

Submission to the Science, Innovation and Technology Committee of the House of Commons

What role is astronomy playing in encouraging greater diversity and inclusion in STEM and public interest in science?

Astronomy is a subject of great interest to the public. It catches people's imagination, young and old. It has immense potential for outreach and for attracting the interest of the young for STEM subjects. Questions such as the creation of the Universe, the formation of the Solar system, the search for extraterrestrial life, or the origin of our Galaxy are both fundamental and of very general fascination. As a subject, it draws from a wide range of scientific areas, such as mathematics, physics, chemistry, biology, geology and computing.

Almost uniquely, it is a subject in which amateurs can make striking contributions. In fact, amateurs have dominated some areas (eg discovery of long-period comets). The onset of big databases has made the role of the citizen scientists more prominent. Voorwerps [1] are a class of astronomical objects discovered in 2007 by a primary school teacher in the Netherlands (Hanny van Arkel). She was participating as a volunteer in the Galaxy Zoo project [2]. Earlier this year, amateur astronomers discovered an enormous emission nebula near the Andromeda Galaxy, the closest large spiral galaxy to us [3]. What is astonishing is amateurs found something striking and unexpected in an area of the sky much studied by professionals. Astronomy is for all, and everyone with time, patience and access to a computer or telescope can participate in the thrill of cutting-edge research and discovery.

Citizen science is scientific research carried out by interested members of the public, in collaboration with professional scientists. Citizen science can bring benefits for science, for society, for policy and for the participants themselves [4]. People become more aware, directly involved and fascinated by scientific problems. The advent of huge open data sources, free AI technology & ready availability of personal computers with significant processing power means that this style of research is becoming very productive. Citizen science projects in astronomy are an extraordinarily powerful way to combat exclusion and to stimulate public engagement. There are many such projects, such as the search for extra-terrestrial life, cloud-spotting on Mars, looking for transiting extrasolar planets, searching for gravitational waves and studying galaxy morphology [5,6]. These dovetail naturally with the emerging technologies of Data Intensive Science, as it is the availability of big data-sets and the artificial intelligence tools to analyse them that drives good citizen science projects. This is important for the science, the economy and the society of the next decades.

On paper, Astronomy could easily, and without even trying, be the flagship subject for diversity and inclusion in STEM and for public interest in science.

Sadly, the reality is very different.

The culture of UK astronomy is poor. There are many examples of individuals, who have suffered serious harassment and bullying [7,8,9]. The only systematic survey of UK astronomy was carried out by the *Royal Astronomical Society* in 2020-2021. They obtained responses from over 650 people. The results are very depressing [10]. A few statistics that give the overall picture are:

- (i) 44% of respondents had suffered bullying and harassment in the workplace within the preceding 12 months,
- (ii) Women and non-binary people in the field are 50% more likely than men to be bullied and harassed,
- (iii) 50% of lesbian, gay, bisexual, and queer astronomers were bullied in the last 12 months.

A figure of 44% of astronomers experiencing bullying and harassment over a year is **grotesque**. It is almost a half of all respondents. The *Royal Astronomical Society* deserves credit for conducting the survey, but the astronomical community has not made any discernible efforts to improve matters since its publication in 2021. Sadly, the survey does not seem to have spurred any serious efforts in the subject for change.

The term “bullying” is often not well defined. This submission uses “bullying” as a general term for all manner of poor behaviour, including sexual harassment, racist/homophobic/gender harassment, intimidation and aggression. Unfortunately, bullies in astronomy are a feature, not a bug.

With its potential as a flagship subject, with discoveries making front-page news and firing the public imagination, astronomy inevitably also becomes a breeding ground for un-collaborative and poor behaviour. Grants, press releases, first author publications, leadership of large collaborations are prized, and huge egos abound. Astronomy is almost constructed to encourage bullying as a productive career choice. This is exacerbated by large numbers of astronomers on fixed-term contracts, funded by grants. They often depend on the principal investigator (PI) of the grant for career progression or sheer survival.

For example, the Institute of Astronomy at the University of Cambridge is one of the largest astronomy departments in the country. It has 16 tenured staff, but 102 untenured or fixed-term postdoctoral research assistants and students. So, 86 % of Cambridge astronomers are on precarious fixed-term contracts of between 2 to 4 years, and spend precious time applying for further positions and funding, their research work hampered by uncertainty. This percentage is high, but a figure of between 70-80 % of all UK astronomers on fixed-term contracts nationally is very realistic. This leads to widespread demoralisation among the majority of astronomers who see no real career structure and limited hope of obtaining a permanent position in their futures.

