



Ten years of the CCP-EM Spring Symposium

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Here, we describe the first ten years of the CCP-EM Spring Symposium, an annual conference to bring together the cryogenic-sample electron microscopy (cryoEM) community to present and discuss the latest methodological advances and applications. We quantify the growth of the event and provide a detailed breakdown of the demographics of the tenth edition.

1. Introduction

The CCP-EM Spring Symposium conference was initiated in 2015 with the aim to provide a forum to highlight state-of-the-art developments in cryogenic-sample electron microscopy (cryoEM) methods (in particular computational) and related themes and to showcase outstanding recent biological applications. It is organized by the CCP-EM (Collaborative Computational Project for Electron cryo-Microscopy) core team and follows the successful domain-specific annual conferences organized by our fellow life-science CCPs: CCP4 (macromolecular crystallography), CCPN (NMR spectroscopy of biological molecules) and CCPBioSim (biomolecular simulation). We intended to provide a medium for the discussion of world-class science in an inclusive, friendly atmosphere, welcoming researchers from all career stages.

As well documented elsewhere (for example, Kühlbrandt, 2014), biomolecular cryoEM has witnessed a step change in usage by the structural biology field and depositions to the PDB have risen from a small minority to close to parity with macromolecular crystallography during the past decade (wwPDB Consortium, 2024). This has been driven by improvements in hardware, in particular direct electron detectors, software for motion correction and likelihood-based 3D reconstruction, and significant worldwide investment for the provision of instrumentation. Concomitantly, there has been a significant influx of researchers entering the field and the Symposium aims to ensure that they are welcomed and that new methods are presented in an accessible manner. As such, we have seen a tenfold increase in attendance from ~100 attendees in 2014 to ~1000 in 2024.

Due to the speed of development in the field the conference does not have a specific yearly theme; rather, external Scientific Organisers are asked to seek presentations from those who have the most impactful advances. Therefore, work is presented from across the field and has included instrument technology and sample preparation, software for image processing, single-particle reconstruction, tomography and model building by researchers from both academia and industrial sectors.

Since 2018 the meeting has been expanded to include the Diamond Light Source (DLS) Biological Cryo-Imaging (BCI) User Meeting and co-organized by DLS. This provides a forum for the UK national facility to highlight recent developments at eBIC (Electron Biology Imaging Centre) and B24 (correlative cryo-imaging beamline) and receive feedback from its user community. CCP-EM has also been fortunate to partner with the IUCr to publish an annual conference proceedings in *Acta Crystallographica Section D Structural Biology*. All speakers are strongly encouraged to contribute an article related to their presentation and proceedings papers are well read and widely cited; at the time of writing, *CCP-EM Proceedings* articles have an average of 71 Web of Science citations and 7408 views.

2. Growth of the CCP-EM Symposium

The first CCP-EM Symposium was held at the Rutherford Appleton Laboratory, Harwell, Oxfordshire over two days in May 2015. The Symposium, so called as a conference or meeting to discuss a particular subject in a convivial (or similar) manner,



Table 1

In-person and virtual attendees for ten editions of the CCP-EM Spring Symposium 2015–2024.

Virtual attendance is calculated from unique Zoom views across the entire event including the BCI User Meeting. The event ran with an informal hybrid format from 2015 to 2019; however, although the talks were streamed, the number of viewers was not captured.

Edition	Venue	Year	In-person	Virtual (unique views)
10	Nottingham EMCC	2024	366	833
9	Nottingham EMCC	2023	257	680
8	Nottingham EMCC	2022	150	917
7	Virtual	2021	—	900
6	Virtual	2020	—	2439
5	Nottingham Jubilee	2019	286	?
4	Keele	2018	180	?
3	RAL	2017	215	?
2	RAL	2016	159	?
1	RAL	2015	100	?

