

# Diversity and inclusion in observatory operations: Advocating for and implementing positive change

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## ABSTRACT

Dedicated diversity and inclusion programs are important tools to utilize in a successful organization. Cross-disciplinary studies show that diversity contributes positively to overall productivity and innovation, in both profit and non-profit sectors. Diverse working groups are capable of producing better science, and creating an inclusive environment is essential to maintaining diversity in the workplace.

This paper first outlines studies of the measured benefits of diversity, and the different ways in which they manifest, in order to emphasize its importance. Demographics data from international astronomy organizations is presented to illustrate the current state of the workforce in observatories and within observatory operations. Finally, a much-needed focus is placed on inclusion in the workplace. We review why creating an inclusive environment is important for the success of maintaining a diverse organization. We discuss how different programs implemented at astronomical observatories contribute to creating an inclusive environment, and detail real-world examples of these efforts taking place in these institutions. The goal is that these strategies can be adapted to benefit other similar organizations.

**Keywords:** Inclusion, Diversity, Observatory demographics, Inclusive environment, Engaged workforce, Culture

## 1. INTRODUCTION

Diversity research over the past 20 years has drifted away from the more negative aspects, such as highlighting the problems with affirmative action, and how diversity may create more opportunities to discriminate in the workplace or create bias among groups.<sup>1</sup> It is discouraging to begin the diversity conversation and immediately encounter naysayers who almost invariably site the pitfalls of affirmative action, and sometimes believe that it is still manifesting within modern diversity efforts. It can evolve into a concerned discussion that unqualified people are getting position offers to fill a quota, or simply serve as an advertisement for the company. The point that is missing from these discussions is that diversity and inclusion programs are not instituted to fill quotas, but to achieve the best possible workforce for the organization and level the playing field for all potential employees.

Hope springs eternal, as results from sociological, psychological, and technological studies of heterogeneous groups - whether they are multi-cultural or multi-ethnic, or have large age range or gender differences - are demonstrating highly positive benefits of diversity. Diverse groups show improved group performance or creativity<sup>2</sup>, better decision-making skills and communication<sup>3</sup>, and even superior complex problem-solving skills<sup>4</sup> vs. non-diverse groups. Finally, the evidence-based statement that “diversity makes better science”<sup>5</sup> serves as a powerful reminder of the benefits of cultivating diversity and inclusion in an astronomical organization.

The work is not finished simply creating a diverse working group, however. Non-homogeneous groups can demonstrate problems such as ostracism or poor communication<sup>3</sup> due to breakdowns in a lack of understanding or ability to exchange ideas with perceived outsiders. Feelings of not belonging or observed cliques within a workplace may weigh down the potential of a diverse group. But this is where inclusion is pivotal. An inclusive environment is essential in mitigating these perceptions from an individual, and in creating a place where everyone is given equal opportunity to contribute if they choose. An inclusive environment is also advantageous to encourage active engagement in the workplace. Psychologically speaking, there exist contradictory “human needs for validation and similarity to others (on the one

hand) and a countervailing need for uniqueness and individualizations (on the other).”<sup>6</sup> Inclusion is the mechanism that allows the coexistence of these conflicting needs.

Following are specific examples of metrics of improved performance and process gains that diverse groups demonstrate. In section 2, we report employee demographics data from two multi-national astronomy organizations to create an idea of the current state of the diversity within observatories and observatory science operations. Section 3 opens the discussion to incorporate inclusion, and finally, section 4 details examples of activities, policy implementation, trainings, and resources to creating an inclusive environment. The goal of this paper is to create a toolkit for others to implement or improve diversity and inclusion programs at their own astronomical/research organizations, and extend the efforts for positive change in the field.

### **1.1 Making better science**

This paper and those referenced rely on the definition of diversity as differences between people that lead to a perception of difference between two individuals.<sup>3</sup> While this statement seems circular, it comes down to asking two questions: “Who am I with respect to myself?” and “Who am I with respect to a group?” There are numerous ways in which these differences emerge: ethnicity, religious beliefs, sexual identity, personal values, or mental or physical abilities. These traits all contribute to creating the unique perspective for that individual. In a diverse group, all of these perspectives can interweave to create a broader range of problem-solving skills, abilities, and worldviews compared to those of a homogeneous group. In turn, this leads to an increase in creativity and innovation.<sup>7</sup>

These different perspectives also contribute to individual successes in scientific discovery. A column published in “Psychological Science” succinctly describes how diversity has positively impacted scientific study and altered methods of investigation.<sup>5</sup> One example of this is a wildlife biologist’s worldview influencing her adopting a non-invasive specimen sample collection in wild buffalo populations. Her First Nations perspective led her to innovate a non-invasive method for DNA sample collection in wild buffalo populations, allowing for observation on free-range populations with no danger to the collector or the animal.<sup>5</sup> This method was not previously used, and minimizes human-buffalo contact. Separating cultural influence on scientific discovery is a difficult task, because it is deeply-rooted in how science is learned in the first place. Cultural practices penetrate into routine practices, so the process by which a new task is learned, or information is absorbed, is highly dependent on an individual’s cultural development.<sup>8</sup>

### **1.2 Creativity, conflict, and computer science**

Among the sea of literature available on the role of cultural diversity, papers that meta-analyze hundreds of empirical studies on multi-cultural teams have emerged with evidence of group benefits in creativity, conflict solution, and satisfaction.<sup>2</sup>

In the case of creativity, studies involved the creation of novel ideas, writing endings to short stories, and proposed solutions to problems or case studies. From this analysis, a stark positive correlation was found between increased cultural diversity in groups and creativity. Task conflict, or the awareness of different viewpoints and opinions in a group, also clearly correlates with diverse groups. It is important to note here that homogeneous groups are more likely to succumb to the acceptance that the ideas and opinions between members of the group are similar, if not completely overlapping.<sup>9</sup> Finally, it is important to acknowledge the result that satisfaction with the group in general, and its performance in particular, also positively increases with group diversity. Satisfaction in task accomplishment and work contributed to an organization is deeply embedded in conversations of inclusion, which is discussed in the section 3. Satisfaction that is derived from social contentment in the group, or from contentment with performance, rises in diverse groups.<sup>2</sup>

Diversity not only has benefits to problem solving, but also has applications to problem solving. Efforts to exploit these ideas for solving difficult computational problems go back further than the majority of studies mentioned in this paper.<sup>10</sup> Drifting away from psychological- and sociological-centric studies, computer science demonstrates how diverse agents can collectively outperform in problem solving, compared to agents with higher abilities to complete these tasks. Capturing functional diversity in a group of agents that are “tasked to maximize a function  $V$  that maps a set of solutions  $X$  into real numbers”<sup>4</sup> resulted in an interesting finding. The groups of agents that had different encoded abilities, and number of attempts, out-matched agent groups with higher-overall ability. In other words, “diversity trumps ability,”<sup>4</sup> even in the application of pure problem solving. It’s not the highest test scores, but a mix of test scores that performs better when tasked to solve a problem.

## 2. DIVERSITY IN OBSERVATORIES

Presented in this section are snapshots of self-reported demographics data collected by the respective Human Resources departments of two international astronomical research organizations: (1) Association for Universities for Research in Astronomy (AURA) and (2) National Radio Astronomy Observatory (NRAO). These data are here to provide a glimpse of the state of diversity, with one respect, within international observatories and science operations. The following sections 3 and 4 iterate how diverse staff can be engaged and included in the workplace, so these numbers do not retreat in a negative direction.

### 2.1 AURA

The figures featured in this section are sourced from the publicly available “Workforce Diversity Progress Report,” published on AURA’s website.<sup>11</sup> Figure 1 is a representation of the AURA workforce separated by binary gender (male and female) and overall population of minority (non-white) employees. These total percentages are compared with the workforce represented in organizations in the private sectors of physical, engineering, or life sciences, as classified by the Equal Employment Opportunity Commission (EEOC).

