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Gender diversity in heliophysics

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1 Introduction

Science is conducted by people. When those people do not feel safe in their workplace, they will struggle to produce quality science. The American scientific community has traditionally been dominated by cisgender white men—*cisgender* meaning that their gender aligns with the one assigned to them at birth. Individuals who are not part of this dominant demographic group have historically been excluded from scientific debate. However, the demographic landscape is changing rapidly [e.g., Jones (2022)], and organizations must ensure early career scientists of all identities feel accepted so they can achieve their goals in the field.

Heliophysics describes the confluence and interaction of historically delineated scientific disciplines, including plasma, solar, and space physics. The scientific architecture of our field is founded on collaboration between people with diverse interests, backgrounds, skill sets, and ways of approaching problems. It should follow that the cohort of heliophysicists is at least as diverse as our research problems. A framing often referred to as “the business case” for diversity holds that perspectives different than our own enrich the ways in which we solve problems and communicates the positive outcomes for diverse working groups Starck et al. (2021). However, this rationale is insufficient in scope and uncompassionate in motivation; the safety of marginalized individuals is just as important as the achievements of a group. From the expectations that marginalized people outperform in order to prove themselves to the tokenization of their inclusion in an otherwise normative space, the “business case” for diversity is often harmful to historically marginalized individuals Haacker et al. (2022). The primary motivation for a diverse constituency of heliophysicists ought to be equity.

Only by accepting the authentic selves of our fellow heliophysicists can we create an environment in which they have the mental and emotional safety necessary to do their best work. This white paper focuses on a particular axis of identity which the authors believe lacks visibility within heliophysics: gender expansion. It begins with definitions, explains the current landscape, and suggests actions toward a better future. The authors seek to shed light on these issues so that we can work together as a community to create a more inclusive, safe, and welcoming space for people of all identities.

2 Terminology and nomenclature

Biological sex is often upheld as a steadfast marker of binary differentiation. It encapsulates a combination of physiological characteristics: chromosomes, gonads, hormones, and genitalia. These markers of biological sex are used to sort individuals into ‘male’ or ‘female’ categories, but can be inconsistent within individuals. Biological sex is far more diverse and complex than our social and legal systems have led us to believe; for example, intersex persons—those with reproductive anatomy or sex traits which differ from the rigid definition of male or female—make up approximately 1% of the population [Ainsworth \(2015\)](#). It is relevant in certain (often medical) contexts to refer not to someone’s (perceived) biological sex but instead to the sex that they were assigned at birth. Outside of such narrow contexts, it is generally not necessary to reference someone’s sex assigned at birth, though gender-expansive individuals may reference their assigned sex when describing specific experiences.

Gender is a social construction of norms, behaviors, and roles within a given social group which is informed by sex assignment. Common categories of gender include boy/man, girl/woman, and nonbinary (often used as an umbrella term for those who do not identify as men or women). These constructions can vary with culture or time; Victorian society had three effective genders—Man, Woman, and a nonbinary “Child” category, which wore dresses and used it/its pronouns [Hawthorn \(2019\)](#). Many indigenous cultures in North America and India have third adult genders in their societal structures as well [Roscoe \(1998\)](#); [Herdt \(2020\)](#); [Nanda \(1986\)](#). *Gender Identity*, on the other hand, is a person’s internal sense of self and their gender. It represents their internal relationship with various genders in their society. Unlike gender expression (below), gender identity is not outwardly visible [Wamsley \(2021\)](#).

Transgender (or trans) refers to someone whose gender identity does not align with their sex assigned at birth, while *cisgender* (or *cis*) refers to someone whose gender identity does align with their sex assigned at birth. Gender expression refers to the way a person may outwardly represent their gender identity—often with clothing, hairstyle, jewelry, or body art. A trans person may choose to transition socially by changing markers of their gender such as their name, pronouns, and appearance to better align with their gender identity; they may or may not choose to transition medically, which could consist of hormone replacement therapy and/or gender-affirming surgeries. The use of a trans person’s prior name after they have socially changed their name is referred to as “deadnaming.” Deadnaming is disrespectful, and can have lasting negative ramifications for trans people, from systemically driving them out of academic disciplines [Whitley et al. \(2022\)](#) to higher suicide rates in trans youth [Project \(2020a\)](#).