was attended by 100 in-person delegates primarily from the UK, with speakers from the UK, Czechia and Germany. From 2015 through to 2019 the presentations were live-streamed for those unable to physically attend; however, no attendance figures were able to be recorded by the video-conference platform used then. The Symposium continued at the RAL site for the following two years, but as attendance grew above 200 (see Table 1) a larger, external, venue was required from 2018. From 2019, external scientific organisers were sought to ensure a broad and impartial range of topics and speakers and the conference had grown to close to 300 in-person delegates, reflecting the increasing interest in the field. During the COVID-19 pandemic it was no longer safe nor suitable to host physical events, so with the aid of STFC Digital Infrastructure (DI) the conference pivoted to online-only using the Zoom video-conferencing platform. This provided a valued way to bring the cryoEM community together in challenging times, and the conference was attended by over 2000 delegates. Post-pandemic, the conference moved to a hybrid format from 2022, offering in-person or virtual attendance via Zoom. Attendance is open (on a first-come first-served basis for in-person delegates) and unlimited and free for virtual delegates. We reduced the number of speakers such that the physical event can provide extensive breakout time for face-to-face networking whilst retaining virtual attendance to enable those unable to travel to participate. Care is taken by session chairs to ensure that questions are fielded from both audiences. In-person attendance has grown steadily since 2022, and the 2024 edition had the largest in-person audience to date, testament to the sustained interest in cryoEM method development.

3. Statistics for the 10th Anniversary CCP-EM Symposium

In 2024 CCP-EM celebrated the tenth edition of the CCP-EM Spring Symposium, held at the East Midlands Conference Centre (EMCC) in Nottingham; it was attended by 366 in-person delegates, the most to date, and the lectures received 833 unique views on Zoom (Table 1). Notably, virtual attendees spent a mean time in session of over 5 h (Fig. 1*a*), illus-

trating that the majority attended multiple talks and sessions. Comparing in-person and virtual attendees, using student and standard registration types as rough indicators of career stage, early-career researchers and students made up a very similar proportion of both attendee types at 41% and 43%, respectively (Fig. 1*c*). CCP-EM aims to make the Symposium accessible to those in both earlier and established careers by providing registration-fee and accommodation bursaries, a range of conference accommodation rates and lowering the registration fees with support from sponsorship, commercial income from industrial licence holders and contributions from MRC core funding. CCP-EM is able to provide bursaries

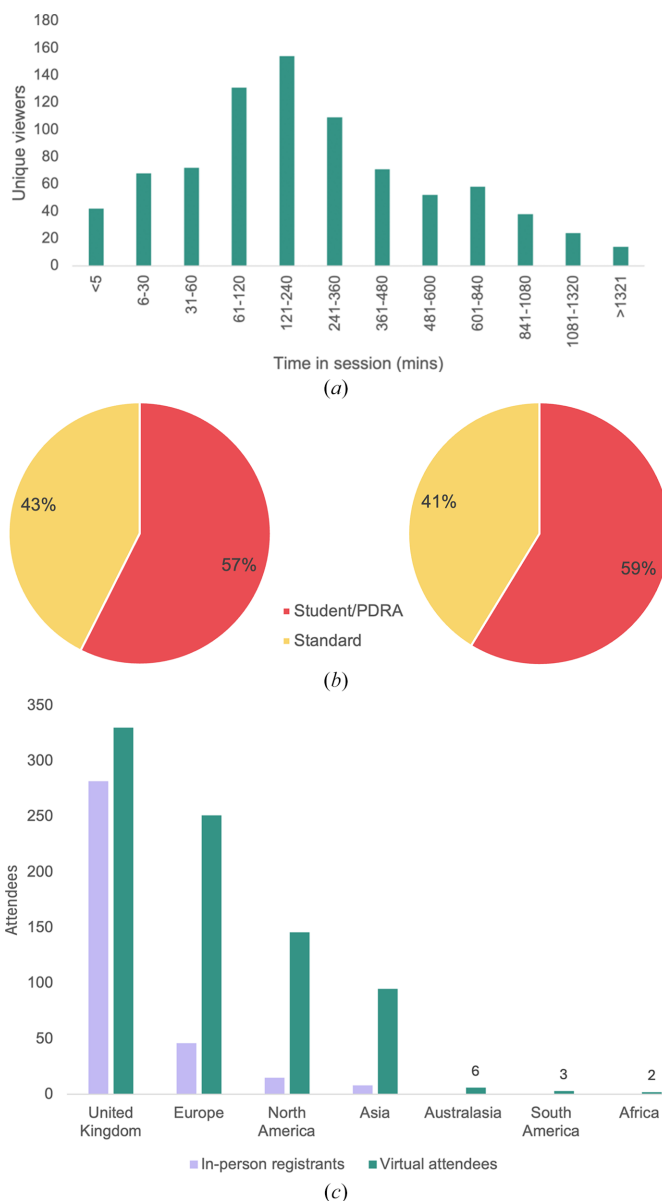


Figure 1 Attendance of the 2024 CCP-EM Spring Symposium. (a) Time in session (minutes) of unique viewers on Zoom across the three days including the BCI User Meeting and Spring Symposium. The mean time in session was over 5 h. (b) Career stage of virtual delegates (left) and in-person delegates (right), not including speakers, organisers and UKRI staff. (c) In-person versus virtual (unique Zoom viewer) attendance by location.