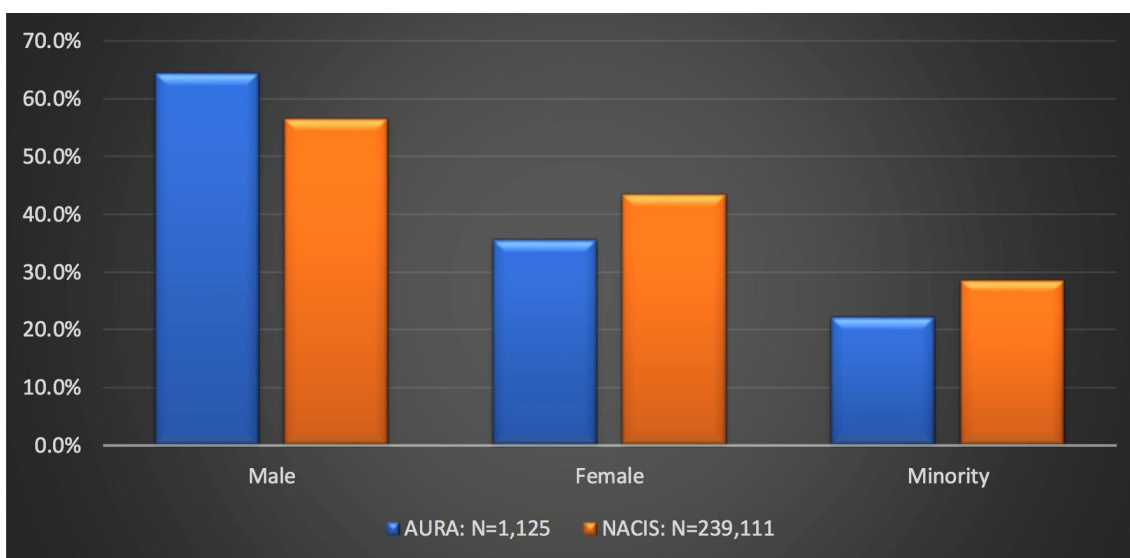


Figure 1. Total workforce demographics for AURA, compared to the total combined workforce from the private engineering, physical, or life sciences sector, as classified by the North American Industry Classification System (NACIS). Figure from “Workforce Diversity Progress Report.”<sup>11</sup>

As of calendar year 2016, of AURA’s 1125 employees who self-reported, over 60% of them identify as male, whereas 36% identify as female. The national average is doing better than AURA in representation, where the percentage of female representation tops 40%. In the case of minority representation as well, the national average is close to 10 points larger than AURA’s.

Figures 2 and 3 contain demographics that are sliced into more divisions, and show data internal to AURA with no national comparisons. It is notable that the demographics reports from AURA are given only from the U.S. perspective, following demographics classification guidelines from NACIS, while several facilities operating under AURA have locations in Chile. From a Chilean perspective, the demographics reports change, as representation is different with respect to the U.S. representation. However, data were not available for the demographics from a Chilean viewpoint.

Figure 2 focuses on the change of the population of minority groups in the AURA workforce with time, from 2009 until 2016. The plot shows small gains in representation in 3 out of 6 underrepresented groups, and an overall growth from 17% of employees who identify with a minority group to 22% in 2016. Historically under-represented groups in Science, Engineering, Math, and Technology (STEM) fields are the Hispanic, African American, Pacific Islander, and Native American groups. AURA saw improvement in 2 of these 4 groups.

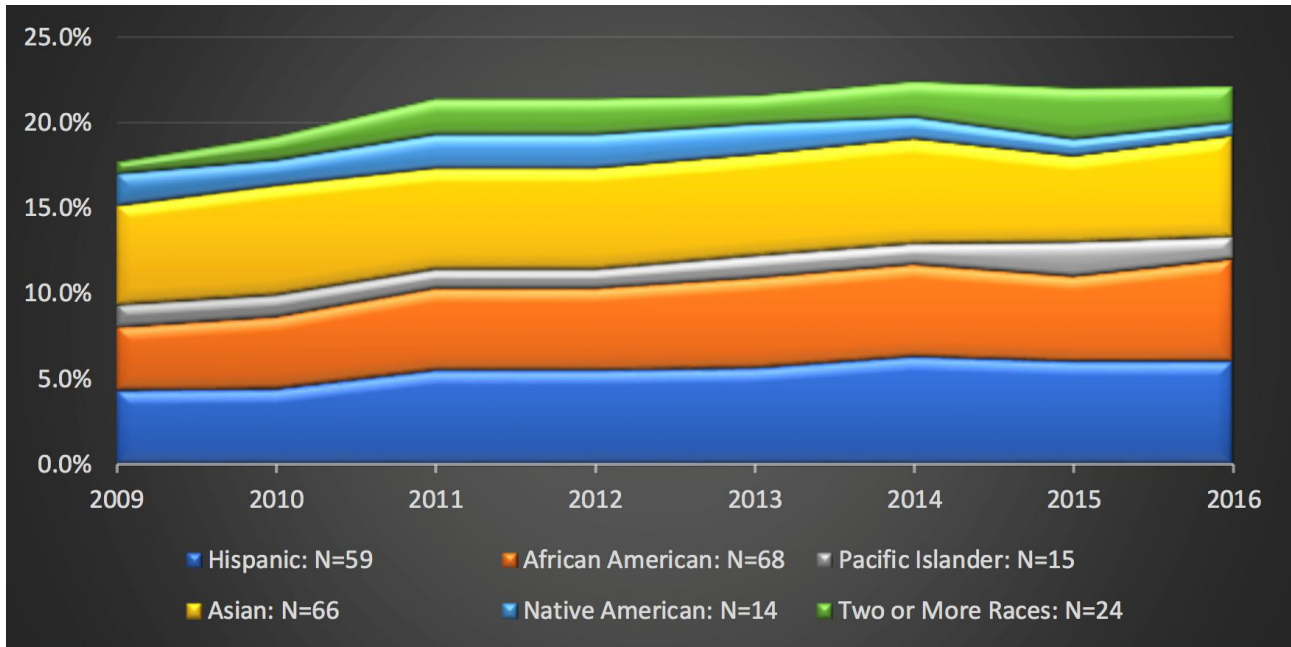


Figure 2. Time-evolution of populations of AURA employees from underrepresented groups. Figure from “Workforce Diversity Progress Report.”<sup>11</sup>

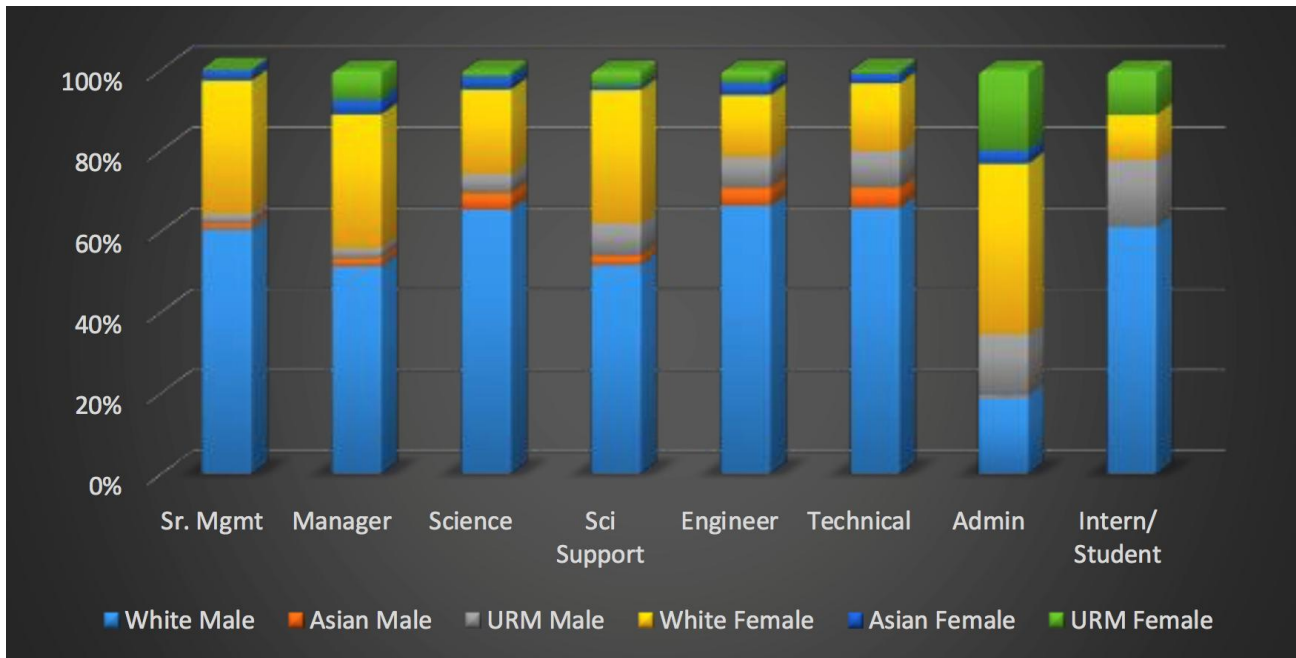


Figure 3. AURA employee population separated into departments. Managers and senior managers are counted in the department groups as well. Figure from “Workforce Diversity Progress Report.”<sup>11</sup>

Figure 3 shows how AURA employee representation is reflected in each department. Administration is the only group with a higher representation of female employees working in the department, however this group and the inter/student population do not have representation from all 6 groups.

