

Around the hybrid conference world in the COVID-19 era

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In-person and online conferences each have their benefits, with hybrid conferences intended to blend the best of both worlds. But do hybrid conferences fulfil the promise? Fifteen attendees across three global conferences share their collective experiences.

In the quest for improvements to the future of collaboration, we have seen the global academic community optimistically turn its gaze to hybrid formats as a way to balance the desire for in-person interaction against the imperative to be more inclusive, sustainable, and accessible in a volatile world. In Moss et al.¹, the challenges of effective hybrid

interaction were discussed with the recommendation of digital-first design as a way of increasing the viability of hybrid meetings (which we define as meetings with some combination of in-person and virtual attendance).

Now, many months and many conferences later, we have an opportunity to reflect on contemporary manifestations of hybrid meetings, their benefits and their pitfalls, and assess where we are as a community in our journey towards a ‘new normal’. The week of 27 June 2022 was a unique one in this context, as three conferences with varying degrees of hybridization took place in different parts of the world, each with a different scale, approach, and community (Fig. 1).

Focused on the radio-quiet site of the Green Bank Observatory (GBO) in the United States, 50 people gathered mostly in person to discuss and explore the latest status of the field of [high velocity clouds](#) (hereafter referred to as HVC). Across Australia in a few local hubs and



Fig. 1 | Representative images from each conference. **a**, Online attendees shown visibly on the large screen in the core ASA hub in Tasmania. **b**, In-person institutional (that is, not at the main hub in Tasmania) gathering for the ASKAP prize talk of ASA. **c**, Photo of the exhibition area of EAS in Valencia. **d**, photo of HVC attendees during the Green Bank Telescope tour. **e**, Screenshot from online attendance of HVC with camera view of in-person presentation. Credit: Aidan Hotan (panel a), Vanessa Moss (panels b and e), Jay Lockman (panel d) and EAS (panel c).

Box 1

Key conclusions for enacting a hybrid model

- Conferences with an in-person component should always be hybrid in order to meet the goals of being a global and inclusive scientific field.
- Hybrid can be achieved with low effort and low budget if necessary, with sufficient volunteer support and appropriate design.
- A functional hybrid format should allow an online attendee to participate rather than be treated as a passive second-class observer.
- Conference organizers and session chairs have an important role to play in proactively minimizing the gap between in-person and online attendees.
- Effective use of technology is critical in assisting with bridging the gap in hybrid audiences.
- Hybrid can be done well with a digital-first approach that does not focus on either in-person or online modes exclusively.

online, more than 300 members of the astronomical community came together under the umbrella of the [Astronomical Society of Australia](#) to share their latest results and developments (hereafter, ASA). And in Europe, after two years of online-only gatherings, almost 2,000 astronomers converged primarily in Spain for the [European Astronomical Society's annual science meeting](#) (hereafter, EAS).

In this Comment, we explore the various ways in which the hybrid aspect was realized for these meetings, and highlight key lessons learned to share with the broader astronomy community (Box 1). To ensure we have captured the breadth of experience associated with each meeting and with a particular mode of attendance, we collectively represent attendance of each meeting via various modes including in-person, online-only, in a blended format, or, if relevant, at a hub (Table 1), and present our perspectives of the conference experience. Where possible, we also collectively represent diversity across various factors including seniority, gender, background, expertise, and location.

It is true that worldwide, across many disciplines and industries, we are still in the process of empirically determining what will eventually become best practice for hybrid gatherings, and there is no single solution that works for all circumstances. By highlighting some of the nuances encountered in each of the hybrid conferences captured here, we aim to contribute to the ongoing improvement of meeting formats in academic collaboration.

When and why should we gather in person?

Across our combined perspectives on each of the three conferences, it was widely acknowledged that in-person interaction has clear value to offer to the academic community. In particular, the role of meeting in person was emphasized for facilitating introductions of new people, interaction between junior and senior members of the community, informal unstructured discussion and serendipitous encounters with what are described in sociology as 'weak ties'². While it is important to enable a contextual introduction to people's work as a motivator for further interaction, it seems less clear now that this should happen

predominantly in the form of talks and parallel sessions, as has been done in the past. That noted, it was seen as critical that content showcased at meetings especially highlights the work of early-career researchers (ECRs) who benefit most from the exposure of their results.