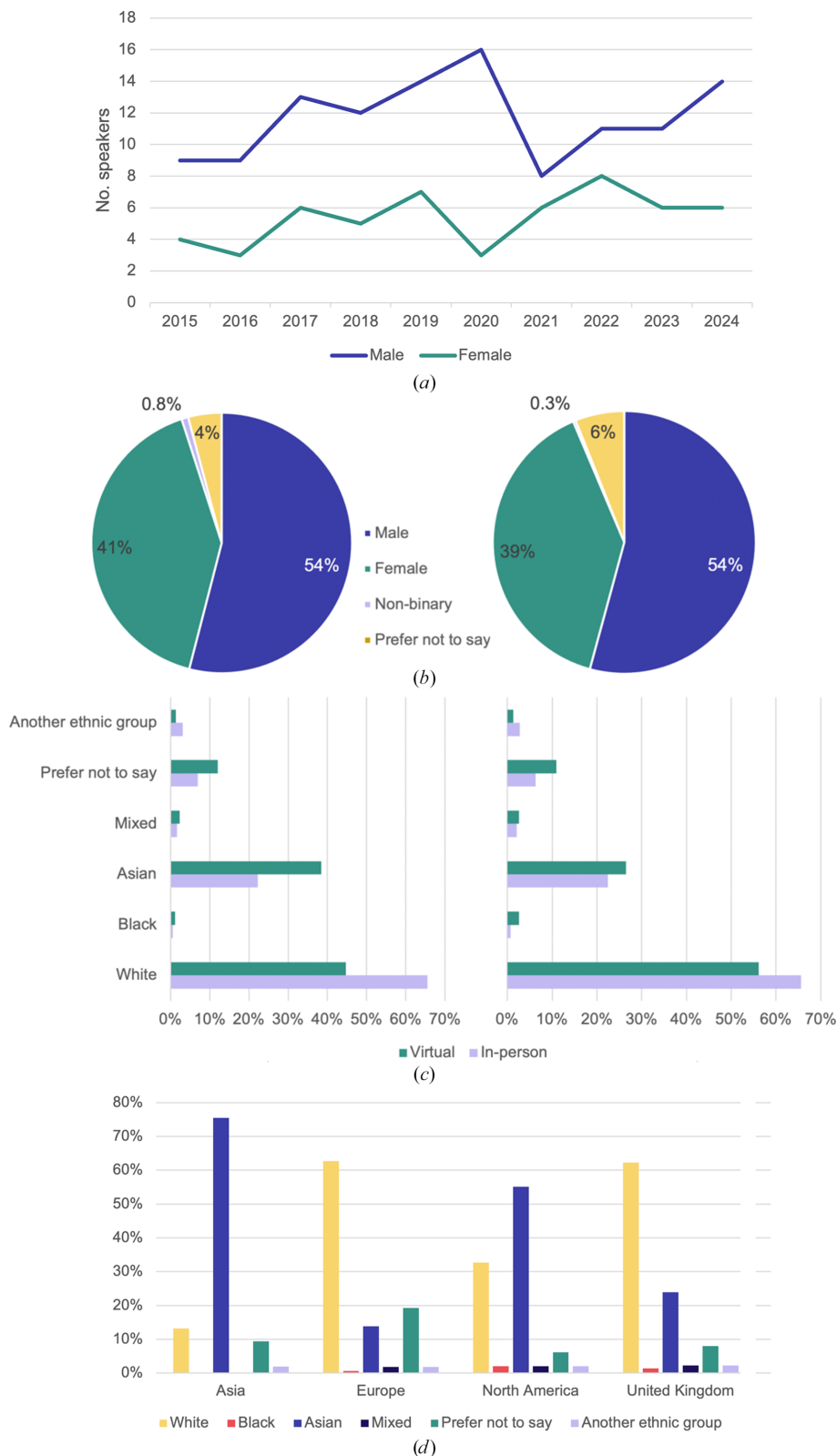


Figure 2

Diversity statistics for the CCP-EM Spring Symposium. (a) Gender balance of speakers at the Spring Symposium (not including the BCI User Meeting) from 2015 to 2024. (b) In-person (left) and virtual delegate (right) gender distributions at the 2024 Spring Symposium and BCI User Meeting (from registration data). (c) Virtual versus in-person delegate ethnicity at the 2024 Spring Symposium, from all delegates registration data (left) and from delegates working in the United Kingdom (right). (d) Delegate ethnicity by continent, including registration data from both virtual and in-person delegates. The categories listed on the registration form were as follows: White (includes any White background); Asian or Asian British (includes any Asian background, for example, Bangladeshi, Chinese, Indian, Pakistani); Mixed or multiple ethnic groups (includes any Mixed background); Black, African, Black British or Caribbean (includes any Black background); Another ethnic group (includes any other ethnic group, for example, Arab); Prefer not to say.

due to the support of event sponsors, and in 2024 CCP-EM awarded 20 such bursaries.

The 2024 Symposium had broad reach and was attended by delegates from six continents, with virtual attendees from six and in-person delegates from three (Fig. 1c). As expected, most in-person delegates worked in the United Kingdom and Europe, and this likely relates to the travel time and expense of attending the conference for those based further afield. There were relatively few virtual attendees from Australasia, South America and Africa, which could be due to the time difference. With the speaker's consent, talks from the Symposium are recorded and uploaded to the CCP-EM YouTube channel to be viewed by those who were unable to stream them in real time; YouTube views are not included in the above statistics. Links to playlists for this, and previous editions, are available on the CCP-EM website: <https://www.ccpem.ac.uk/symposium/>.

A welcoming and inclusive ethos is a central tenet of the conference. Fig. 2(a) provides a historic gender breakdown of speakers at the CCP-EM Spring Symposium; there has been a greater proportion of male speakers across all years. Since 2019, at least one of the two scientific organisers formally appointed each year has been female. This was influenced by a 2017 study by Kalejta and Palmenberg, which demonstrated that better female representation on speaker-selection committees improves gender parity (Kalejta & Palmenberg, 2017). The Symposium does not have target quotas for speaker diversity, but the scientific organisers are tasked with inviting a broad range of speakers with regard to location, ethnicity, career stage and gender.