Table 1. Quantitative data of AURA employees from each group, separated by department. Table from “Workforce Diversity Progress Report.”<sup>11</sup>

	Sr. Mgmt	Manager	Science	Sci Support	Engineer	Technical	Admin	Intern/Student	Totals
White Male	46	56	163	94	213	79	52	11	714
Asian Male	1	2	10	4	14	6	1	0	38
URM Male	2	3	12	15	25	11	41	3	112
White Female	25	36	52	60	49	20	114	2	358
Asian Female	2	4	8	2	10	3	9	0	38
URM Female	0	8	4	7	10	1	54	2	86
<b>Totals</b>	<b>76</b>	<b>109</b>	<b>249</b>	<b>182</b>	<b>321</b>	<b>120</b>	<b>271</b>	<b>18</b>	<b>1346</b>

The table above represents the data from figure 3 in tabular, numerical form. Even though some departments have full representation, there is an obvious difference in quantities between these groups. Facilitating an inclusive environment can also potentially mitigate the chances of alienation of employees in the groups that are represented by only one or two employees.

Further data is provided in Figures 4 and 5 to show representation among the AURA science department and the engineering staff, separated into the five AURA centers: (1) Gemini Observatory, which has sites in Chile and Hawaii; (2) National Optical Astronomy Observatory (NOAO), which has sites in Arizona and Chile; (3) National Solar Observatory (NSO), which has sites in Hawaii, Colorado, and New Mexico (although the move to Boulder may be complete); (4) Large Synoptic Survey Telescope (LSST), which is in construction phase, but has employees in Arizona and part-time in Chile; and (5) Space Telescope Science Institute (STScI), which operates in Maryland.

Regardless of the centers’ multiple geographic locations, the dominant group across centers in science research and engineering staff is white male, with a minimum representation of 60% in these groups within each center. These data are not coupled with the local demographics of each center. In the case of Chile, for example, the different population creates a different pool of available workers, changing how demographics at Gemini South are compared to local and expatriate populations, so this picture is incomplete.

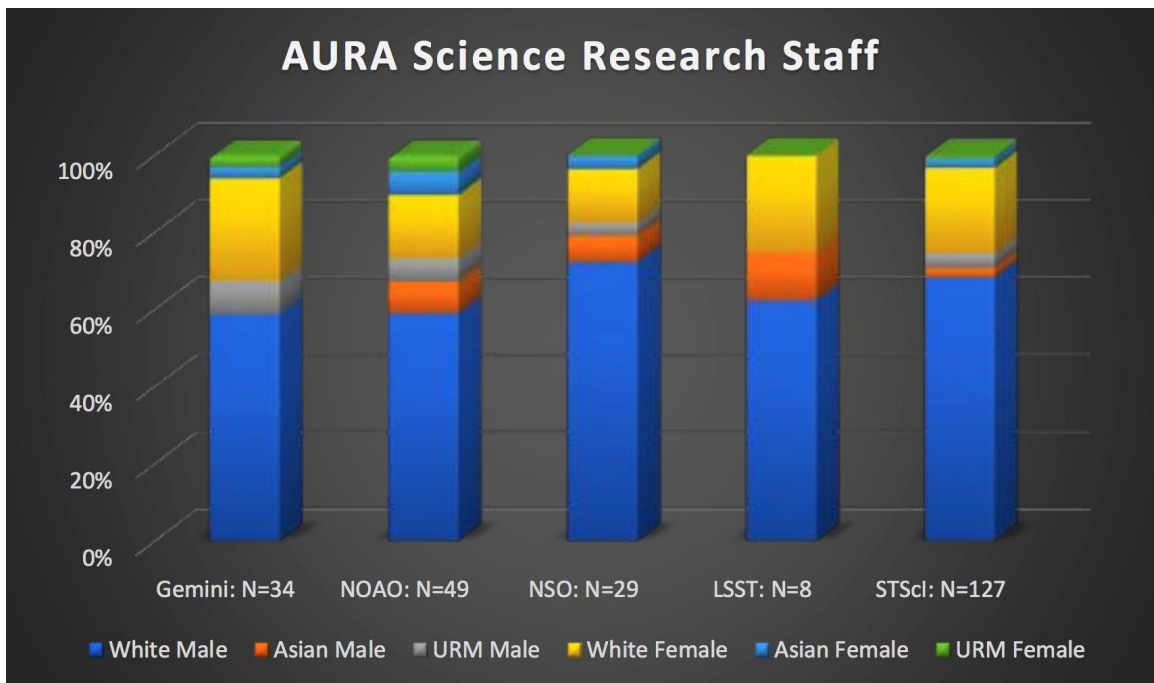


Figure 4. AURA employees working in science research, separated by AURA center. Figure from “Workforce Diversity Progress Report.”<sup>11</sup>

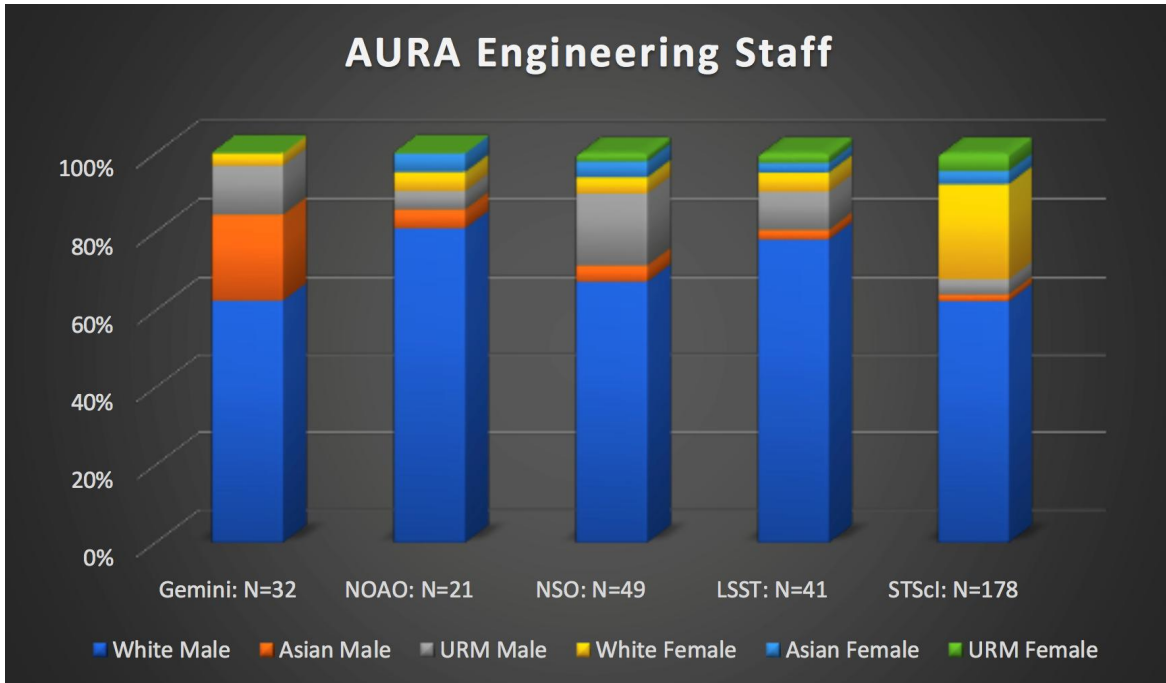


Figure 5. AURA employees working in engineering departments at all centers. Figure from “Workforce Diversity Progress Report”<sup>11</sup>.

## 2.2 NRAO

The following data was kindly provided by the Human Resources department of NRAO in a private communication. As with the AURA data, the demographics data here does not represent the whole story. Demographics data from the Atacama Large Millimeter/Submillimeter Array, located in northern Chile, is not shown. There are no direct comparisons with a national or industry average. The demographics slices at NRAO are slightly different than those made by AURA, as well. For example, NRAO separates post-doctoral staff from science staff. All of the data from NRAO is compared between two samples, from fiscal years 2012 and 2017. Nevertheless, the takeaway is that even if the picture appears discouraging now, positive change and strong initiative in diversity and inclusion programs at each organization can improve these statistics.

Figure 6 presents the NRAO employee population divided into three sites: (1) Charlottesville, the administration offices located in Virginia; (2) the Green Bank site, located in West Virginia; (3) the Socorro offices and the Very Large Array, located in New Mexico. The biggest standout is the Green Bank site that is 99% white. This number has not changed in the 5 years between data collection.

Figures 7 and 8 display the stark comparisons between white staff and all other minority groups in the entire engineering and technical staff and science staff, respectively. In both groups, small gains have been made in minority representation. In the scientific staff, slight loss in female representation is reported between fiscal years 2012 and 2017.