Fixed-term contracts are a serious obstacle to encouraging greater diversity and inclusion in astronomy for the following reasons:

- (i) Researchers supported on fixed term contracts are beholden to a Principal Investigator (PI) who was awarded the grant (e.g., from *the Science and Technology Facilities Council*). The power of seniority and a tenured position coupled with financial power can easily lead to coercive control and abusive behaviour. Contracts can be terminated irrespective of productivity, further employment made conditional on direction of research or even undermined by unfair referencing. This leaves individuals vulnerable to the opinions and behaviour of just one person, the PI, interfering with creativity, research independence and diversity of ideas and people. Over-reliance of career progression on single individuals, coupled with the serious power imbalance between senior and fixed-term astronomers, puts those vulnerable to bullying, harassment and discrimination at serious risk. Although the survey is US-based rather than the UK, Moss & Mahmoudi (2021) provide a disheartening picture of abusive supervision in science [11].
- (ii) It is impossible to make long-term plans whilst on a temporary contract. Early career researchers in astronomy often face a choice between progressing their career or starting a family. This affects male family planning choices, but is evidently most detrimental to women. Decisions on permanent astronomy jobs in Universities are often made when a researcher is in his/her mid or late thirties. This places women at a particular disadvantage. Astronomy has made some progress towards gender equality over the last decade, but it remains true that women are under-represented at all levels, especially the most senior. The last study by the *Royal Astronomical Society* in 2016 found 12% of professors, 18% of senior lecturers/readers and 29% of lecturers in astronomy are women [12].
- (iii) Financial insecurity bedevils the life of anyone on a fixed-term contract. If you are on a fixed-term contract, you know that one day soon the job will end. This uncertainty is particularly damaging for people who cannot afford to risk little or no pay — including those from low socio-economic backgrounds, those on visas with strict salary requirements, and researchers with families or other caring obligations. This puts an unfair economic bias on the success of academic careers, which is again detrimental to diversity of ideas and people. It would be very helpful to obtain statistics on socio-economic backgrounds in Astronomy, both for professional astronomers and for amateurs. My impression is that professional astronomers in the UK are overwhelmingly drawn from an affluent background and that this bias has become worse over the last two decades, not better. It is noticeable that amateur astronomy societies — to whom I often give talks — are drawn from a much wider socio-economic demographic than professional astronomers.

Without updating the fixed-term contract system, it is not possible to create diverse and inclusive astronomy communities.

As most astronomers are employed by Universities, a large part of the blame for the poor culture in astronomy belongs with the Universities for the following reasons:

- (i) Universities take the benefits of success, but completely absolve themselves of any responsibility for the longer-term survival and future of the people contributing to their success. Universities won't update the fixed-term contract system — or even ameliorate its worst features — despite simultaneously and insincerely insisting on their commitment to diversity and inclusion. The risk in the system is entirely borne by the fixed-term researcher.
- (ii) Universities themselves are indolent in tackling bullying and harassment. My own University — Cambridge — has a particularly poor record [13-15]. In a survey by Unite, UNISON and UCU, twenty-one percent of staff at Cambridge said they had been subjected to bullying or harassment, while 23% reported having witnessed such behaviour towards other staff. Most Universities simply do not have a fair complaints procedure. Misconduct thrives and is largely unpunished.

What can be done to improve matters?

“Success” in astronomy needs to be defined not only as individual breakthroughs but as a collective responsibility to ensure continuity for the success of the field by building up the next generation of researchers as independent, diverse and productive individuals regardless of background and creed. Successful mentorship must be on a par with successful research as a positive contribution to the success of the institution, and to society. A good astronomer must be defined not just by what he or she has done to advance the field, but also by what he or she has done to help others advance the field. Astronomy is a collaborative endeavour.

At least some fixed-term contracts can be replaced by open-ended contracts, with people moving to new funding sources as they become available. This is much more common in other areas (e.g., medical statistics, experimental particle physics) than astronomy. Universities should show much more awareness, engagement and responsibility in policing some of the inevitable abuses of the system currently in place (such as poor behaviour by senior PIs). This responsibility would entail a revision of the Universities' complaints procedures so that they are effective.

Bullying and harassment is found by repeated surveys to be rife [10,13], but Human Resources departments – or HR Business partners as they have now become in Cambridge – seem chronically unable to identify any bullying behaviour at all, let alone discipline any individual bullies. This problem of course is not limited to astronomy but occurs throughout most Universities. But, it is a major reason why astronomy is not fulfilling its role in encouraging greater diversity and inclusion.

In fact, diversity and inclusion in my University astronomy department has become entirely performative, with little meaningful action actually being taken. There is zero interest in reforming UK astronomy, because — frankly — too many people at the top have reaped massive benefits from the system as it is, and see no need for any change.

This is all quite unlike astronomy as it really could be. The magnificent role it could play in encouraging greater diversity and inclusion in STEM and public interest in science is undermined by its culture. We are all the poorer for this. My hope is that the Committee will insist that UK astronomy set out a roadmap to genuine reform.

Wyn Evans is Professor of Astrophysics at the Institute of Astronomy, University of Cambridge. He has become increasingly concerned at the widespread acceptance of a culture of bullying in astronomy. He has over the last year published a number of articles in 'The Times Higher Educational Supplement' on the damage done by bullying and harassment in academia.

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