While we often think of the term transgender to describe only those who medically transition, trans is an umbrella term that

encompasses all people whose gender identity does not align with their at-birth sex assignment. We will use terms such as gender-diverse, gender-divergent, or gender-variant as synonyms for this expansive ‘trans umbrella’ throughout this paper.

3 Context and the current landscape

Gender-expansive scientists face many challenges unrelated to their work that inhibit their scientific progress. The present environment is not necessarily inclusive or safe to navigate, but the authors believe that a concerted effort can begin to restructure the landscape. Right now, trans individuals are fighting to safely exist; the present operating frameworks fail to support them.

This section will explore issues that gender-expansive people encounter as they relate to work: coming out in the workplace, pervasive misgendering and deadnaming, and bathroom use. [Figure 1](#) highlights the current landscape, some goals, and mechanisms toward improving inclusion of gender-expansive space scientists.

3.1 Need for dedicated gender education workshops

Because of the historical and ubiquitous erasure of gender diversity around the world [e.g., [Roscoe \(1998\)](#); [Billard and Nesfield \(2020\)](#); [Herdt \(2020\)](#)], gender-divergent people face disproportionate socioeconomic challenges, including having on average fewer financial resources and less familial support than their cisgender peers [Foundation \(2021\)](#); [Badgett et al. \(2019\)](#). These difficulties are often more pronounced for multiply-marginalized people and there is subsequently a larger barrier to enter academic fields such as heliophysics. When major support structures are lacking, affected individuals must prioritize safety and security over research, course work, proposal writing, and other tasks [Cech and Waidunas \(2022\)](#). Further, exorbitant amounts of time are often needed to carve out space within one’s community in order to feel accepted and safe at work; this time commitment can manifest as conversations with colleagues, informational presentations, trainings, and more, all of which fall outside of the scope of work as a heliophysicist [e.g., [Whitley et al. \(2022\)](#)]. The process of educating cisgender colleagues about one’s identity and experience is perpetual and requires time, effort, vulnerability, and intentionality. The lack of formal and accurate educational programs on gender diversity, coupled with the minimal funding [Coulter et al. \(2014\)](#) of studies on trans and gender-expansive people, place the burden to inform and educate on already disenfranchised individuals.

Because gender operates both intrinsically (i.e., how one sees oneself) and relationally (i.e., how one relates to/with others),

Current Landscape	Goal	Mechanism	Success Metric
People misgender and/or deadname gender-expansive people.	Cultivate a culture where sharing pronouns and preferred names is normalized and well-practiced.	Dedicated funding for pronoun and implicit bias workshops	Gender-expansive people hear their correct names and pronouns, experiencing basic respect.
A psychologically unsafe atmosphere results in non-optimal scientific data return.	Gender-expansive scientists can dedicate more mental energy to science	Positive reinforcement, kindness, empathy, and open-mindedness are routine and authentic.	Everyone is supported and respected, and thus the environment facilitates maximal science output.
Gender-expansive folks harassed in restrooms, hinders water consumption/brain functionality	All persons have equitable access to restrooms in convenient locations; necessarily means access to single-stall restrooms or gender-neutral restrooms.	Dedicated intentionality to include gender-neutral and/or all-gender facilities in workplaces, conferences and future building designs.	Everyone is hydrated and has access to bathrooms that meet their gender identity needs.
Gender-expansive people are written/spoken out of existence through binary vocabulary.	People speak of/about each other using language that represents each person accurately – including but not limited to pronouns, descriptors, categories.	Use phrases such as “the individual,” “they” or the person’s name instead of “he/she” on documents; use gender-neutral salutations instead of “ladies and gentleman;” and ask others how they like to be referred to.	Everyone is represented in oral/written communication.

