

# GIF Quantum ER System

## Model 965

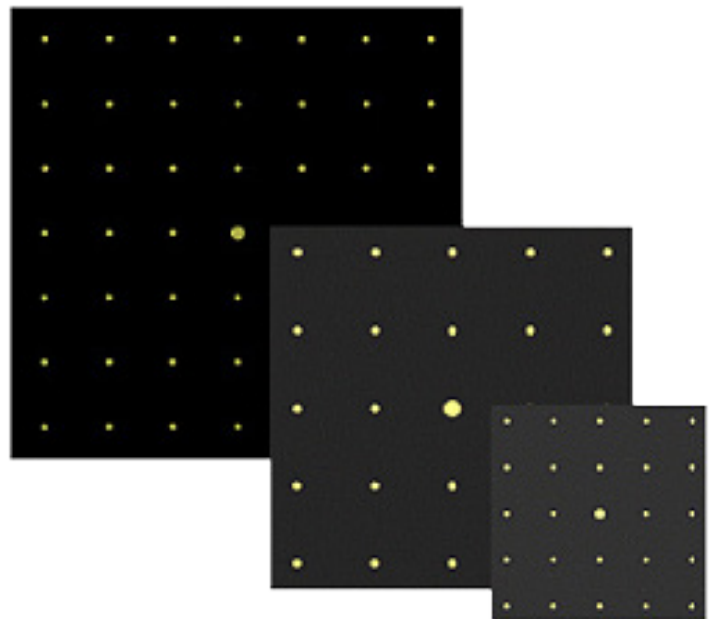
The GIF Quantum® ER imaging filter combines the best features of an energy filter with those of a dedicated electron energy loss spectroscopy (EELS) spectrometer. It is ideally suited to serve as the primary detector system for most analytical transmission electron microscope (TEM) / scanning TEM (STEM) systems.

As a spectrometer, high spectral resolution of the GIF Quantum ER system is well matched to both cold-FEG and some monochromated microscopes while the microsecond shutter and high speed detector take full advantage of the high beam current of a Schottky emitter. The 2.5 and 5 mm standard spectroscopy apertures of the GIF Quantum ER imaging filter fully support the high collection angles required for atomic column resolution EELS analysis, and the 1000 spectra/s, high speed EELS acquisition mode means you can make use of every electron that hits the sample. The integrated STEM detector of the GIF Quantum ER system ensures annular dark-field (ADF) and EELS collection angles are correctly matched.

The GIF Quantum ER system also excels as an imaging filter. The 9 mm entrance aperture provides an excellent field of view while the 5<sup>th</sup> order aberration correction keeps the total energy variation below 2 eV over that view. The overall effect is a profound simplicity of operation on any TEM system. By applying 3<sup>rd</sup> order correction, the total image distortion added by the image filter can be reduced to negligible levels yielding unsurpassed filtered imaging performance.

### Benefits

- **Electrostatic shutter:** Acquire images and spectra with unprecedented exposure control and dynamic range
- **1000 spectra/s:** High speed, dose-efficient STEM EELS spectrum imaging (SI) for detail rich mapping (SI mapping requires optional components)
- **9, 5 and 2.5 mm entrance apertures:** Large field of view energy-filtered imaging, mapping and diffraction with narrow slit widths. Improved collection efficiency for aberration corrected STEM EELS
- **Integrated bright and dark field (BF/DF) detector:** Optimized ADF and EELS performance
- **Dual-speed camera readout:** Low-noise imaging and high-speed viewing from the same detector
- **60 – 300 kV operation:** Broad range of operating modes and configurations
- **2000 eV EELS range:** Capture a broader range of edges in a single spectrum for simplified quantification



**Figure 1.** 7 x 7 alignment mask for the GIF Quantum ER system compared to the 5 x 5 mask for the GIF Tridiem® and GIF2000 systems. Masks are shown at the same scale (Image fidelity after 3<sup>rd</sup> order distortion tuning. Maximum distortion is 0.43%).

