

Volume Electron Microscopy



Paul Verkade



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What is volume EM?



Volume EM: The Quiet Revolution

The Structure of the Nervous System of the Nematode *Caenorhabditis elegans* (The Mind of a Worm)

J.G. White, E. Southgate, J.N. Thomson, and S. Brenner

Laboratory of Molecular Biology, Medical Research Council Center, Hills Road, Cambridge, CB2 2QH, U.K.

Phil. Trans. R. Soc. Lond. B (1986) 314: 1-340

doi: [10.1098/rstb.1986.0056](https://doi.org/10.1098/rstb.1986.0056)

PDF version of paper

(Received 9 August 1984 - Revised 12 November 1984)

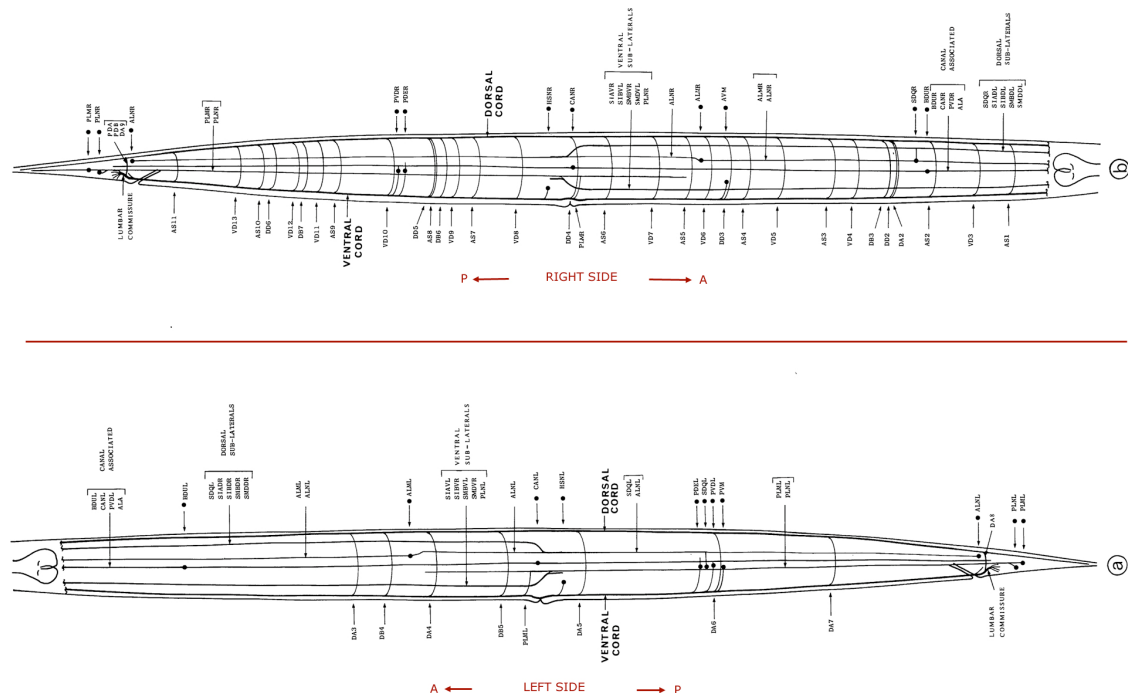


FIGURE 7. For description see opposite.

What is volume EM?



