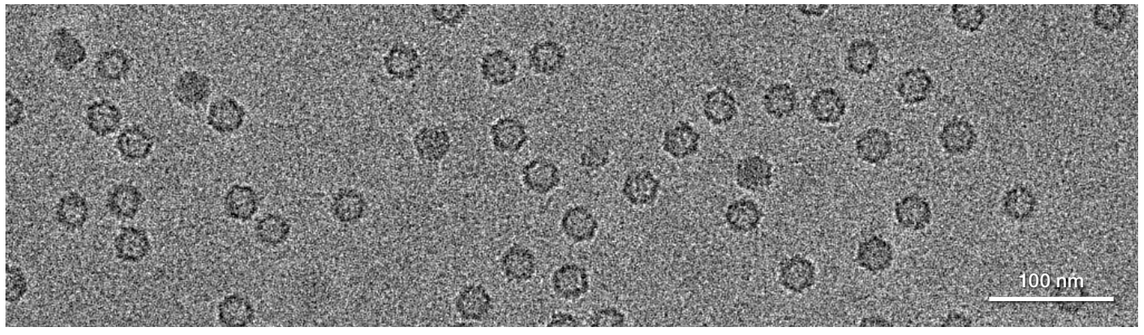
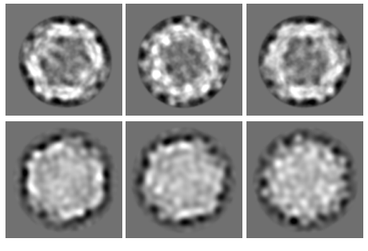


Figure 7: A typical cryo-EM image of a doxil liposome sample (left). Size distribution of individual particles was assessed by manual measurements and plotted in a histogram (right).





Classification	Particles	Fraction
Empty capsids	8789	94%
Filled capsids	573	6%

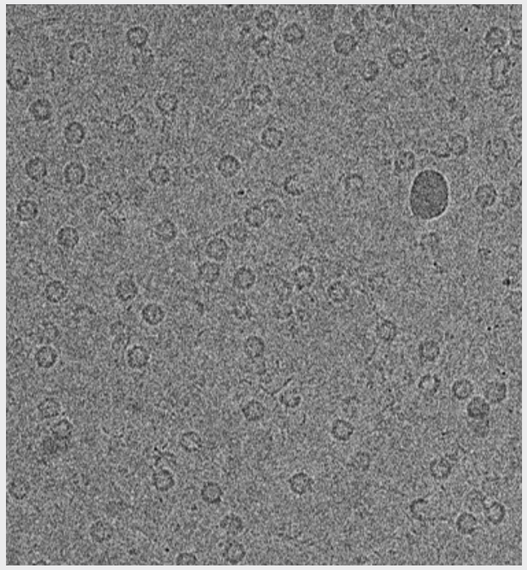
Figure 8: Determination of the fraction of filled and empty AAV-2 capsids by cryo-EM and two rounds of reference-free 2D classification in Relion 3.1.

Optimize samples for cryo-EM

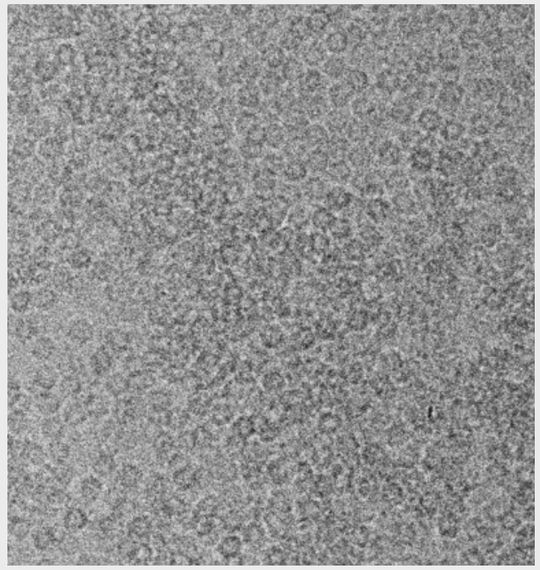
Cryo-EM enables determination of the 3D structure of regularly shaped proteins and macromolecules at high resolution using single particle analysis. However, sample quality remains the main bottleneck for achieving high resolution. The Talos L120C G2 is ideally designed to quickly assess the stability, homogeneity and concentration of purified samples using negative stain EM. With the flexible Talos L120C G2, users can additionally assess sample quality under cryo-EM conditions and optimize sample preparation for high resolution cryo-EM imaging in thin ice (such as ice thickness, density of particles, water-air interface artifacts, preferred orientation of particles and more).