FIGURE 1

This table highlights the most actionable difficulties faced by gender-expansive heliophysicists today. Those problems are presented alongside eventual goals for a more inclusive scientific field, mechanisms to enact change in order to reach those goals, and concrete success metrics for gauging our community’s progress.

gender-expansive persons rely on those with whom they interact to refer to them in ways that align with how they see themselves. This social contract is only upheld with concerted effort, and is often violated. The authors are aware of a number of appalling examples from within the heliophysics community: from the persistent, intentional deadnaming of a graduate student by their peers; to students hearing their advisor mock the use of pronoun stickers, which led them to hide their own pronouns for years; to a researcher being told that nobody wanted to talk to them or collaborate out of fear of messing up their pronouns or saying something inadvertently offensive; to the continued and intentional deadnaming of a researcher by their thesis advisor, which has repeatedly forced them to immediately out themselves to senior scientists to avoid being further deadnamed going forward. These blatantly toxic events have led gender-expansive heliophysicists to remain closeted for years due to the fear that coming out would harm their careers. The accumulation of these experiences over the years meant some of these individuals nearly left the field because they had lost hope that they could find a workplace where they would be respected; others did [Cech and Waidzunus \(2022\)](#); [Maloy et al. \(2022\)](#). These striking narratives demonstrate the dire need to provide funding for dedicated education programs.

Although we have all been conditioned to make assumptions about someone’s assigned sex at birth, extrapolate that assumption to their gender identity, and use terms that align with their perceived gender, gender is not an “observable [Rasmussen et al. \(2019\)](#)”. Despite the recognition that this presumed-sex-to-gender evaluation process is ingrained in our social structures and thus subliminal, it is nonetheless frustrating

and draining for those with non-normative genders to constantly determine whether they want to either engage in a corrective conversation or gloss over an incident. The decision fatigue that comes from this continuous risk assessment and conflict evaluation, particularly in professional work settings, consumes mental resources which could be used for research.

3.2 Workplace safety

In a recent survey, “Pronouns Usage Among LGBTQ Youth,” The Trevor Project reported that 25% of Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ+) youth use gender neutral pronouns; 1/3 of the millennial generation knows someone who uses gender neutral pronouns [Project \(2020b\)](#). The 2020 National Survey on LGBTQ Youth Mental Health found that trans and nonbinary individuals who were in an environment where everyone respected their pronouns were 50% less likely to commit suicide [Project \(2020a\)](#). The future of heliophysics relies on the performance of the next generation—the community must learn how to respect the gender diversity of its constituents. That means not only respecting the pronouns a gender-expansive person provides when they introduce themselves, but also acknowledging and respecting someone’s new name and pronouns when they come out.

Coming out to the larger community of one’s department or laboratory can be a difficult and frightening experience. Disclosing one’s gender identity should always be strictly voluntary; having one’s gender identity revealed without consent is not only ethically wrong, it is potentially

dangerous for the person whose identity is being revealed [Dowad \(2021\)](#). Reputation is instrumental to a scientist's career and will inevitably be affected by coming out, often in ways which are decidedly negative. For many gender-expansive scientists coming out invites marginalization, harassment, and discrimination [Whitley et al. \(2022\)](#); [Cech and Waidzunus \(2022\)](#); [Barthelemy et al. \(2022\)](#). This affects a scientist's relationship with all of their colleagues, including their mentor who may also experience retaliation if the mentor chooses to support their gender-expansive mentee [Hughes \(2018\)](#).