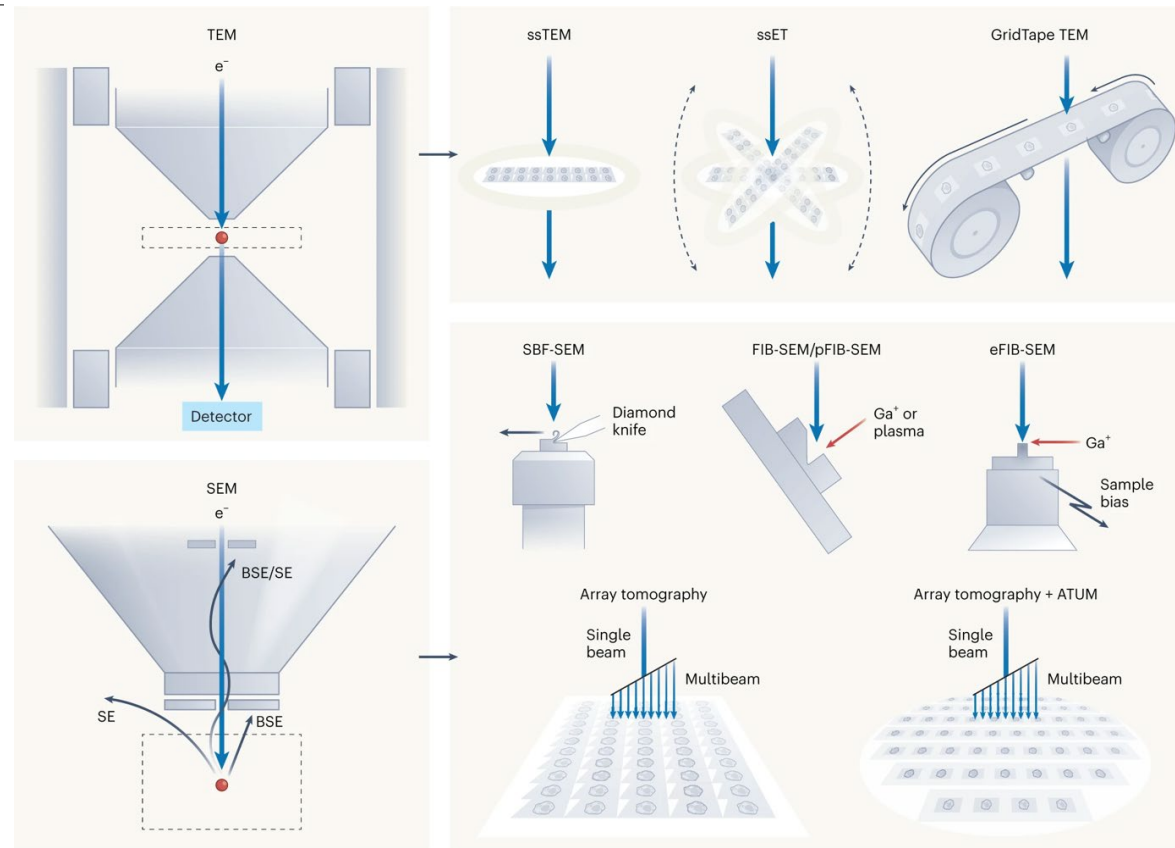
<https://doi.org/10.1038/s41592-023-01861-8>

Volume EM: a quiet revolution takes shape

Lucy M. Collinson, Carles Bosch, Anwen Bullen, Jemima J. Burden, Raffaella Carzaniga, Cheng Cheng, Michele C. Darrow, Georgina Fletcher, Errin Johnson, Kedar Narayan, Christopher J. Peddie, Martyn Winn, Charles Wood, Ardan Patwardhan, Gerard J. Kleywegt & Paul Verkade

Volume electron microscopy (vEM) is a group of techniques that reveal the 3D ultrastructure of cells and tissues through continuous depths of at least 1 micrometer. A burgeoning grassroots community effort is fast building the profile and revealing the impact of vEM technology in the life sciences and clinical research.

Collinson, L.M., Bosch, C., Bullen, A. *et al.* Volume EM: a quiet revolution takes shape. *Nat Methods* **20**, 777–782 (2023).
<https://doi.org/10.1038/s41592-023-01861-8>



What is volume EM?