"The Talos L120C is installed in the regular biochemistry lab next to other sample preparation equipment. Users can prepare samples there and directly load them in the microscope. We have found a good correlation between samples imaged in negative stain EM and in cryo-EM. The microscope is also a good training tool for new users as the working and user interface are very similar to the Krios G3 in the lab."

Dr. Dennis Thomas
Facility Manager, CSHL, Cold Spring Harbor, NY



Increase concentration



Optimize sample buffer

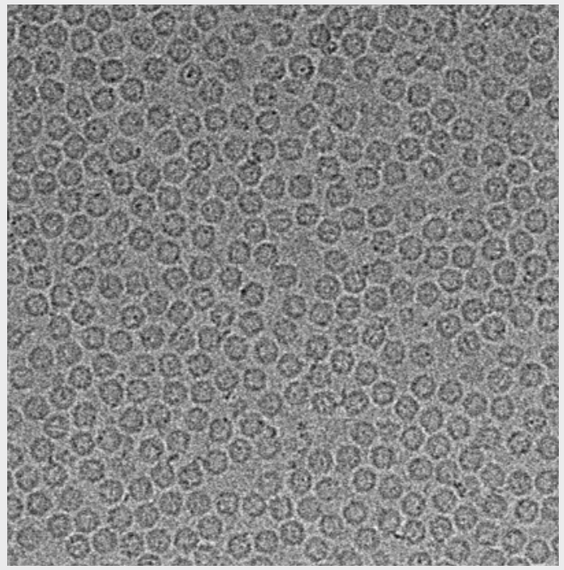
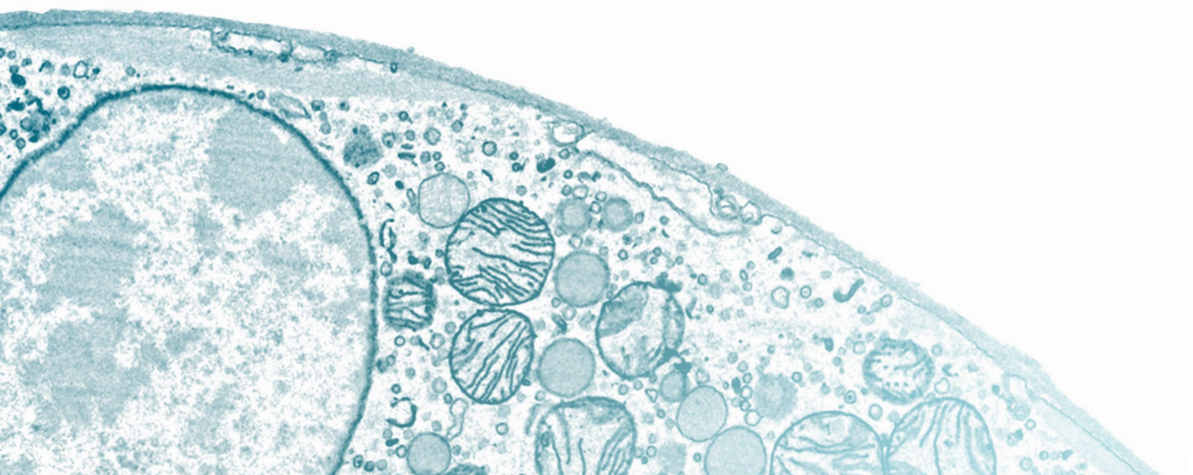


Figure 9: Optimization of purified apoferritin protein complex for high-resolution cryo-EM, either using Thermo Scientific protein concentrators to increase density of imaged particles in acquired images (left) or using Thermo Scientific VitroEase™ buffer screening kit to overcome particle aggregation in thin ice (right).



Reveal the molecular architecture of protein complexes

The 3D molecular architecture and inter-subunit interactions of protein complexes can be uncovered using single particle analysis, providing insight into the molecular mechanisms of their function. The Talos L120C G2 (S)TEM can resolve the 3D structure of protein complexes up to ~6 Å, at which individual protein subunits, their arrangement and interactions as well as internal fold structures can be determined.