Table 2. Overall change in staff in each group from FY 2012 and FY 2017. Data provided by NRAO Human Resources.<sup>12</sup>

	FY12	FY17	Change over 60 Month Period	
Amer Indian	1	3	2	200.0 %
Asian	24	19	-5	-20.8 %
African American	8	6	-2	-25.0%
Hispanic or Latino	55	55	0	0.0 %
Pacific Island	0	1	1	100.0 %
Multiple	1	7	6	600.0 %
White	396	424	28	7.1%
<b>TOTAL</b>	<b>485</b>	<b>515</b>	<b>30</b>	<b>6.2%</b>
<b>All Minorities</b>	<b>89</b>	<b>91</b>	<b>2</b>	<b>2.2%</b>

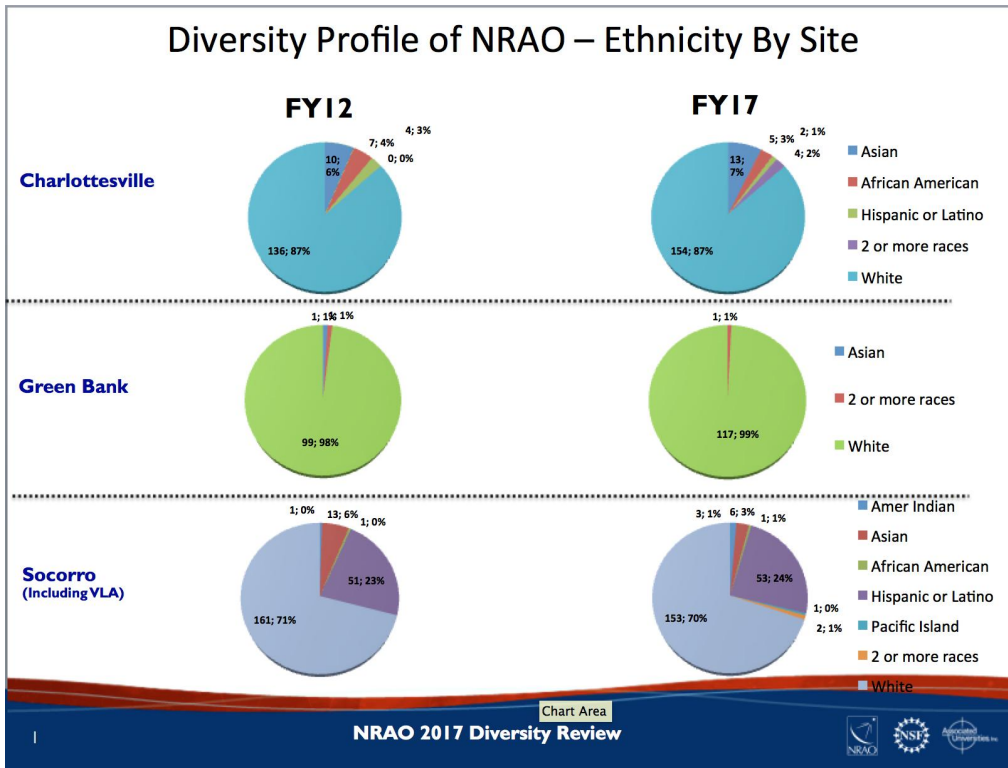


Figure 6. NRAO employee demographics by site. Data provided by NRAO Human Resources.<sup>12</sup>

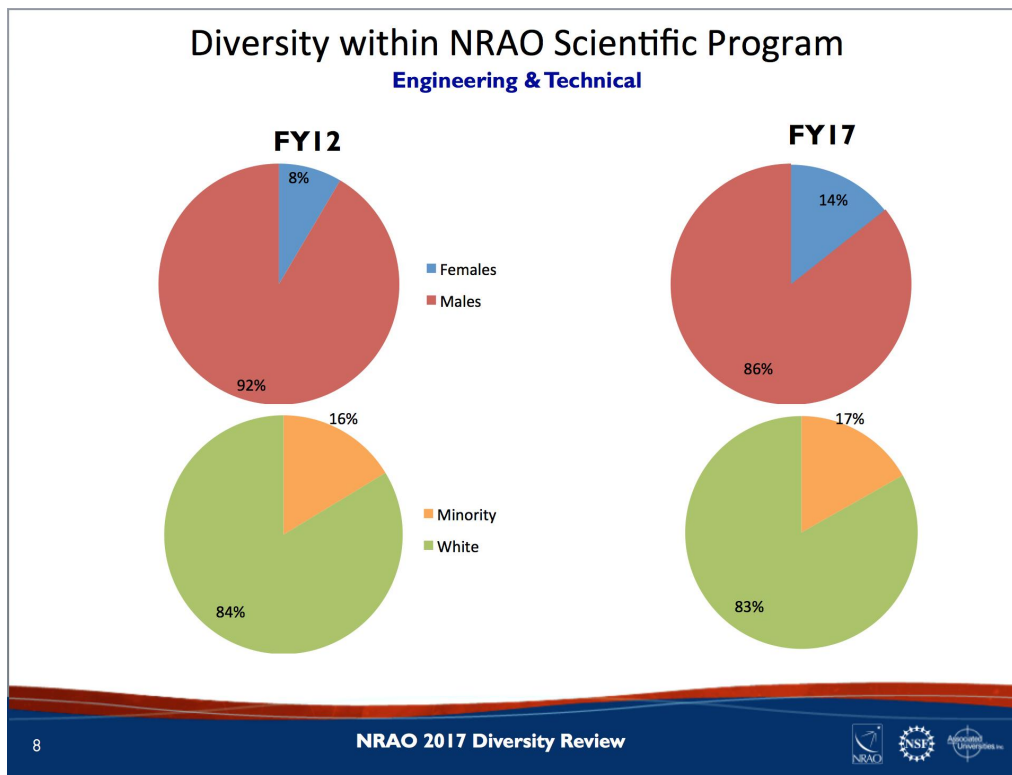


Figure 7. Changes in representation in the engineering and technical staff for male and female employees, and combined minority groups. Data provided by NRAO human resources.<sup>12</sup>

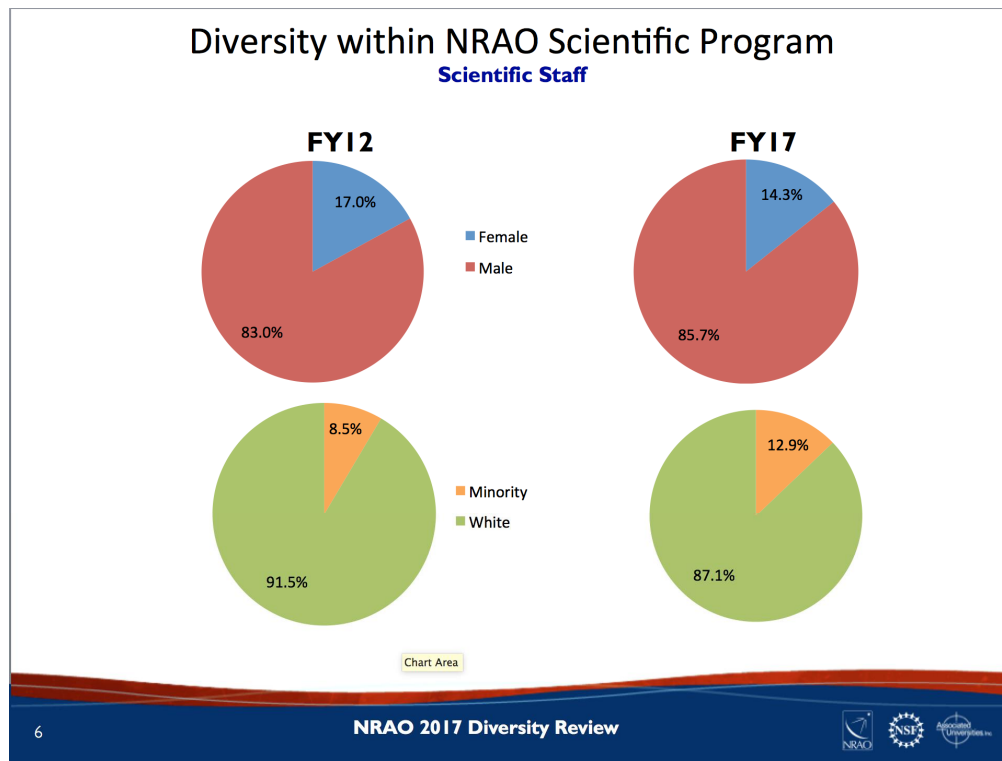


Figure 8. Changes in representation in the science staff for male and female employees, and combined minority groups. Data provided by NRAO human resources.<sup>12</sup>

### 3. INCLUDING INCLUSION

Diversity and inclusion is a well-known phrase in this work, but in the literature, and in practice, the “diversity” theme of the phrase takes center stage in efforts to improve representation. Demographics and hiring practices and employment metrics dominate the conversation, but these tools are only half the battle. Creating an inclusive work environment maintains the diverse workforce that best hiring practices and career pipelines help to populate. It is essential to facilitating good communications and understanding between employees of a diverse group. In this section, we discuss how an inclusive environment positively impacts workplace culture and employee retention, how employees perceive workplace climate, and introduce inclusive leadership. We present a review of a conceptual framework of inclusion and inclusive practices that directly relates to the real-world practices of an inclusive environment, discussed in section 4.