Moreover, transgender scientists often find themselves working with people who intentionally misrepresent them by using an incorrect name or pronouns; this can cause undue stress, anxiety, fear, humiliation, dysphoria, and other negative consequences. The time commitment required to adequately handle these incidents can be huge—sending emails to department chairs or human resources officers, filing reports of Title IX violations, attending disciplinary meetings, and recounting events. There is also the possibility of social retaliation for standing up for oneself, resulting in further time and stress. Even when such events are not reported through official channels, time is required to recover from these at-best stressful, at-worst degrading experiences. For someone who may be considering coming out at work, the anticipated anxiety of marginalization, harassment, and discrimination alone can be enough to delay or terminate their desire to come out. For those who do choose to come out at work, it is seldom a singular event but rather a drawn-out process. Sometimes this is because someone has to come out in stages—conversing with one or a few individuals at a time. Other times it is because they need to have repeated conversations with a single person to ensure their pronouns are respected. Often there are compounding factors; the authors wish to emphasize that coming out requires multiple conversations and engagements and thus significant time and energy.

3.3 Accessibility challenges

Not only is the social environment difficult to navigate for trans and gender-expansive scientists, lack of accessible infrastructure in the workplace negatively impacts health and productivity. Lack of all-gender restrooms forces gender-expansive scientists to compromise either their mental or physical health. Using a gendered restroom invites retaliation from cisgender users of that restroom through direct confrontation or other actions such as staring, putting up unwelcoming signs on the restrooms, and otherwise trying to dissuade the gender-expansive person from using the restroom. Even in absence of overt aggression, people using a restroom that does not align with their gender identity often experience severe

dysphoria that negatively impacts their mental wellbeing. Due to this frequent conflict in restrooms, many gender-expansive scientists may choose to travel to another building to use an all-gender restroom or to dehydrate themselves to use the restroom as infrequently as possible. The brain has limited functionality without hydration and therefore a peaceful refuge to perform natural bodily functions will increase scientific productivity.

One must also consider the disproportionate impact of these challenges on students, post-docs, and early career scientists who rely on stable positive relationships with more experienced members of their institution. Early career scientists are more susceptible to isolation and alienation because they are often without the same degree of social support, economic stability, and career stability as their more senior colleagues. Additionally, the generations currently in the early stages of their careers have a statistically higher incidence of individuals self-identifying as transgender than preceding generations and thus lack role models from gender-expansive identity groups [Jones \(2022\)](#). When people do not have role models in an environment that they can see aspects of themselves in, they can internalize that those spaces are not meant for them.

4 Recommendations

Here we provide a list of actions to improve the professional climate for trans and nonbinary heliophysicists. This list is based on experience and may be incomplete. It is intended as a starting point, not the final word. These recommendations are further categorized into actions which can be taken by individuals, and those which require change on an institutional or systemic level.

4.1 Individual

- Normalize sharing preferred name and pronouns. This can be as simple as including your pronouns in your email signature/Slack name/other digital identifiers, or offering up your name and pronouns when being introduced to someone. Note it should never be mandatory for people to share pronouns, as this can force people currently questioning their gender to make uncomfortable choices about how to present themselves, or out someone before they are ready. Rather, the opportunity to share should be affirmatively presented.
- Speak up for your trans and nonbinary colleagues. An easy example of this is correcting someone when they misgender a colleague (assuming the colleague being misgendered is out in that setting and is comfortable with you correcting people on their behalf); it is exhausting for trans individuals to be perpetually correcting people misgendering them [e.g., [Whitley et al. \(2022\)](#)]. If you are corrected about someone's

name and/or pronouns, simply (1) thank the person for correcting you, (2) re-state the sentence using the correct name/pronouns, and (3) move on with what you were saying.

- Educate yourself. Many institutions have safe space or ally training, which often comes with a sign to put on an office door to indicate your completion of the training. Your gender-expansive colleagues and students will see this and know you have taken the time to educate yourself about their experiences and how to be supportive of them.
- Show support. Similarly, you can create your institution's version of the You Are Welcome Here campaign (<https://lgbtq.mit.edu/you-are-welcome-here>), and share widely. Note that the authors do not recommend required training be associated with this effort, as many supportive allies may not be able to dedicate the time and bandwidth necessary for a mandatory training.