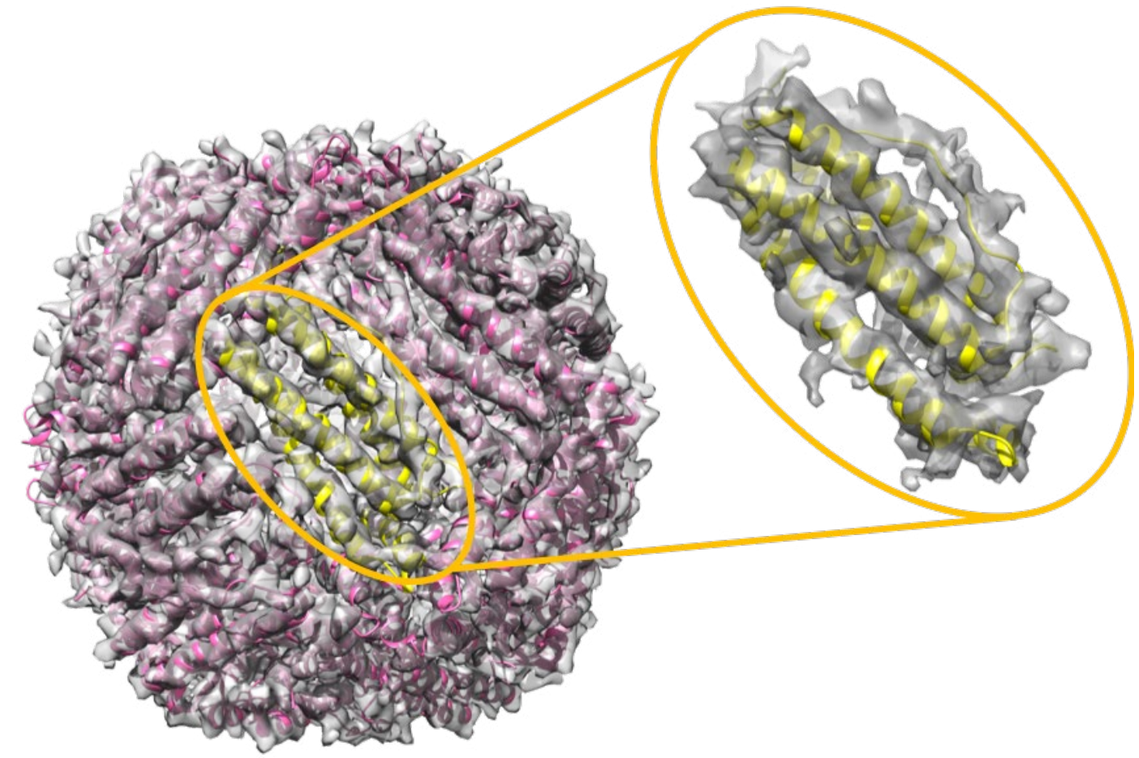


Figure 10: Cryo-EM map of human apoferritin reconstructed at 5.7 Å resolution using Talos L120C G2 equipped with Ceta-F camera. The cryo-EM map was fitted with the atomic model PDB-6WX6. the inset show extracted density of one apoferritin subunit.