#### 3.1 Benefits of an inclusive workplace

Current inclusion literature tends to have a theme of identifying and trying to balance the desires of an individual to belong to a group and to remain unique. Being a part of a group incites “loyalty, cooperation, and trustworthiness among group members,”<sup>13</sup> but if members are perceived as too similar, the members become interchangeable and stronger need to reestablish individuality arises. On the other hand, to fulfill the need for belongingness, people identify social themes of a particular group and seek acceptance in them. This prevents feelings of isolation and creates a sense of connection.<sup>14</sup> An individual is most motivated to identify with a group when it allows for the satisfaction of both belongingness and uniqueness, and these levels vary on a case-by-case basis.<sup>15</sup> When these needs are jeopardized, people will engage in efforts to fulfill these needs and restore the balance. Sometimes these efforts include self-stereotyping, differentiating themselves within a group, or placing greater value on one social identity that may not be in line with that of the group.<sup>14,15,16</sup> Throughout this literature, authors argue for work environments where “diversity is pervasive and part of an overall perspective and strategy that is inclusive of all employee differences.”<sup>17</sup>



There is empirical evidence of the benefits of inclusion to the organization as well. One study found a direct correlation between inclusion and job satisfaction,<sup>18</sup> while exclusion from decision-making was shown to be a strong predictor of an employee's intention to leave.<sup>19</sup> In the case of the positive correlation between job satisfaction and inclusion, the employees' perceptions of inclusion and exclusion in the workplace influenced their level of satisfaction at work. The concept of inclusion perception is discussed more in the following subsections. Perceived inclusiveness has also been found to positively correlate with intent to remain in a workplace or position.<sup>20</sup> Employees who feel more involved and socially accepted in the workplace identify much more strongly with the organization and create a sense of attachment.<sup>19</sup>

### 3.2 Perceptions of Inclusion

The perception of being included delves into highly technical fields of psychology outside of the scope of this paper. However, an easy way of interpreting the feeling of inclusion is to equate it to having an "insider status." An "insider" is considered a legitimate member of an organization, and highly identified by it. This person feels that they are capable of acting within the best interests of the organization, and, more importantly, will receive support to do so. They will be more likely to act altruistically on behalf of the organization,<sup>21</sup> which could manifest in dedicated work ethic and striving to contribute more to improve the organization, not just the betterment of the self. Studies that evaluated employees' perceptions of inclusive leadership (see section 3.3) between different organizational statuses found that positive perceptions contributed to team engagement.<sup>22</sup>

### 3.3 Inclusive leadership

Institutional improvement has no foundation without support from the top. Positive change is a trickle-down function that falls onto a solid foundation of implementation. For this, inclusive leadership on every level is critical to maintaining a healthy inclusive workplace culture. The importance that the organization gives to the philosophy and values pertaining to diversity and inclusion directly affects acceptable practices in the work place. The organization's commitment to foster inclusion also defines the expectations of the employees.

Leaders that solicit others' contributions and invite input from all group members engage in inclusive practices.<sup>22</sup> Employees that have perceptions of fairness from leadership - such that everyone's values or actions have equal weight, or their positions in the group are equal - take pride in group membership, and making positive contributions to it. Unfair treatment, on the other hand, conveys to a group member that they are not equal or respected, which could result in performance withdrawal and low identification with the group.<sup>23</sup>

The ideas just discussed have application at all levels of leadership, but direct managers have strong impacts on worker experience, so it is necessary to understand the benefits of having a well-trained management staff that act inclusively and understand the organization's policies regarding diversity and inclusion. High levels of leader-member exchange (LMX) in diverse and low-differentiation (members are equal) groups are associated with lower turnover rates.<sup>24</sup> Leader-member exchange, such as employees contributing ideas in group meetings or managers properly giving support and credit to employees, is a very important communication tool for an organization.<sup>24</sup> For this to be the most effective, leaders need to display behaviors consistent with group values, as well as fairly distribute awards and opportunities for subordinates. Dual focus on diverse member acceptance and acting within the organization's code of conduct is essential to create a high level of LMX.<sup>25</sup> These leaders contribute much to the culture of inclusion in the workplace, since they help establish the practices that support this culture. High LMX goes to actively engage potential resistance to diversity and inclusion efforts, which will make individual efforts of workplace inclusion more successful.<sup>26</sup>

### 3.4 Inclusive framework and practices

Shore et al. (2011) presents a framework with which to evaluate the current literature on diversity and inclusion. This framework is useful as a toolkit to organize efforts to improve inclusive practices, and to recognize possible areas of weakness or strength in an organization's diversity and inclusion policies. This section is devoted to explaining this adapted framework and how it can be applied to practice in the workplace. This will be linked to section 4, which details the different mechanisms used to apply these themes in a working observatory.

The chart presented in figure 9 is a way to visualize the unity of an employee's sense of uniqueness and belongingness in the group, which work together to create feelings of inclusion. Each of the cells in figure 9 has a label in the chart. Each cell is explained in more detail here.

*Inclusion:* An example of how this can take place in the workplace is an older employee who has knowledge of the industry and the organization. This person should be treated as an insider to the group - as an asset with valuable

knowledge - but this person can also benefit from working with younger employees. They can share their experience with newer members, and create feelings of inclusiveness with the younger staff. This person can benefit from continuing to learn from the newer employees' different perspectives as well. Diversity literature demonstrates evidence of the benefits of maximizing belongingness and uniqueness. Minority members with developed networks report high levels of career optimism.<sup>27</sup> Diverse work groups that adopt an "intergration-and-learning"<sup>1</sup> perspective involve respecting uniqueness because diversity is treated as a resource, and belongingness because members are equally respected.<sup>28</sup> These organizations are able to facilitate more effective cross-departmental collaboration, and allow the individuals in the group to enhance their own skills.<sup>28</sup>

*Exclusion:* This is the low-belongingness/low-uniqueness cell in figure 9. This is where there are apparent cases of unfair treatment of an individual in the organization. In one case, this individual may not be considered an insider, and others clearly are. Whether explicitly or implicitly excluded, there are documented consequences of harmful cognitive, emotional, or behavioral outcomes.<sup>1</sup> Workplace exclusion has also been found to be detrimental to work attitudes and psychological health.<sup>29</sup> Generally speaking, a member of the organization who treats unique characteristics as unimportant or irrelevant is contributing to an exclusive environment.

*Assimilation:* In appearance, this appears to be a positive initiative, because all of the individual members of the group are given equal weight as long as they conform completely to the workplace culture without input. This is a tricky place, because there must be give and take. One example is a cultural phenomenon that took place in the United States. The concept was to say that a person is "colorblind," so that no races exist or that they are not recognized as having different experiences. This works to fit everyone in a group, but it washes away the uniqueness or identity of the individual, and they are forced to conform to a new culture – one that is potentially very different from their previous experience. An individual may interpret this as having an "undesired" characteristic, and they have the choice to downplay it or modify themselves to conform to the group.<sup>30</sup> One example of this is when women were found to adopt more masculine behaviors in order to fit the model of a successful male attorney.<sup>31</sup> Another example is when African American executives surveyed reported that to get ahead, they felt they had to dress and act in an expected way, like a "typical" executive, so they could fit in to the group more effectively.<sup>32</sup> Emotional exhaustion and high turnover followed these actions of conformity, as it is a heavy strain to modify the self day after day just to adapt to the expectations of the group's culture and values.<sup>33</sup>

*Differentiation:* People have a need to be moderately unique, and people with higher needs of uniqueness tend to be more creative.<sup>34</sup> Organizations have increasingly treated uniqueness as a form of human capital they may even grant the group competitive advantage.<sup>35</sup> The downside of this is that these individuals are not treated as part of the group, or an organizational insider. Diversity was sometimes adopted as a way to reach certain markets, but these minority members were not considered to be a true part of the larger organization, and they were subject to isolation and sometimes privy to race-based stereotypes.<sup>28</sup>