In the case of HVC, the talks were an appreciated mechanism to frame and inform the considerable number of unstructured discussions throughout the meeting, while for ASA and EAS, the use of parallel sessions had the advantages of providing more opportunities to present work (especially of early and mid-career researchers) and enabling exposure to diverse research, while having potential drawbacks of inhibiting cross-field interaction, creating attendance conflicts, and overwhelming people with significant amounts of content. In a world of increasingly blended formats, an antidote to the ever-increasing contributions of a growing community may be to consider shifting programme elements to before or after a focused synchronous meeting. ASA successfully ran a meet-a-mentor session one week prior to the conference itself, and some conferences have demonstrated that pre-recorded presentations can precede the more interactive, discussion-focused parts of a conference. For example, the role of a session chair could be to provide a high-level summary of pre-recorded material to begin an unstructured discussion session, or online engagement with short recordings distributed in advance could be used to determine which talks or topics are given a longer platform at the live conference.

Despite being a standard and potentially valuable networking mechanism, we found posters were generally not integrated well across in-person or online modes. ASA proactively implemented optional 30-second pre-recorded poster talks, which were scattered throughout the sessions and played back by chairs. Unfortunately, in practice, the lack of an advertised schedule and technical playback issues reduced the effectiveness of this approach. Posters were not given a central role in any of the three hybrid cases, and as such, the level of exposure for those who were presenting posters was low. To improve on this, poster sessions need to be explicitly scheduled and made available to both online and in-person audiences with posters given adequate space and exposure as part of the meeting. Technology blurs the boundaries between talks and posters, with both potentially containing rich media assets, and so the future distinction between talk and poster may only reflect the delivery mode. Alternative avenues other than talks and posters for presenting results should also be explored to better suit the modern era.

On the importance of a suitable location

For an effective hybrid meeting, choosing a location is critical in terms of access to adequate infrastructure to support the bridging of the in-person and online communities. Local astronomical/university facilities were used for both HVC (the Green Bank Observatory) and ASA (University of Tasmania's main campus as core hub, plus other university-based hubs across Australia), which had the benefits of minimizing costs in a relatively flexible and familiar setting. Conversely, EAS, due to its scale and recent growth, needed to make use of a large conference venue, which resulted in significant restrictions (and cost limitations) around the use of technology. These costs could be lowered by reducing the scale of the meeting, potentially by shifting digital-compatible content online. The use of hubs in the case of ASA was a positive outcome in the context of sustainability, although around 115 attendees still travelled to Tasmania (producing approximately 100 tonnes of CO₂-equivalent emissions, while hubs prevented 100 tonnes due to local attendance). In all cases, the use of a hybrid mode

Table 1 | Overview of attendee perspectives

Location	Position	Conference	Planned mode	Attended mode	Cost (AUD)
Sydney, AU	Staff	ASA; EAS; HVC	Online; Online; Online	Online; GA only; Online	50; 0; 0
Hobart, AU	Staff organizer	ASA	In-person (Tasmania)	In-person (Tasmania)	500
Brisbane, AU	Student	ASA	In-person (Queensland)	In-person (Queensland)	240
Sydney, AU	Student	ASA	Online	Online	50
Brisbane, AU	Student	ASA	In-person (Tasmania)	In-person (Tasmania) + online	4,640 ^a
Perth, AU	Postdoc	ASA	In-person (Perth)	In-person (Perth)	107 ^b
Barcelona, ES	Staff	EAS	In-person	In-person	1,528
Garching, DE	Staff	EAS	Online	GA only	0
Amsterdam, NL	Staff	EAS	In-person	Online	1,513
Heidelberg, DE	Staff	EAS	In-person	In-person	2,597
Leiden, NL	Staff organizer	EAS	In-person	In-person	2,063
Green Bank, US	Staff organizer	HVC	In-person	In-person	0
Kelowna, CA	Staff	HVC	In-person	Online	0 ^c
Green Bank, US	Staff organizer	HVC	In-person	In-person	795
Baltimore, US	Postdoc	HVC	In-person	In-person	795