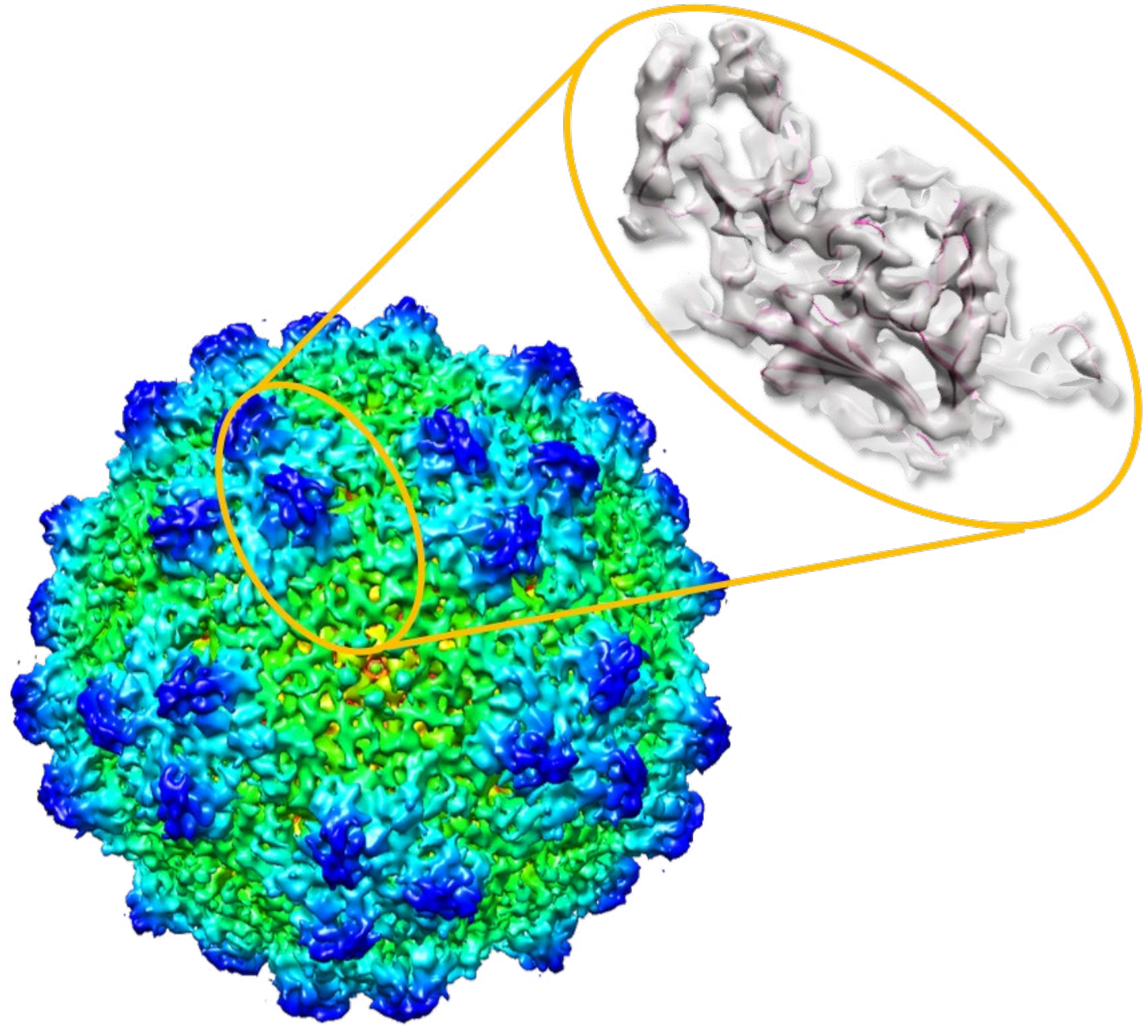
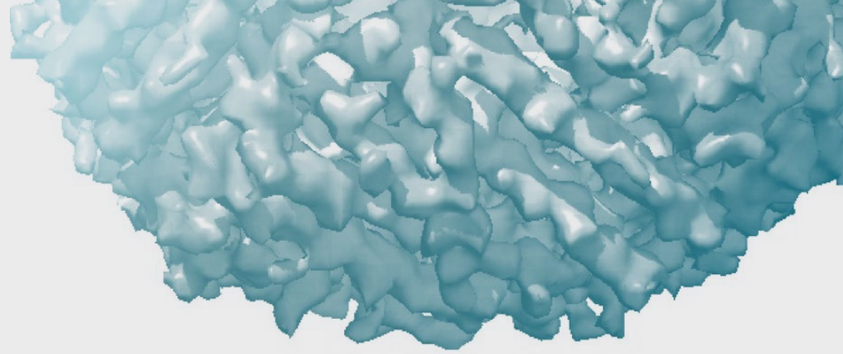


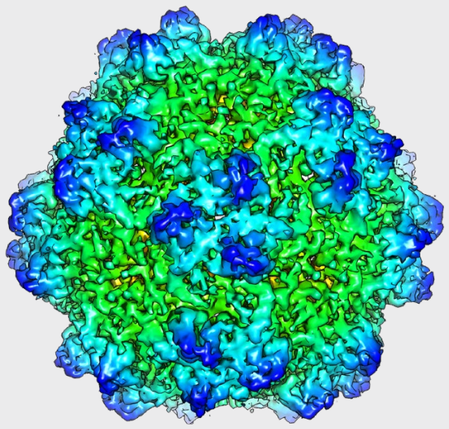
Figure 11: Cryo-EM map of AAV-2 capsid reconstructed at 6.8 Å resolution using Talos L120C G2 equipped with Ceta-F camera. The cryo-EM map was fitted with the atomic model PDB-6U0V. the inset show extracted density of one AAV subunit.