	Low Belongingness	High Belongingness
Low Value in Uniqueness	<p style="text-align: center;"><b>Exclusion</b></p> <p>Individual is not treated as an organizational insider with unique value in the work group but there are other employees or groups who are insiders.</p>	<p style="text-align: center;"><b>Assimilation</b></p> <p>Individual is treated as an insider in the work group when they conform to organizational/dominant culture norms and downplay uniqueness.</p>
High Value in Uniqueness	<p style="text-align: center;"><b>Differentiation</b></p> <p>Individual is not treated as an organizational insider in the work group but their unique characteristics are seen as valuable and required for group/ organization success.</p>	<p style="text-align: center;"><b>Inclusion</b></p> <p>Individual is treated as an insider and also allowed/encouraged to retain uniqueness within the work group.</p>

Figure 9. Inclusive framework. Figure used from Shore et al. (2011).<sup>1</sup>

An inclusive climate involves all members of the group receiving fair treatment. System justice is built into the foundation of the organization. It is expected that codes of conduct, procedures, and information generation, processing, and reception is the same on all levels of the organization, for individuals and for groups.<sup>36</sup> An inclusive climate is also a "climate for opportunity," in which an individual perceives established processes for fair advancement and interpersonal treatment.<sup>37</sup> A diverse organization has more than one racial identity, so this organization is prepared and open to embracing value differences and deals with racial conflict and diversity issues openly.<sup>38</sup> A climate of inclusion also includes fair hiring practices, a fluid mechanism for integration of employees from all walks of life, and involvement in decisions on different levels.<sup>38</sup> Figure 10 displays a flowchart containing these principles and the associated outcomes of these ideas in practice.

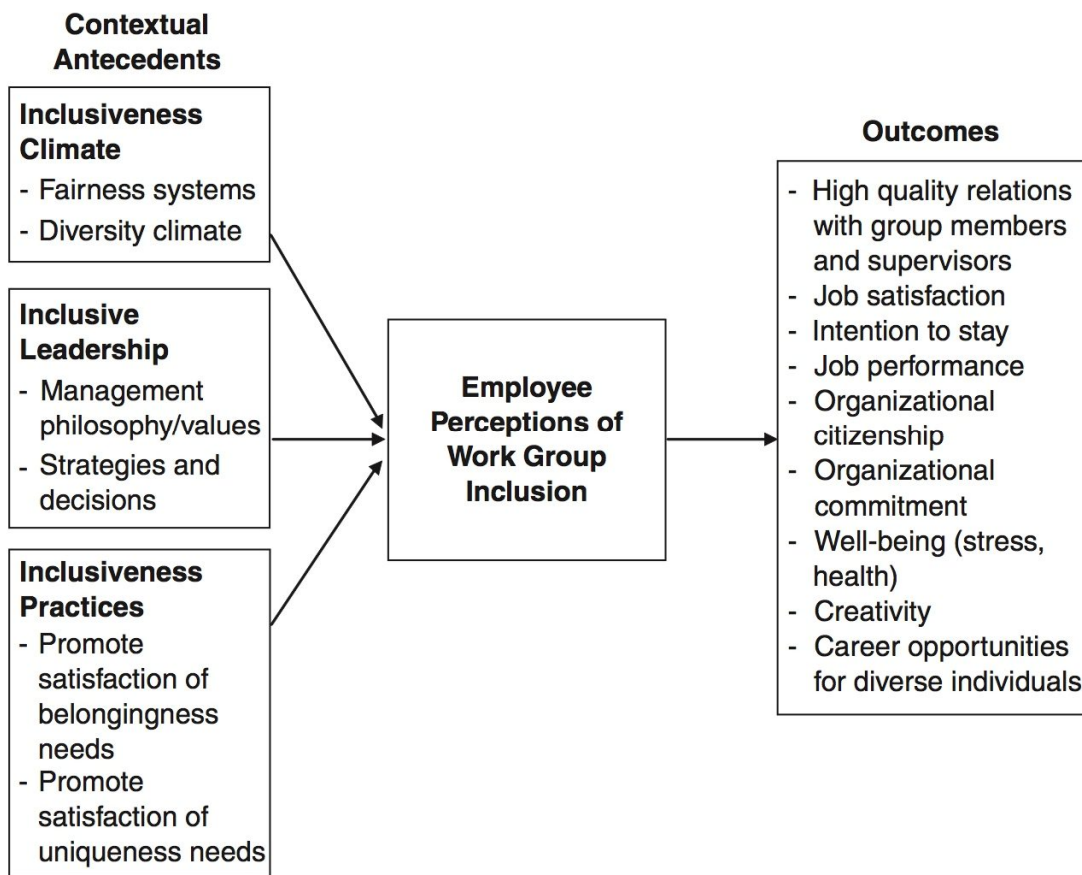


Figure 10. "Antecedents and Outcomes of Inclusion," figure used from Shore et al. (2011).<sup>1</sup>

#### 4. DIVERSITY AND INCLUSION IN PRACTICE

The following section details efforts at a few different observatories located in the United States and Chile. The themes of inclusive climate from section 3 are put into practice. These efforts are anecdotal, and are presented with the idea that they are adaptable to other observatories or scientific research organizations. The important takeaway from this section is that individuals organized these initiatives, with support from their centers, illustrating there are ways that one or two people can begin positive institutional change.

#### 4.1 How to start the conversation

Starting the conversation about diversity and inclusion in the workplace is important. Reaching out to the staff and working through potential roadblocks or doubts in diversity and inclusion efforts establishes an open dialogue about potentially-charged subjects. It allows for the most effective exchange of ideas, and more importantly, individual experience. It's monumental to these efforts to understand that the people we work with, even in the same group, may have a completely different working experience, or set of values, than we do. These conversations are effective on a small group level, as detailed below. They are useful tools to find potential allies (described in section 4.4) and to give everyone a chance to challenge or question the concepts. This is inclusion in action – making sure that the individuals or groups that don't share the same mentality have a chance to express their ideas and concerns as well.

The AURA centers located in Chile reside on a shared compound with separate office buildings serving the observatories. In addition to this, the different telescopes at high-altitude summits have staff working different shifts covering all 24 hours. There are summit facilities and lodging for day and night staff. With so much staff spread amongst different locations day-by-day, it was decided the best way to reach all of them was to host a series of smaller meetings at each center to reach as many interested participants as possible. Over three months, meetings took place in La Serena at the different offices of Gemini South, CTIO, SOAR, and AURA administration. We also traveled to Cerro Pachon and Cerro Tololo, the summit locations of the telescopes, 90 km from the offices in La Serena, and held meetings in the afternoon so interested day and night staff could participate. We sent invitations to each center roughly two weeks before each session, introducing ourselves and explaining the motivation for these sessions, described previously.

These meetings were informal one-hour coffee chats that took place in break rooms or conference rooms with open doors and attendance. We did not want to influence the conversation too much, but offer the participants to bring up any issues or ideas they had about diversity and inclusion at AURA, or in a general context. We did come prepared with a few opening questions to begin the discussion, listed below:

1. "How do you feel about diversity in the workplace? Do you think it's important?"
2. "If you had time and resources to make change, what would your priorities be?"
3. "How do you describe your work to your friends or significant others?"
4. "If you were a brand new employee at AURA, what would you want or expect to help adjust to the move and to the workplace?"
5. "If you have any sort of issues in the workplace, what resources do you have to resolve them? Are these resources sufficient? Do you think there can be any improvements?"
6. "In one year, what kinds of changes do you think are possible? What would you like to see the most? How would you accomplish this?"

Every coffee chat, or "Round Robin" as we referred to it, took a different theme. Employees used the time to ask us about who we are and why these initiatives were taking place. Employees shared their own experiences and observations working at the different centers, and shared their own ideas about what they would do with simple resources or a support group to improve workplace culture. There were also attendees who came and asked great questions about what "diversity & inclusion" means, in the sense of what our goals are, and why these initiatives are necessary. Talking through our goals with other employees helped us identify the top priorities, and we were able to take some of these ideas and make policy recommendations to center leadership. Most importantly, the conversation was initiated.

After initiating the conversation, it's important to keep it going. Informal groups that meet to discuss current events in diversity and inclusion or keep updated on the current status of the organization's initiatives can be easy to organize. An open-door attendance policy and open mind is essential to maintaining an informal group, as well as a bit of effort to keep the meeting dates established and a way to suggest topics. Informal or advocate groups will not run short of current events in diversity and inclusion, from the good: the release of "Hidden Figures," a major blockbuster film highlighting the contributions that African American women made to NASA – to the bad: the slow change of demographics in

science from the most recent decadal survey – and the very ugly: the high-profile cases of sexual harassment disputes with tenure-track scientists that have emerged from the United States. All of these things bring diversity and inclusion into light, and make for interesting discussion within the context of the group’s specific organization.