The gender balance is very similar between in-person and virtual delegates (Fig. 2b). One inference that could be drawn from this is that gender is not a barrier to in-person attendance. The gender balance of symposium attendees is likely to be representative of the wider cryoEM community. Fig. 2(c) (left) shows the ethnic distribution for all in-person and virtual attendees and there is a noticeable difference in distribution. To decouple from geographic location, the attendance distribution is also shown for UK-based researchers only in Fig. 2(c) (right). Virtual attendance aids inclusivity by removing the financial cost and the need to travel, thereby also reducing environmental impact. We regret that some ethnicities currently have lower representation and we aim to improve this in future editions. Per-continent ethnic distribution is shown in Fig. 2(d) (note that Africa and Australasia are not included here due to low sample numbers) and again we

suggest that this can be used as an indication of the ethnic diversity of the field at present.

4. Future perspectives

CCP-EM has been delighted to observe and help contribute to the incredible growth in the field since 2014 and we plan to continue organizing the Symposium on an annual basis for the foreseeable future. Indeed, there are many exciting avenues for method development currently being explored including, but not limited to, tomography and *ex vivo* cryoEM/T, heterogenous reconstruction methods to reveal multiple conformations and compositions, increased automation for data processing and improvements in atomistic models for ligand complexes and larger structures, as well as imaging and computational hardware improvements. We look forward to many of these exciting developments being recorded in the proceedings virtual issue of *Acta Crystallographica Section D*. We hope to emulate the longevity of the CCP4 Study Weekend conference, which was first held in 1979 (Agirre & Dodson, 2018) and continues to this day. We are excited to follow their success and relish the thought of the potential advances in electron microscopy by 2060.

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