- **DualEELS™ upgrade:** Effortlessly measure precise energy shifts and apply advanced quantification routines for a new level of EELS analysis (optional)
- **Advanced auto tuning:** Confidence your imaging filter is operating at peak performance
- **Dodecapole-based optics:** Outstanding energy resolution and very low image distortions

### Applications

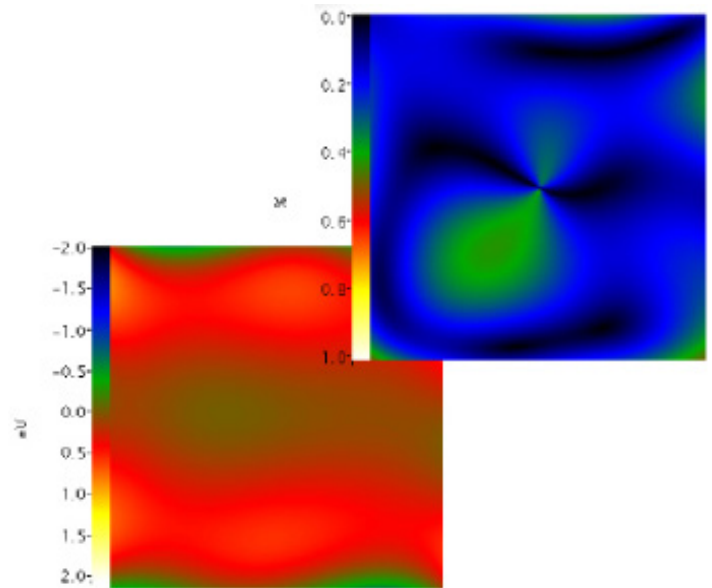
- Materials research
- Failure analysis
- Catalyst research

## Specifications

Primary setup energy (keV)	80	200	300
Entrance aperture sizes (mm)	9.0/5.0/2.5		
Slit width min. (eV)	0.9	2.0	2.9
Slit width max. (eV)	43	100	143
<b>Imaging mode</b>			
Mask image distortion RMS (%)	0.50		
Mask image distortion max. (%)	0.75		
<b>Non-isochromaticity (at selected energy)</b>			
Residual energy variation RMS (eV)	0.38	0.50	0.69
Non-isochromaticity max. (eV)	1.50	2.00	2.75
<b>Chromaticity/aberration (over energy range)</b>			
Chromatic distortion RMS (% over 50 eV)	0.40	0.25	0.25
Chromatic distortion max. (% over 50 eV)	0.50		
<b>Spectroscopy mode</b>			
Max. range on detector (eV)	810	2048	2048
Max. spectrum channels	2048		
<b>Energy resolution/stability</b>			
Filter resolution at zero-loss (eV)*	0.10	0.10	0.15
Filter resolution at 500 eV loss (eV)*	0.11	0.11	0.17
Filter thermal energy drift coefficient (eV/°C)	0.3	0.3	0.4

Specifications are subject to change.

\*Filter contribution of the total system energy resolution. Does not include electron source or environmental contributions. The final system resolution is typically a quadrature sum of all contributions. For example, a sFEG TEM with a 0.55 eV source and no environmental noise would expect a system resolution of  $(0.55*0.55+0.10*0.10)^{0.5}=0.56$  eV.



**Figure 2.** Right: Image fidelity after 3<sup>rd</sup> order distortion tuning; maximum distortion is 0.43%. Left: Energy fidelity after 5<sup>th</sup> order correction; maximum deviation is  $\pm 0.85$  eV (data recorded at 200 kV).

## Ordering

Model	Description
965	GIF Quantum ER system
<b>Options and upgrades</b>	
963.U3	DualEELS system
963.U4	High speed 2 kV spectrum offset module
777.U1	STEMPack™ system–BF/DF not included
777.U2	STEMPack system–high speed SI upgrade
806	High-angle annular dark field (HAADF) STEM detector system
702.90	Advanced AutoFilter® suite