

Quantum Diamond Microscope

Wide-field imaging of magnetic fields, with applications spanning electronic systems, geoscience, bio-imaging, materials characterization, and quantum research

Highlights

Image millitesla to nanotesla magnetic fields

Tunable spatial resolution down to less than one micron and field-of-view up to (4×4) mm².

Correlate magnetic and optical images

Collect magnetic and optical images of samples using the same optical system for straightforward co-registration.

Vector measurements

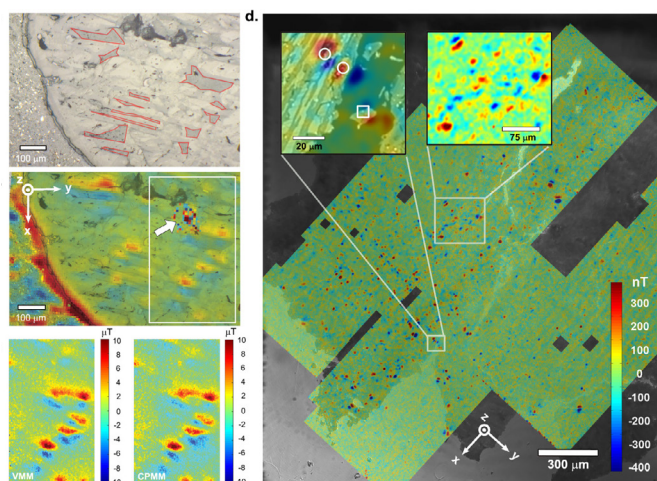
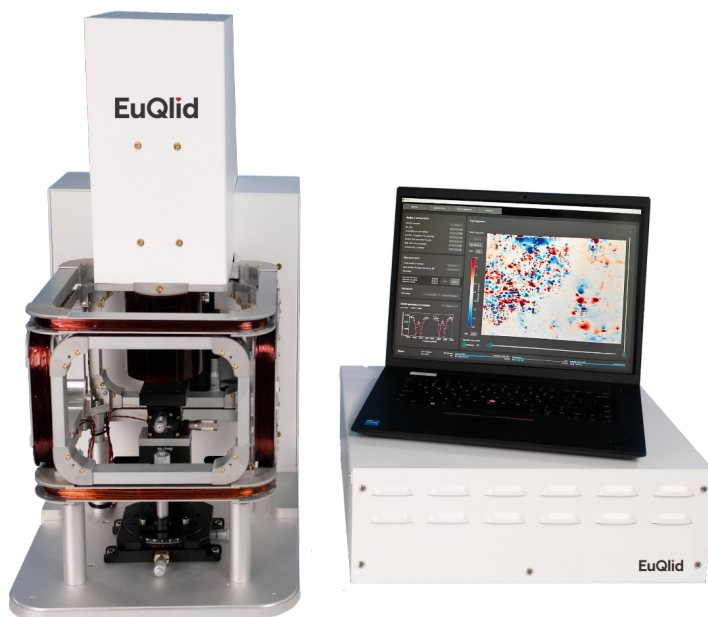
The NV-diamond sensor enables reconstruction of the magnitude and direction of magnetic fields, providing superior reconstruction of magnetic source distributions.

Quantum-grade diamond

Manufactured by QDM.IO partner Element Six, with properties optimized for microscale magnetic field mapping applications.

Robust and easy to use

Operates under ambient room conditions, with no cryogenics, vacuum systems, or special power requirements.



Imaging of a geological sample using a quantum diamond microscope. Reproduced from GGG, Vol. 18, Iss. 8, 3254-3267 (2017). DOI: 10.1002/2017GC006946

Operated using Ferrum

Easily configure measurements with Ferrum

Fully integrated software with an intuitive graphical user interface, including live visualization of data during acquisition.

Built from the ground up for wide-field magnetic imaging

Continuously updated with new features and supported by expert QDM.IO technical staff.

GPU-accelerated data analysis

Go from raw hyperspectral imaging data to magnetic field maps in seconds using a suite of GPU-based data analysis tools.

Specifications

Microscope

PERFORMANCE (TYPICAL)

Metric	Value
Magnetic Sensitivity	$< 5 \mu\text{T}/\text{Hz}^{1/2}$ (at $1 \mu\text{m}$ spatial resolution) , $< 200 \text{ nT}/\text{Hz}^{1/2}$ (at $10 \mu\text{m}$ spatial resolution)
Minimum Spatial Resolution	$\leq 1 \mu\text{m}$
Field of View (FoV)	Up to $(4 \times 4) \text{ mm}^2$ per FoV (larger samples can be imaged with tiling, motorized stages)
Operating Frequency	DC - 100 Hz
Dynamic Range	At least 0.2 mT

GENERAL

Dimensions (W x L x H)	500 mm x 350 mm x 620 mm
Cooling	Air-cooled
Vibration	Op. Theatre (ISO) or better
Weight	32.5 kg
Environment	$10^\circ\text{C} - 35^\circ\text{C}$, $<90\%$ R.H. (non-condensing)