<https://doi.org/10.1038/s41592-023-01861-8>

Volume EM: a quiet revolution takes shape

nature methods

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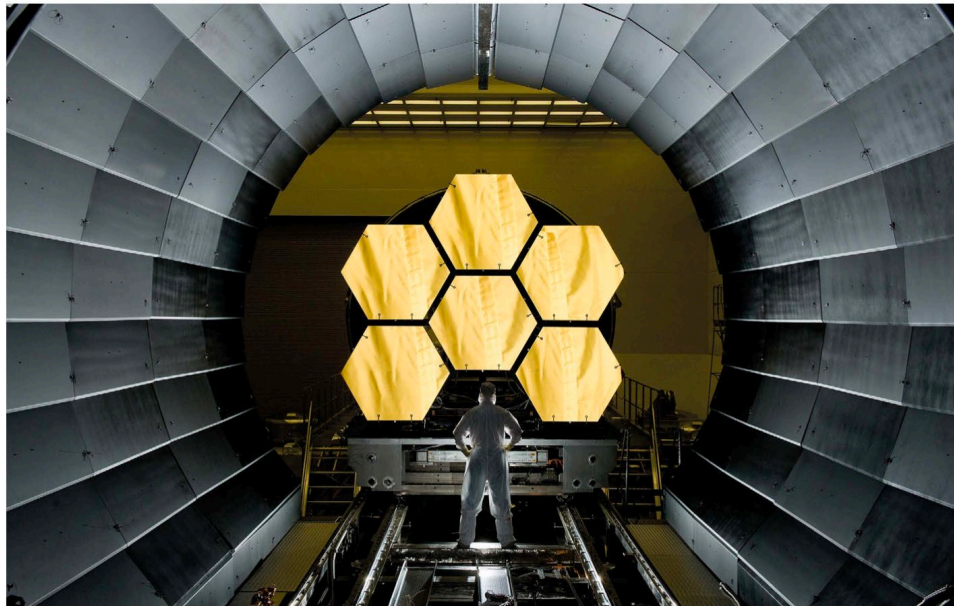
Volume electron microscopy (vEM) is a group of techniques that reveal the 3D ultrastructure of cells and tissues through continuous depths of at least 1 micrometer.

Collection of imaging approaches that use **transmission and scanning electron microscopy** to allow the interrogation of **cell and tissue ultrastructure in 3D**, at **μm to mm volume scales** and **nm resolutions**.

- Organelles and larger
- $1\ \mu\text{m}$
- Not molecular structure

Volume EM: A Quiet Revolution no more

Work / Technology & tools



The James Webb Space Telescope's 6.5-metre primary mirror (6 of 18 segments shown) can detect objects billions of light years away.

SEVEN TECHNOLOGIES TO WATCH IN 2023

Nature's pick of tools and techniques that are poised to have an outsized impact on science in the coming year. By Michael Eisenstein

Volume electron microscopy

Electron microscopy (EM) is known for its outstanding resolution, but mostly at the surface level of samples. Going deeper requires carving a specimen into exceptionally thin slices, which for biologists are often insufficient for the task. Lucy Collinson, an electron

“It’s probably on the same order of magnitude as the effort to map the first human genome.”

microscopist at the Francis Crick Institute in London, explains that it can take 200 sections to cover the volume of just a single cell. “If you’re just getting one [section], you’re playing a game of statistics,” she says.

Building a vEM community



Town Hall meetings



2019: First UK vEM Community Discussion

Lucy Collinson, Gerard Kleywegt, Ardan Patwardhan, Paul Verkade, hosted by the Wellcome Trust. To discuss state-of-the-art in VEM, gaps and bottlenecks, and community and infrastructure building.

2020: 2nd vEM Town Hall meeting, virtual

- Working Groups kick off meeting on Zoom.

2021: 3rd vEM Town Hall meeting, virtual

- 250 participants, international

2022: 4th vEM Town Hall meeting, virtual

- Application for Gordon Research Conference
- Chan Zuckerberg Initiative application

2023: 5th vEM Town Hall meeting, virtual

- Continue to build international reach
- CZI grant and GRC

2024: 6th vEM Town Hall meeting, virtual

- vEM Tech forum
- vEM community 5 years!

Building a vEM community



December 2020: 6 working groups established

vEM working group co-chairs
70+ WG members

VOLUNTEERS

Just imagine what we could do with proper support!