The table gives a summary of the attendance modes of gathered perspectives covered in this Comment. ‘Location’ indicates the institutional base of the attendee, and ‘Position’ gives whether they are student, postdoc or staff (noting that staff in this case captures a broad range of functional roles). In two EAS cases, attendees switched from ‘online’ to ‘GA only’ attendance, which meant signing up to attend the EAS General Assembly (GA) only, due to the limited provision of content via online attendance. In one ASA case (^a), COVID isolation meant switching from in-person to online attendance and staying an extra week in Tasmania, which raised the costs from 2,800 Australian dollars (AUD) to over 4,600 AUD. In another ASA case (^b), registration was waived, which significantly reduced the cost of attending in person. In one HVC case (^c), transition from in-person to online attendance reduced costs from an anticipated approximately 4,000 AUD to 50–1,900 AUD, depending on as-yet unknown refund of flight costs after airline-caused cancellation. Thus for HVC, our in-person perspectives cover relatively local attendance and so the costs are indicative only of registration fee (including meals and accommodation at Green Bank Observatory) in the absence of additional travel costs. We have not, in this case, provided an estimate of carbon costs associated with travel, but note that costs would be negligible for online attendance, minor for local attendance, significant for domestic attendance and major for international attendance, depending on the mode of transport¹⁴. Costs in other currencies were converted to their AUD equivalent as of 27 June 2022 for ease of comparison.

still resulted in orders of magnitude more carbon emissions than the equivalent online-only format. We note that in-person formats are the highest contributors to emissions for meetings, which account for a significant fraction of overall emissions by academics^{3–6}.

In the case of HVC, location played a unique role in achieving the goals of the meeting. The geographic isolation of the site, lack of mobile phone service and absence of internet connectivity in the meeting room enabled focused interaction and engagement throughout the day, across meals and into the evening for lounge-based discussion. While this worked well in this case for a community that was largely based in North America, this model does not necessarily scale inclusively for an international gathering, particularly in cases where attendees may not have the ability to physically travel to a single location, and highlights the need to explore similar opportunities provided in an online-only context (including unstructured interaction sessions).

To be, or not to be, a fly on the wall

The most common realization of contemporary hybrid interaction is best described as ‘fly on the wall’, where the focus is primarily on providing a passive stream of in-person content to an online audience that otherwise exists in the void. In the three conferences considered here, HVC was the most ‘fly on the wall’. This was partly by design, due to the intentional focus on in-person elements of the gathering, limited technical resources, and the late addition of an online component. EAS was locked to an in-person contract pre-pandemic and ultimately ended up similarly ‘fly on the wall’, with most sessions unavailable to

online attendees and very limited interaction opportunities due to both design and technical execution.

Conversely, ASA did relatively well at minimizing the impact of audience location due to the use of established video and text collaboration platforms to provide the digital venue and the fact that the audience, speakers, and session chairs were distributed fairly evenly across Australia. In the perspectives provided for ASA, it was also noted that a lack of mode or location dominance plus flexibility to attend either in person or online interchangeably meant it was much easier for participants to switch with limited effect on their ability to take part (Fig. 2).

Following on this note, running a conference with an online component undeniably improves accessibility^{7–9}. Even for in-person attendees, streaming and recording can make a difference. For those with any form of impaired vision, or simply seated at the back of the room, being able to have their own screen in front of them helps with following proceedings. A small and dedicated audio-visual team with basic technical expertise can stream recordings for broader access and also manually correct automatically generated subtitles if necessary. Access to subtitles can make a difference not just for people with hearing impairment but also potentially for multilingual support. While hybrid implementation is not necessarily free (though advancing technology is rapidly reducing the cost), gains such as these for accessibility and inclusivity are worth the investment.