## 4.2 Building interest

Finding outside learning or training resources strengthens the argument. There are many authorities on modern diversity and inclusion initiatives, and these agencies create an unbiased picture of the importance of these practices. One such agency we found was the Centro Interdisciplinario de Estudios de Género (Center of Interdisciplinary Studies of Gender, CIEG), a non-profit research organization in the Department of Anthropology in the University of Chile, Santiago. We invited members of this research group to come and give a public one-hour talk to employees of AURA Chile centers about the current status of the women’s workforce in Chile. This talk also incorporated themes of the local culture, and what efforts and businesses were leading the way to balance the unbalanced employment in Chile. This public talk was web-linked with the remote sites, or users could connect individually, so the remote staff could participate as well. As this research group is based in Chile, their primary language of communication is Spanish, which is the first language of roughly half of the employees based in Chilean AURA centers. The first talk was given in Spanish in the morning, and after the lunch break, managers from the different AURA centers were invited to participate in an interactive group workshop, where these issues and themes of unconscious bias, as well as stereotypes, were discussed extensively. After these events, we sent a center-wide email survey to get feedback for the event. The responses were anonymous. The survey questions are listed below in English and Spanish:

1. “The talk was interesting and informative. / La charla fue interesante y efectiva.”
2. “I would like to see more talks or trainings like this in the future. / Me gustaria ver otras charlas o talleres como este en el futuro.”
3. “I think that it is important to understand the working culture at AURA. / Creo que es importante entender la cultura laboral en aura.”
4. “I will use what I learned at this presentation in the workplace at AURA. / Voy a emplear en mi lugar de trabajo lo que aprendi en esta actividad.”
5. “I felt that my time was well-spent attending this talk. / Creo que el tiempo empleado en esta actividad valió la pena.”

Five options were given: (1) Strongly agree; (2) agree; (3) indifferent; (4) do not agree; (5) strongly disagree. Two encouraging results of this survey was that 85% of the respondents reported that they agreed (40%), or strongly agreed (45%), that they would apply what they learned in the workplace. 95% of the respondents agreed (35%) or strongly agreed (60%) that they felt their time was well spent attending the public presentation. We invited the group back to give the same talk and workshop in English, and one representative traveled to the CTIO summit to give the presentation and a shorter workshop to the remote staff, to ensure that everyone had access to the material.

CIEG was chosen because they offered a good opportunity to hold a discussion about diversity and inclusion from a Chilean perspective. Exclusively bringing in American trainers to talk about American issues or cases to a staff that is composed of a majority of non-Americans is not the way to begin a dialogue. In some cases, it can be interpreted as impressing only American ideals and standards on a workforce that does not identify with the same. At the same time, it is better for expats and Chileans to understand that diversity and inclusion is being built into the local working culture, and as a part of local culture, we should be aware of current issues and initiatives in Chile. In general, aiming to offer material that speaks to as many groups or individuals as possible is the most effective way to engage as many as possible.

These talks are one possible example of offering trainings for staff. The next step was to discuss with Human Resources (HR) what we thought should be a priority in management training. The HR staff is equipped with many employee-training sources, and as diversity and inclusion has become a noticeable part of the working culture, they have access to trainings in this topic as well. In 2017, for the two Gemini centers, in response to recommendations from the round robin

talks and advocates from the centers, HR implemented an immersive 2-day diversity and inclusion training. An instructor from the American Management Association (AMA) offered a course for leadership at Gemini north, and for managers at all of the AURA-managed centers in Chile.

In the case of limited funding or time, resources such as <https://www.lynda.com/>, an extensive free library of trainings that is searchable by subject, are very valuable. In the United States, the National Diversity Council is a non-profit organization that offers member access to diversity and inclusion resources, such as webinars, trainings, and a large community of other members, both non- and for-profit entities, both state-wide and national<sup>39</sup>. In Chile, Accion Empresas<sup>40</sup>, offers similar benefits to members. Options that don't include the organization becoming a member are to seek out advocate groups in the local university or community college campuses. CIEG was discovered this way, and it is clear that these groups are eager to discuss diversity and inclusion. They could be a vital and inexpensive resource to diversity and inclusion material. Also, a partnership or communication link between the observatory and local education groups is a major plus to observatory outreach efforts or employee pipeline construction.

Other smaller scale activities to involve all employees include a billboard updated monthly with current diversity and inclusion topics, and anything relevant to the ongoing discussions in that center. Other ideas are observatory employee jamborees given with snacks and coffee or tea, allowing for those who are interested to share their research or work projects with everyone. It provides an opportunity to share experiences, to get to know each other better, as well as to take pride in everyone's different accomplishments regarding work. Apart from implementing awards systems, this is a much more casual way to celebrate the work of the observatory employees. To celebrate talents outside of work achievements, we implemented a mobile artists' corner, where volunteers can share their projects such as jewelry-making, sculpting, photography, and drawing. All of these activities build interest, engage more participants than formal trainings or meetings, and are geared for inclusivity and accessibility.

### **4.3 Participating in diversity and inclusion events outside of the workplace**

This can take place on an individual or a group level. Conferences such as the Society of Women in Engineering (SWE), the National Society of Black Physicists (NSBP), the National Society of Black Engineers (NSBE), or the Women in Astronomy (WiA) (to name a few in the United States), are excellent resources to represent the organization or to train individual employees. These include career fairs, seminars, and trainings on topics geared toward workplace culture improvement, better hiring and communication practices, and the current state of diversity in science industries. Individuals or companies at SPIE, AAS, and AO for ELT offer talks about their efforts of workforce improvement taking place (similar to the scope of this paper), to share ideas of what works and what doesn't in industry diversity and inclusion efforts.

Smaller scale events take place locally. If not a member of a community like the National Diversity Council, as mentioned in section 4.2, begin with the local university and community colleges. They will not only host career fairs, but will have many active advocate groups for students. Educational institutions want their students of all backgrounds to succeed in the workforce, and will likely present a wealth of resources for diversity and inclusion engagement and discussion. Funding opportunities aren't infinite, so free, local events are a great opportunity to engage employees.

### **4.4 Finding resources from within your organization**

It is important to talk with leadership and HR to establish what efforts they are taking to improve workplace culture or to improve diversity in the center. Define with these groups what the priorities of the center are, and gather recommendations about what they should be. Find allies in the center. We were able to find interested volunteers for future projects from the "Round Robin" talks we gave to the different AURA centers. The establishment of allies is essential to working effectively in the organization, but allies in administration as well as in the general workforce of the center, offer a good mix of resources and opportunity for idea exchange. Administration and leadership are the ways to implement policy change, so a good working relationship with these groups is essential to success.

Other resources such as time allocation, travel funding for conference attendance, or work recognition are also important to define for starting or continuing these efforts in any center. Volunteers need not act out of altruism entirely, as it should be recognized as work contributed to the organization to aid these initiatives. Efforts such as participating in group sessions, attending talks, or hosting meetings to create policy change ideas take work and time, and they should not go unnoticed. Contributing to building interest is also an effort that should be recognized by the organization.

Resources to send employees to international or local events might be allocated after a need is established. When effort is recognized and there is consistent and reliable leadership or administrative support, the organization's commitment to diversity and inclusion is well-established.

## 5. CONCLUSION

In this paper, we reviewed the evidence that diversity in working groups has positive benefits to the group or organization as a whole. Higher creativity, better problem solving, and conflict resolution are some of the measured benefits of a diverse group vs. a homogeneous one. Examples of the current state of diversity in the workforces of two major international observatories, AURA and NRAO show unbalanced representation in the industry. These data were presented in order to illustrate the need for stronger diversity and inclusion initiatives in observatory operations. Inclusion was emphasized in this paper, to give it the proper equal weight with diversity initiatives, such as good hiring practices and effectively dealing with unconscious bias. Inclusion is often left out of the conversation, but creating an inclusive environment is essential to attracting and maintaining diverse staff, as reviewed in section 3.

The remainder of the paper outlined anecdotal evidence of inclusive practices in a working international observatory. The examples come from the efforts of individuals at the different centers in Chile, Arizona, Colorado, Hawaii, and Maryland. The goal of this is to give an idea of adaptable inclusive practices, in the hopes that readers or listeners find ideas or inspirations to create inclusion initiatives at their own institutions. These efforts overlap quite a bit with those proposed in a previous SPIE proceedings paper, "Gender equality issues in astronomy: facts, fiction, and what the adaptive optics community can do to close the gap."<sup>41</sup> This paper can serve as an extension of those ideas put to practice, for not just the adaptive optics community, but observatory operations and other astronomy research groups. Starting the diversity and inclusion conversation, finding and creating alliances, and building interest activities are all efforts that are possible by just one person to take steps to initiate positive change in the industry.