Jemima Burden



Chris Peddie

Community



Georgina Fletcher



Anwen Bullen

Outreach



Carles Bosch



Michele Darrow

Sample Prep



Kedar Narayan



Martyn Winn

Data



Raffa Carzaniga



Errin Johnson

Training

(Charles Wood)
(Chen Cheng)
Paul Verkade



Lucy Collinson

Infrastructure proposal

Building a vEM community



Chan Zuckerberg Initiative Award for vEM

Enabling Volume Electron Microscopy: Building a Global Community and Resources

Advancing Imaging Through Collaborative Projects

to accelerate the adoption of volume electron microscopy technology in the scientific community by building effective resources, expanding the global community, and emphasizing outreach and dissemination

- ▶ **Kirk Czymmek**
Donald Danforth Plant Science Center
- ▶ **Michele Darrow**
Rosalind Franklin Institute
- ▶ **Paul Verkade**
University of Bristol
- ▶ **Jemima Burden**
University College London
- ▶ **Georgina Fletcher**
The Royal Microscopical Society
- ▶ **Alice Liang**
New York University Langone Health
- ▶ **Martyn Winn**
Science and Technology Facilities Council
- ▶ **Anwen Bullen**
University College London
- ▶ **Leandro Lemgruber Soares**
University of Glasgow
- ▶ **Raffaella Carzaniga**
Francis Crick Institute
- ▶ **Chris Peddie**
Francis Crick Institute

Building a vEM community



vEM Technology Forum

22nd - 24th
October 2024



Early bird registration still open!



Financial support is available for early career and overseas visitors.

Session Topics will include:

- Multimodal and/or Correlative Imaging
- AI & Volume EM
- Future Technologies - What's on the Horizon?
- Big picture challenges - Calls to Action
- Microscopy Software or Hardware Technology Developments
- New Workflows for Microscopy or Data Analysis
- Sample Preparation Improvements
- Data Analysis/Data Processing Hardware and Software Automation & Scalability
- Translational vEM (medical, biomedical, models of disease)

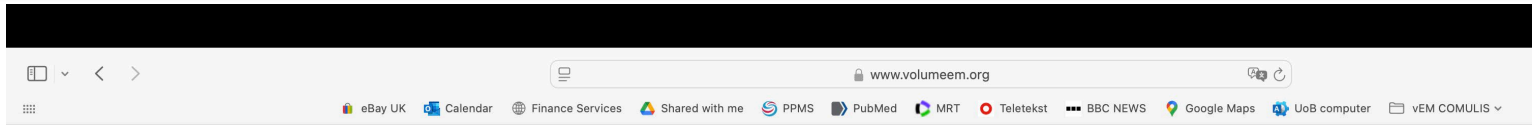
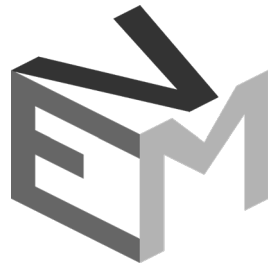
Sponsors:



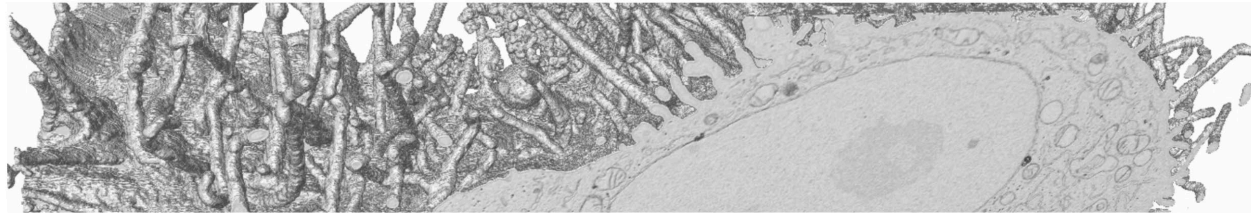
Challenge Panel Sessions:

- Volume EM Facility Management
- Data Struggles
- Sample preparation Challenges

Building a vEM community



[Home](#) [vEM explained](#) [Case Studies](#) [Resources](#) [Events](#) [Working Groups](#)



Quick Links

Top Resources

- [New! Looking for video volunteers](#)
- [Global vEM map](#)
- [Focal Plane vEM Blog](#)
- [vEM Virtual Pub](#)
- [vEM Monthly Newsletter](#)
- [News](#)

WORKING GROUPS



**FOCUSED INTEREST
GROUPS**



Welcome to the Volume EM
Community Website