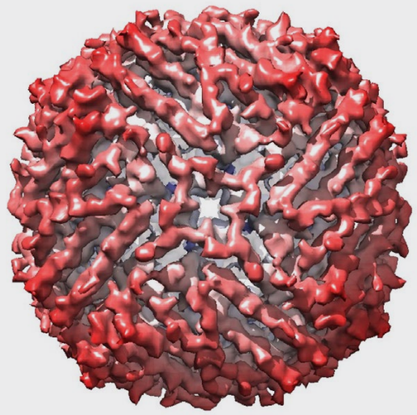


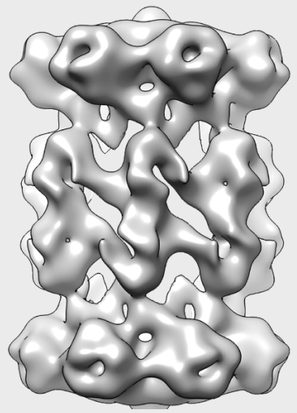
Uncover the structures of proteins and viruses

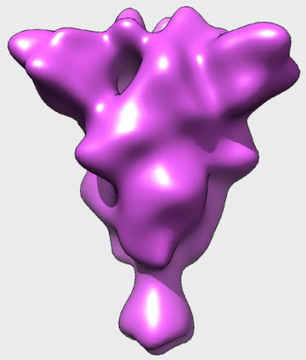
High symmetry assemblies

Macromolecular complexes





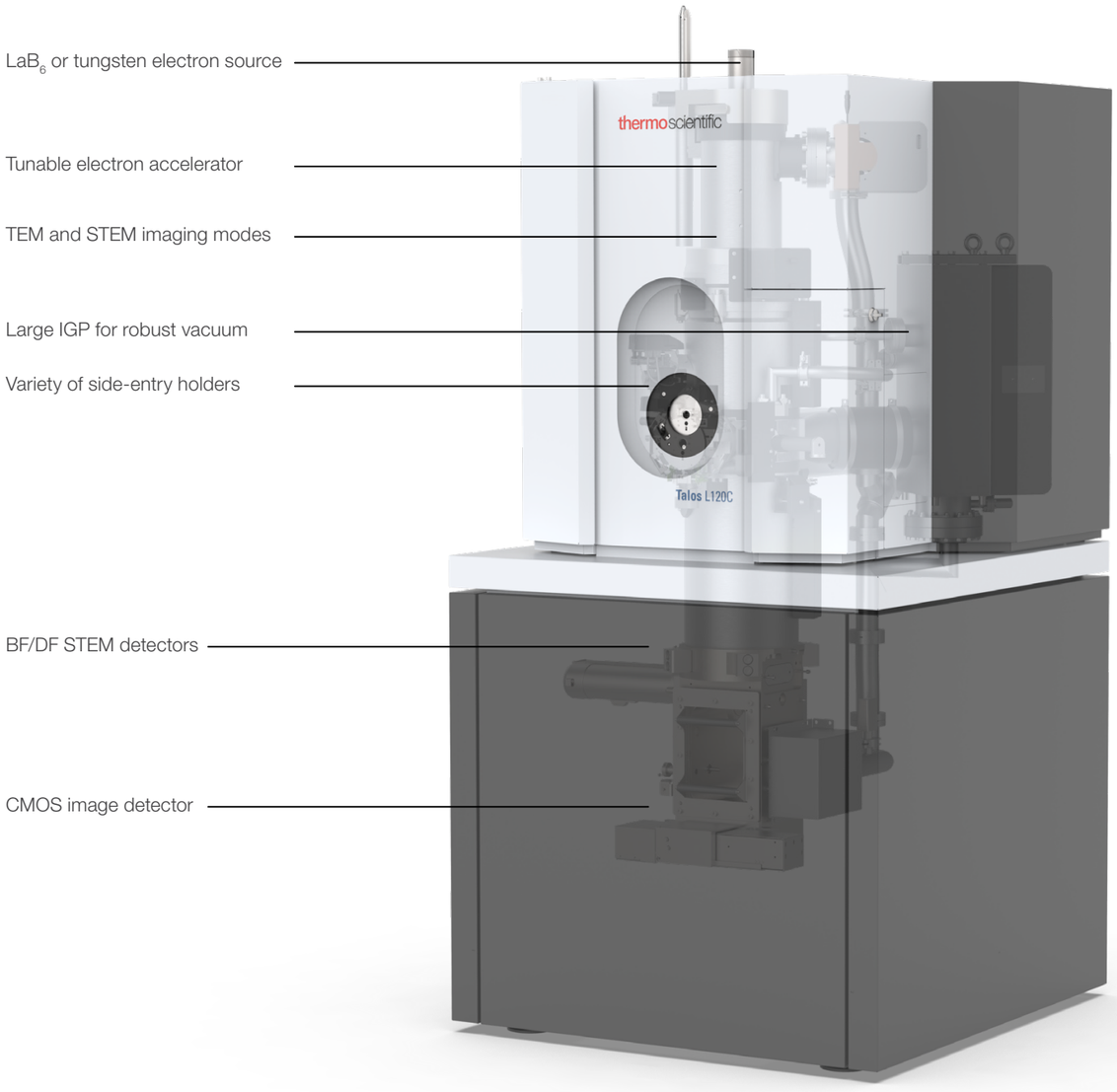




	AAV-2 capsid	Apoferritin	20S proteasome	SARS-CoV-2 spike
Molecular weight	3.8 MDa	444 kDa	750 kDa	438 kDa
Symmetry	Icosahedral (60 asu)	Octahedral (48 asu)	D7 (14 asu)	C3 (3 asu)
Camera	Ceta-F	Ceta-F	Ceta-S	Ceta-F
Pixel size	0.72 Å/pix	0.72 Å/pix	0.72 Å/pix	0.72 Å/pix
Dataset size	1050 movies	1314 movies	12 images	672 movies
Particles (picked/used)	~11k/~10k	~150k/~48k	~3500	~120k/~50k
Achieved resolution	**6.8 Å**	**5.7 Å**	**12 Å**	**12 Å**

Versatile multi-application (S)TEM microscope

Designed for routine TEM/STEM imaging and characterization of variety of samples including resin embedded cells, soft materials, nanoparticles or protein complexes.



Technical Highlights	
Electron source	Thermionic emission using LaB_6 crystal or W-filament
Accelerating voltage	Continuously adjustable acceleration voltage within 20-120kV
Optics	Constant-power objective lens for superior beam stability
Covers	Robust system enclosure for high system stability
TEM imaging	• Digital search-and-view camera for sample examination at day-light conditions • Standard Ceta16M CMOS camera with fast readout • Optimized Ceta-S or Ceta-F camera for low dose applications of beam sensitive samples • Optimized Ceta-D camera for microED applications
STEM imaging	• HAADF detector • Panther STEM (BF/DF) detectors with high sensitivity and increased redout speed