Controller

Cable Length (to microscope)	$>1.8 \text{ m}$ (custom lengths available)
Operating Voltage	90-264 VAC, 50/60 Hz
Power Consumption	1200 W max. 400 W typical
Cooling	Air-cooled
Weight	9.5 kg
Environment	10°C to 35°C , $<90\%$ R.H. (non-condensing)
Dimensions (W x L x H)	480 mm x 420 mm x 135 mm (rack-mountable)

Three-Axis Bi-Polar Coil Current Supply

Cable Length (to microscope)	3 m (custom lengths available)
Operating Voltage	100-240 VAC, 50/60 Hz
Power Consumption	450 W max. 250 W typical
Cooling	Air-cooled
Weight	4.5 kg
Environment	10°C to 35°C , $<90\%$ R.H. (non-condensing)
Dimensions (W x L x H)	480 mm x 300 mm x 90 mm (rack-mountable)

Quantum Diamond Microscope

GEOSCIENCE

Paleomagnetic evidence for a long-lived, potentially reversing martian dynamo at ~3.9 Ga

SC Steele, RR Fu, MWR Volk, TL North, AR Brenner, AR Muxworthy, GS Collins, and TM Davison

Science Advances 9, eade9071 (2023).

DOI: <https://doi.org/10.1126/sciadv.ade9071>

Plate motion and a dipolar geomagnetic field at 3.25 Ga

AR Brenner, RR Fu, ARC Kylander-Clark, GJ Hudak, and BJ Foley

PNAS 119 (42), e2210258119 (2022).

DOI: <https://doi.org/10.1073/pnas.2210258119>

Micrometer-scale magnetic imaging of geological samples using a quantum diamond microscope

DR Glenn, RR Fu, P Kehayias, D Le Sage, EA Lima, and BP Weiss

Geochemistry, Geophysics, Geosystems 18 (8), 3254-3267 (2017).

DOI: <https://doi.org/10.1002/2017GC006946>

Solar nebula magnetic fields recorded in the Semarkona meteorite

RR Fu, BP Weiss, EA Lima, R. J Harrison, X-N Bai, SJ Desch, DS Ebel, C Suavet, H Wang, DR Glenn, D Le Sage, T Kasama, RL Walsworth, and AT Kuan

Science 346, 1089-1092 (2014).

DOI: <https://doi.org/10.1126/science.1258022>

LIFE SCIENCES

Single-cell magnetic imaging using a quantum diamond microscope

DR Glenn, K Lee, H Park, R Weissleder, A Yacoby, MD Lukin, H Lee, RL Walsworth, and CB Connolly

Nature Methods 12, 736-738 (2015).

DOI: <https://doi.org/10.1038/nmeth.3449>

Optical magnetic imaging of living cells

D Le Sage, K Arai, DR Glenn, SJ DeVience, LM Pham, L. Rahn-Lee, M. D. Lukin, A. Yacoby, A Komeili, and RL Walsworth

Nature 496, 486-489 (2013).

DOI: <https://doi.org/10.1038/nature12072>

Mapping the microscale origins of magnetic resonance image contrast with subcellular diamond magnetometry

HC Davis, P Ramesh, A Bhatnagar, A Lee-Gosselin, JF Barry, DR Glenn, RL Walsworth, and MG Shapiro

Nature Communications, 9(1): 131 (2018).

DOI: <https://doi.org/10.1038/s41467-017-02471-7>

CONDENSED MATTER, MATERIALS SCIENCE, AND ELECTRONICS

Imaging Viscous Flow of the Dirac Fluid in Graphene Using a Quantum Spin Magnetometer

MJH Ku, TX Zhou, Q Li, YJ Shin, JK Shi, C Burch, H Zhang, F Casola, T Taniguchi, K Watanabe, P Kim, A Yacoby, and RL Walsworth

Nature 583, 537-541 (2020).

DOI: <https://doi.org/10.1038/s41586-020-2507-2>

Magnetic Field Fingerprinting of Integrated-Circuit Activity with a Quantum Diamond Microscope

MJ Turner, N Langellier, R Bainbridge, D Walters, S Meesala, TM Babinec, P Kehayias, A Yacoby, E Hu, M Lončar,

RL Walsworth, and EV Levine

Physical Review Applied 14, 014097 (2020).

DOI: <https://doi.org/10.1103/PhysRevApplied.14.014097>

QUANTUM RESEARCH

High-Precision Mapping of Diamond Crystal Strain Using Quantum Interferometry

MC Marshall, R Ebadi, C Hart, MJ Turner, MJH Ku, DF Phillips, and RL Walsworth

Phys. Rev. Applied 17, 024041 (2022)

DOI: <https://doi.org/10.1103/PhysRevApplied.17.024041>

Characterisation of CVD diamond with high concentrations of nitrogen for magnetic-field sensing applications

AM Edmonds, CA Hart, MJ Turner, PO Colard, JM Schloss, KS Olsson, R Trubko, ML Markham, A Rathmill, B Horne-Smith

Mater. Quantum. Technol. 1 025001 (2021)

DOI: <https://doi.org/10.1088/2633-4356/abd88a>