4.2 Institutional/systemic

- Use preferred names wherever possible. This includes on websites, name badges/name tags, door signs, email, etc. Modern Human Resources (HR) systems are more than capable of connecting a preferred name to the correct employee. In university contexts, it is ideal if the preferred name be associated with the student from application through graduation; this way they are universally known by their preferred name. Likewise, preferred names should be easy to change if a student comes out or transitions while enrolled, and be allowed on diplomas and dissertations. Any preferred name system available to students should also be available to faculty and staff; they have a unique university ID number and are still identifiable using their preferred name; there is no reason their legal name needs to be on their ID. In government institutions, the situation can be more nuanced, as federal employees may be subject to the legal name and gender marker on their Personal Identity Verification (PIV) Card of Standards and Technology (NIST, 2022), as governed by Homeland Security Directive 12 12 (Homeland Security, 2004). However, in alignment with recent Executive Orders (EO13988 and EO14035) combating workplace discrimination on the basis of gender 13988 (Excellence Diversity and Inclusion, 2021a); 14035 (Excellence Diversity and Inclusion, 2021b), NASA has only begun to update their guidance name display on email and online records nas (National Aeronautics and Space Administration, 2014; NASA, 2022). Other federal agencies have already implemented this and other crucial policies supporting gender expansive individuals osc (Office of Special Counsel, 2016); int (Department of

Interior, 2013); epa (Environmental Protection Agency, 2016); nsa (National Security Agency, 2021); icg (International Intelligence, 2018). Even though the Office of Personnel Management gives general oversight for all agencies opm (Personnel Management, 2022), policies are not always implemented correctly and the burden may lie on the gender-expansive individual to enforce equitable practices. In gender transition action plans, the scientist's supervisor is largely responsible for success; the heliophysics community must be subsequently aware of the sensitive issues raised in this white paper.

- Ensure *easy* access to all-gender restrooms. If your institution is constructing a new building, find out if they're including all-gender restrooms, and if so, how many and how accessible. If accessible, all-gender restrooms are not included, the planning process is the easiest time to intervene! Beyond your institution, you can start or join a campaign to change municipal codes so all-gender restrooms count toward code requirements (more often than not, code requirements only count gendered restrooms, which makes it difficult to convert existing facilities). If your institution is organizing a meeting or conference, ensure that the venue will be able to accommodate gender-neutral or all-gender facilities.
- Ensure your health coverage adequately covers gender-affirming care. This includes hormone therapy and gender-affirming surgeries.

5 Discussion and summary

This white paper strives to define the “state of the field” for gender-expansive heliophysicists and provide recommended actions to improve this state going forward. The LGBTQ + community is heavily marginalized, and that effect is amplified in Science, Technology, Engineering, and Mathematics (STEM) fields. However, there are concrete actions that can be taken by the heliophysics community to better welcome gender-expansive scientists.

Many of the recommended actions benefit others outside the transgender umbrella—for example, a preferred name policy benefits everyone who does not go by their full legal name, and increased availability of all-gender restrooms can also improve access for cisgender women in buildings which lack women's restrooms. One easy change that has already been made is the implementation of simpler name change policies at many academic journals, which benefits not only transgender scientists, but scientists who choose to change their name after marriage or for other reasons. The difficulties we have outlined and solutions we have proposed are all a matter of showing trans and nonbinary scientists the respect everyone deserves in the

workplace; we hope you will join us in working toward a future where this respect is ubiquitous.

Author contributions

MK and JV were responsible for the organization of this article. MK, JV, and AB worked on the early stages of the project, from building a conceptual consensus on the intended role and outcome(s) of the paper to concretely determining the focus points of the paper. MK and JV wrote the first draft of the paper. MA, NM, and AG provided robust feedback and edits on said first draft. MA and NM revised the paper, conducted additional background research, and wrote several additional iterations produced a finalized version.

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