Our key conclusions with respect to enacting a hybrid model are as follows. Firstly, conferences with an in-person component should always be hybrid, to the greatest extent possible, in order to meet the

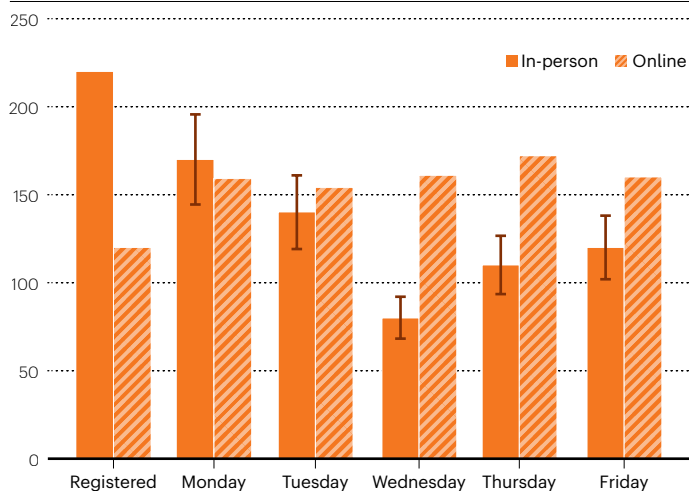


Fig. 2 | Balance between online and in-person attendance for ASA. This figure shows how attendance at ASA evolved over the course of the week, with registered attendance in the left-most column. In this case, in-person means attending at any of the hubs. Since all attendees had access to the online links, it was easy for attendees to switch from in-person to online attendance. The number of people online was extracted from connection logs. The number shows unique users (as opposed to the total number of participants) which accounts for the fact that some participants were connecting and disconnecting multiple times throughout the day. The number of people in-person represents an approximate headcount performed daily (no strict attendance list or ‘ticket check’ was performed, hence no access to exact data) and is accompanied by a 15% error-bar. The actual number of people online was larger than in-person on almost all days and highlights the value of hybrid modes of attendance.

goals of being a global and inclusive scientific field, in line with the UN 2030 Agenda for Sustainable Development¹⁰. This can be achieved with low effort and low budget if necessary, assuming that sufficient volunteer or in-kind effort can be sourced and that scale-appropriate technical expertise is available. Secondly, a functional hybrid format should allow an online attendee to participate rather than be treated as a passive second-class observer, especially in formal sessions like talks. This does not necessarily require high production value or high costs in order to be successful and inclusive. Thirdly, conference organizers and session chairs have an important role to play in minimizing the gap between in-person and online attendees by ensuring they are aware of and equally considerate of both groups in both planning and execution. Effective use of technology is critical in assisting with bridging the gap. Finally, hybrid can be done well, and it is not just a case that we need to focus on either in-person or online modes exclusively. While best practice is still evolving rapidly and future iteration is vital (see for example, ref. ¹¹), the ASA meeting was a decent example of how hybrid conferences can work with a digital-first approach.

Balancing the costs in a hybrid approach

An important challenge for hybrid, particularly when it comes to scale, is the expected scaling of associated costs. We are still seeing the evolution of registration costs in terms of how best to balance fees for in-person versus online versus mixed attendance. One key message that we can emphasise is this: online registration should always be a lower fraction of the in-person registration cost. The associated costs

of an in-person venue (for example, location hire, catering, insurance) typically far outweigh the costs of any online component (even taking into account parallel sessions), so it is inequitable to expect an online audience to significantly subsidize in-person attendance. Fortunately, none of the three conferences here adopted this model, and online registration was relatively affordable (free for HVC, and approximately 20% of the in-person fee for EAS and ASA), though varied in what it provided. Future organizers should keep in mind that while the online fee could potentially be a higher fraction, the online offering needs to always be well-matched to what is paid. Generally speaking, more effort can (and should) be invested to waive or reduce conference fees specifically in order to support a more diverse and inclusive attendance.