Application software	• Velox for fast 2D imaging with basic image processing • MAPS for 2D imaging of large areas (tile stitching, batch acquisition) • EPU for automated collection of single particle datasets • TOMO for automated collection of tilt series (batch acquisition)
Room dimensions	• Layout: 4.0 x 2.98 m (13.2 x 9.78 ft) • Ceiling: 2.6 m (8.53 ft)

"The high level of automation means productivity. Besides the automation, you get contextual information. I can see the entire tissue and know that the particular chloroplast I took a picture of, where it is in the tissue because I have the rest of the context. In the end, it strengthens the quality of the science that we can produce, when we have this kind of information coming through."

Dr. Kirk Czymmek
Director, Advanced Bioimaging Laboratory,
The Donald Danforth Plant Science Center, St. Louis, MO

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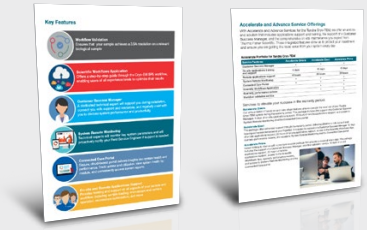
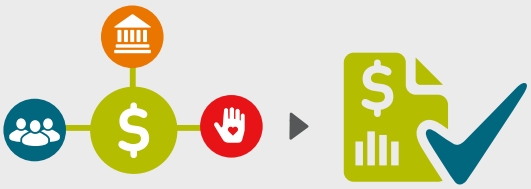
Additional resources



The pre-sale and post-sale customer care includes optional support for site preparation (both in existing and new facilities), site surveys and monitoring to meet the site requirements. Applications training and professional services are then available both on-site and remotely to facilitate fast startup and smooth EM facility operation.



The Electron Microscopy Funding Support Center offers technical content, resources, and proposal writing tools to help you acquire the research instrument you need.

Learn more at **thermofisher.com/Talos-L120C-TEM**