## ACKNOWLEDGEMENTS

Thank you to the authors of this paper for their contributions to workplace climate improvement at their organizations. Thank you to Faye Giles at NRAO for providing the employment demographics data from HR. Thank you to anyone who contributes to this work. It is essential to the ongoing accessibility and betterment of the astronomy industry.

## REFERENCES

- [1] Shore, L. M, Randel, A. E., Chung, B. G., Dean, M. A., Ehrhart, K. H., Singh, G., "Inclusion and Diversity in Work Groups: A Review and Model for Future Research," *Journal of Management*, 37(4), 1262-1289 (2011).
- [2] Stahl, G. K., Maznevski, M. L., Voigt, A., Jonsen, K., "Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups," *Journal of International Business Studies*, I-20, (2009).
- [3] Roberge, M. E., Dick, R., "Recognizing the benefits of diversity: When and how does diversity increase group performance?," *Human Resource Management Review*, 20, 295-308 (2010).
- [4] Hong, L. & Page, S., "Groups of diverse problem solvers can outperform groups of high-ability problem solvers," *Proc. National Academy of Sciences*, 101(46), 16385-16389 (2004).
- [5] Medin, D. L. & Lee, C. D., "Diversity makes better science," *Association for Psychological Science*, May/June 2012, <https://www.psychologicalscience.org/observer/diversity-makes-better-science> (27 April 2012).
- [6] Brewer, M. B., "The social self: On being the same and different at the same time," *Personality and Social Psychology Bulletin*, 17, 475-482 (1991).
- [7] De Dreu, C. K., & West, M. A., "Minority dissent and team innovation: The importance of participation in decision making," *Journal of Applied Psychology*, 86, 1191-1201 (2001).
- [8] Bang, M., Medin, D. L., Altran, S., "Cultural mosaics and mental models of nature," *Proc. National Academy of Sciences*, 104(35), 13868-13874 (2007).

- [9] Jehn, K. A., & Mannix, E. A., "The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance," *Academy of Management Journal*, 44(2), 238-251 (2001).
- [10] Clearwater, S., Huberman, B., & Hogg, T., "Cooperative solution of constraint satisfaction problems," *Science*, 254, 1181-1183 (1991).
- [11] Mountain, M., Hamel, H., Bruff, S., Barker, N., "Workplace and Diversity Progress Report," *Diversity Progress Reports*, <http://www.aura-astronomy.org/diversity.asp?diversity=progress> (2016).
- [12] Internal NRAO Diversity Review, Human Resources, Private communication.
- [13] Brewer, M. B., "The importance of being we: Human nature and intergroup relations," *American Psychologist*, 62, 728-738 (2007).
- [14] Pickett, C. L., Silver, M. D., & Brewer, M. B., "The impact of assimilation and differentiation needs on perceived group importance and judgments of group size," *Personality and Social Psychology Bulletin*, 28, 546-558 (2002).
- [15] Pickett, C. L., Bonner, B. L., & Coleman, J. M., "Motivated self-stereotyping: Heightened assimilation and differentiation needs result in increased levels of positive and negative stereotyping," *Journal of Personality and Social Psychology*, 82, 543-562 (2002).
- [16] Jetten, J., Spears, R., & Manstead, A. S. R., "In-group similarity and group variability: The effects of group distinctiveness on the expression of in-group bias," *Journal of Personality and Social Psychology*, 74, 1481-1492 (1998).
- [17] Chrobot-Mason, D., & Thomas, K. M., "Minority employees in majority organizations: The intersection of individual and organizational racial identity in the workplace," *Human Resources Development Review*, 1, 323-344, (2002).
- [18] Acquavita, S. P., Pittman, J., Gibbons, M., & Castellanos-Brown, K., "Personal and organizational diversity factors' impact on social workers' job satisfaction: Results from a national Internet-based survey," *Administration in Social Work*, 33, 151-166 (2009).
- [19] Mor Barak, M. E., Levin, A., Nissly, J. A., & Lane, C. J., "Why do they leave: Modeling child welfare workers' turnover intentions," *Children and Youth Services Review*, 28, 548-577 (2006).
- [20] Avery, D. R., McKay, P. F., Wilson, D. C., & Volpone, S., "Attenuating the effect of seniority on intent to remain: The role of perceived inclusiveness," *Proc. Meeting of Academy of Management*, 13 (2008).
- [21] Stamper, C. L., & Masterson, S. S., "Insider or outsider? How employee perceptions of insider status affect their work behavior," *Journal of Organizational Behavior*, 23, 875-894 (2002).
- [22] Nembhard, I. M., & Edmonson, A. C., "Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams," *Journal of Organizational Behavior*, 27, 941-966 (2006).
- [23] Kreiner, G. E., & Ashforth, B. E., "Evidence toward an expanded model of organizational identification," *Journal of Organizational Behavior*, 25, 1-27 (2004).
- [24] Nishii, L. H., & Mayer, D. M., "Do inclusive leaders help to reduce turnover in diverse groups? The moderating role of leader-member exchange in the diversity to turnover relationship," *Journal of Applied Psychology*, 94, 1412-1426 (2009).
- [25] Douglas, C., Ferris, G. R., Buckley, M. R., & Gundlach, M. J., "Organizational and social influences on leader-member exchange processes: Implications for the management of diversity," [Dealing with Diversity], G Graen, Greenwich, CT: Information Age (2003).
- [26] Wasserman, I. C., Gallegos, P. V., & Ferdman, B. M., "Dancing with resistance: Leadership challenges in fostering a culture of inclusion," [Diversity Resistance in Organizations], New York: Taylor & Francis Group/Lawrence Erlbaum, 175-200 (2008).
- [27] Friedman, R., Kane, M., & Cornfield, D. B., "Social support and career optimism: Examining the effectiveness of network groups among Black managers," *Human Relations*, 51, 1155-1177 (1998).
- [28] Ely, R. J., & Thomas, D. A., "Cultural diversity at work: The effects of diversity perspectives on work group processes and outcomes," *Administrative Sciences Quarterly*, 46, 229-273 (2001).
- [29] Hilton, R. T., Clifton, R. J., & DeSoto, M. C., "Perceived exclusion in the workplace: The moderating effects of gender on work-related attitudes and physical health," *North American Journal of Psychology*, 8, 217-235 (2006).
- [30] Bell, M. P., Ozbilgin, M. F., Beauregard, T. A., & Surgevil, O., "Diversity, voice and silence in 21<sup>st</sup> century organizations: Strategies for inclusion of sexual minorities," *Human Resource Management*, in press (2008).
- [31] Ely, R. J., "The power of demography: Women's social constructions of gender identity at work," *Academy of Management Journal*, 38, 589-634 (1995).



- [32] Anderson, E., "The social situation of the Black executive: Black and White identities in the corporate world," [The cultural territories of race: Black and White boundaries], Chicago: University of Chicago Press, 3-29 (1999).
- [33] Hewlin, P. F., "Wearing the cloak: Antecedents and consequences of creating facades of conformity," *Journal of Applied Psychology*, 94, 727-741 (2009).
- [34] Dollinger, S. J., "Need for uniqueness, need for cognition, and creativity," *Journal of Creative Behavior*, 37, 99-116 (2003).
- [35] Lepak, D. P., & Snell, S. A., "The human resource architecture: Toward a theory of human capital allocation and development," *Academy of Management Review*, 24, 31-48 (1999).
- [36] Sheppard, B. H., Lewicki, R. J., & Minton, J. W., [Organizational justice: The search for fairness in the workplace], New York: Macmillan, 13 (1992).
- [37] Hayes, B. C., Barlte, S. A., & Major, D. A., "Climate for Opportunity: A conceptual model," *Human resource management review*, 12, 445-468 (2002).
- [38] Chrobot-Mason, D., & Thomas, K. M., "Minority employees in majority organizations: The intersection of individual and organizational racial identity in the workplace," *Human Resource Development Review*, 1, 323-344 (2002).
- [39] <http://www.nationaldiversitycouncil.org/>
- [40] <http://accionempresas.cl/>
- [41] D'Orgeville, C., Rigaut, F., Maddison, S., Masciadri, E., "Gender equity issues in astronomy: facts, fiction, and what the adaptive optics community can do to close the gaps," *Proc. SPIE 9148*. 91481V, 10.1117/12.2059088 (2014).