Of the three conferences, only EAS made use of a commercial conference company. While the use of such an organization can offload some of the administrative work in theory, it also adds a significant cost overhead, one that is often less visible or quantifiable when managed by in-kind resources provided by host or sponsor institutions (for example, volunteers or administrative support). It remains unclear in the current, rapidly evolving era whether conference organizing companies have yet adapted sufficiently to provide valuable or viable hybrid models. ASA (and to a lesser extent, HVC) demonstrated that hybrid modes can be run on medium scale without significant cost, leveraging affordable (or free) technologies that provide a perfectly workable and engaging hybrid experience. New technologies (for example, fisheye cameras with intelligent focusing on active speakers or mixed-reality headsets) are also on track to revolutionize the way we meet such that the gap between in-person and online is less meaningful, both formally and socially. We have so far found that conference-specific technology platforms tend to lag behind the rapidly advancing world of collaborative tools designed for workplace environments and often lack the means to continue conversations outside the conference time period. The role of technology in facilitating the future of meetings, conferences and collaboration cannot be understated¹².

Our advice here is that conference organizers should endeavour to experiment and determine which technology is best suited to their meeting and outsource to third parties only what they identify as truly beneficial and necessary for the cost.

The viral elephant in the room

The COVID-19 pandemic is indisputably not over, nor will the lasting effects of it be minimized for quite some time. COVID impacted all three conferences to different extents. HVC fared best, with no known cases of transmission and only one person isolating during the meeting. There are a number of possible factors here, including the much smaller scale reducing the probability that any participant arrived with COVID, the requirement that all attendees be fully vaccinated, a significant amount of voluntary masking in the meeting room, the summer weather allowing outdoor gathering, and some degree of luck. While adhering to local health advice, EAS and ASA resulted in significant transmission of COVID amongst attendees, with ASA meeting doing a commendable job of both tracking the transmissions and providing expeditious financial support to those affected.

Our general conclusion is that conferences must adopt a clear COVID policy and should ensure that their practices prioritize the safety of attendees. This means using outdoor or well-ventilated settings as much as possible, supporting regular testing where relevant, and adopting a mask policy to the greatest extent possible. Further, it is critical that we adopt standardized ways of tracking and monitoring

COVID spread at our scientific gatherings while supporting both speakers and attendees to readily switch modes of attendance, and ideally we also include budgeted means of supporting those who might be affected.

The astronomy meeting of 2050

Given the above, what might the path to the astronomy meeting of 2050 look like? Will we see the triumphant return of the in-person conference with zero accommodations for other modes, as has been observed for some seemingly anachronistic 2022 conferences? Will we see a dramatic shift towards online formats, based on the combined benefits of minimizing expense, carbon emissions, exclusion, risk, and overhead, but at the potential cost of the human interaction that is also core to the experience? Will we instead alternate between the exclusiveness of a traditional in-person conference and the often less-favoured online format in an attempted compromise between all the costs and benefits? Might we see the evolution of something like an astronomy world fair, occurring rarely and focused on diversity of attendance, informal interaction and exchange of ideas? Will technology revolutionize the game entirely as mixed reality becomes more mainstream in the near future? Or will we perhaps evolve to use a blended mix of modes, changing the way we meet more concretely to best suit the goals of interaction?

One might argue that the future is in the hands of the ECRs among us, and thus as a community we should listen most carefully to those who will inherit the choices we make today. One noticeable trend when it comes to the voices of ECRs is that they are generally more measured and balanced in the discussion of the evolution of meetings. While a common argument in favour of in-person interaction uses the benefits to ECRs as a motivation, this argument is rarely made by the ECRs in question. Köhler et al.¹³, for example, provide a level assessment of the various factors and implore their community to seek a solution that is both inclusive and sustainable while ensuring ECRs are still integrated properly into their field.

The week of 27 June 2022 offered a unique contemporary glimpse into the future of hybrid meetings in astronomy. For possibly the first time in history, you could jump from Australian astronomy in Hobart, to Galactic high velocity clouds in Green Bank, to the future of the European Astronomical Society in Valencia. That alone is a remarkable feat, to travel across several continents with ease and be part of a truly global scientific community.

Perhaps then the hope is that the astronomy meetings of 2050, should we get there, allow such natural and ready traversing of the world that the question of “to hybrid or not” is retired to the archives of history.

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