

## Session 9: Astronomy and Inclusion



## Introduction

Session 9 on Day 5 begins with “Women in science: the need for a global cultural change” by Karen Hallberg. Karen begins by mentioning the relatively low participation by women in STEM and give as an example the number of female Nobel laureates versus the number of males. She then discusses examples of some strong women in science, but concludes that there still is much to be done to inspire more girls to pursue science.

Next, from Jarita Holbrook, is another invited talk, “ASTROMOVES: Astrophysics, Diversity, Mobility.” Here Jarita describes the ASTROMOVES project that she has created to gather data regarding women needing to work abroad longer or have had more positions abroad to advance their careers to parallel those of male colleagues. The project is intended to study astrophysicist career decision making and changes of positions in terms of relocations and changes in job titles while staying in one place. She discusses methodology and gives several examples. She concludes by discussing plans for the future.

Following the talk Anahí Caldú asked:

*With Covid-19 I would expect that the situation is special for the people that are looking for jobs this year (I know administrative processes have slowed down). It would be interesting to compare these results to post-pandemics ones. What do you think?*

Jarita answered:

*Yes, it would be a good future comparison. Interestingly, those that I have interviewed that are mentoring postdocs/grad students at that transition are talking about what is going on due to the Pandemic.*

Anaely Pacheco Blanco asked:

*Are you using social media to look for people to interview? or there is a webpage were there is an eligibility list (as I understood is focused in EU)?*

Jarita replied :

*I am not using social media to find interviewees because the users are skewed to those that are younger, not 8 years past PhD. Second it would give me too many people to interview – given that I’m slow to get people scheduled, etc. ALSO anyone can volunteer to be interviewed if they make the criteria.*

Silvia Casu, Gian Deiana, and Emilio Molinari describe “The inmate sky – Astronomy in a juvenile detention institute,” which is a discussion of the “Open up, Sky!” project for astronomy education at a juvenile detention institution in Sardinia, Italy. They give an overview of the project, outline its implementation, and close with a discussion of results.

José Gómez asked Silvia:

*What was the main problem when working with young people in prison?*

Silvia replied:

*The main difficulty is related to the extreme heterogeneity of the target group. Of 12 youg involved, 6 were from abroad (Africa and East Europe). They have different ages*

*(from 16 to 23 years old), different school, familiar and religious background. Some of them were in jail for severe crimes, other for drug dealing or theft. Another problem is their possible attitudes. Some of them have opposite attitudes, and they do not want to show interest in something which could be related to “school”. You need some time to build an emotional relationship, to show them that you do not judge them or do not confond them with their crimes. Another problem is gender related: I am a woman, they are men, and they feel they have to show me they are “strong” and “real men”. We spent some time to discuss about gender roles misconception.*

The section continues with “Accessible Astronomy Activities for the Blind and Visually Impaired in Puerto Rico” by Gloria Isidro Villamizar, Carmen Pantoja Pantoja, and Mayra Lebrón Santos. They describe the development in Puerto Rico of astronomy activities accessible for the blind that can include three-dimensional tactile material to help the users conceptualize a topic. They highlight many activities that were employed at the workshops that have been conducted.

“Inclusive Eclipse: a sensorial experiencing along Chile” was written by Paulina Troncoso Iribarren, Carlos Santander, Javiera Diaz, Henry López del Pino, Erika Labbé, Ignacio Schacht, Carlos Morales Marín, and Angie Barr. It continues the discussion of the use of LightSound in Chile during the eclipse of 2019. They describe the device and how it functions

This section concludes with “Women in Astronomy and in Sciences: cracking the code with a third culture” by Anna Curir. Anna also talks about the under-representation of women in STEM. She cites a UNESCO report, “Cracking the code: Girls’ and women’s education in STEM” Anna relates that girls are often brought up to believe that STEM topics are more masculine with women better suited for the humanities. She talks about two cultures, scientific and humanistic, and adds that a third culture of astronomy could help due to the interdisciplinary study of its ancient history.

# Women in science: the need for a global cultural change

Karen Hallberg 

Centro Atómico Bariloche and Instituto Balseiro (CNEA, CONICET, UNCuyo),  
Bustillo 9500 (8400) Bariloche, Argentina  
email: [karen@cab.cnea.gov.ar](mailto:karen@cab.cnea.gov.ar)

**Abstract.** This paper summarizes the talk given at this conference in which the cultural aspect of the low participation of women in science, mainly in STEM (Science, Technology, Engineering and Mathematics) areas, is emphasized. A few personal recollections will be presented and some striking numbers to illustrate the current situation will be given. In addition, some thought provoking ideas on what is known as “neurosexism” are explicated and a tribute is made to three women that overcame the challenges posed to them in different times in history (including current times) and helped paved the way to the new generation. However, there is still a long way to go. The inclusion of women and of other relegated sectors of society in scientific and technological activities is an important pending issue which will be achieved when our society as a whole reaches the necessary cultural maturity.

**Keywords.** women in science, inclusion, cultural change

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## 1. Introduction

To illustrate the situation, some personal experiences are mentioned. Several years ago, while I was a postdoc at the Max-Planck Institute for complex systems in Dresden, Germany, I was about to submit a paper on my recent work on a new numerical method to calculate quantum electronic properties of novel materials, which I had written on my own. So I passed it on to a (male) colleague and he said he thought it was ok but strongly suggested me to sign with my initials and not with my full name, “so that you have a greater chance that the paper gets published because it’s strange that a scientific paper is signed by a woman alone”, he said. I thought this was somewhat strange and, as I have a strong character and like challenges, I decided to write my full name. After some struggle with the referees the paper was accepted [Hallberg (1995)].

Some time ago I had been invited to lecture at a conference on my work on quantum interference mechanisms in nanoscopic systems. After the talk, my host came up to me saying he had liked the talk very much and that he was positively surprised because, he said, “the whole talk was very rational, clear and logical, you seem to think like a man” (no comments).

In the beginning of this year (my last trip in 2020 due to the pandemic) I was invited to a workshop on Entanglement in Strongly Correlated Systems in Benasque, Spain. I wasn’t surprised to count only 5 women among 55 participants (see Fig 1), a situation which has been like this since I began my professional career in this topic.

This could be also the story of many young girls who follow STEM careers. I invite you to look around, to think about the meetings you’ve participated in and to reflect on the proportion of women in those forums, not only on the numbers, but also on their role in leadership and in decision making. Women are not only a minority, but they are far



**Figure 1.** Typical low participation of women in physics conferences (yellow circles), for example at the Workshop on Entanglement in Strongly Correlated Systems, Benasque, Spain Feb. 2020 (photo from the Centro de Ciencias de Benasque Pedro Pascual web site <http://benasque.org/2020scs/cgi-bin/pictures.pl>)

from being protagonists in decision and policy making. Few exceptions confirm the rule and men continue to dominate the field.

Worldwide in science, according to UNESCO [UNESCO (2019)], less than thirty percent of scientists are women. And this includes all sciences, natural, biomedical, exact and social sciences. If we consider natural, technological, engineering, mathematical, and computational sciences alone, the numbers are even lower since the proportion of women in biomedical and social sciences greatly outweigh the other fields.

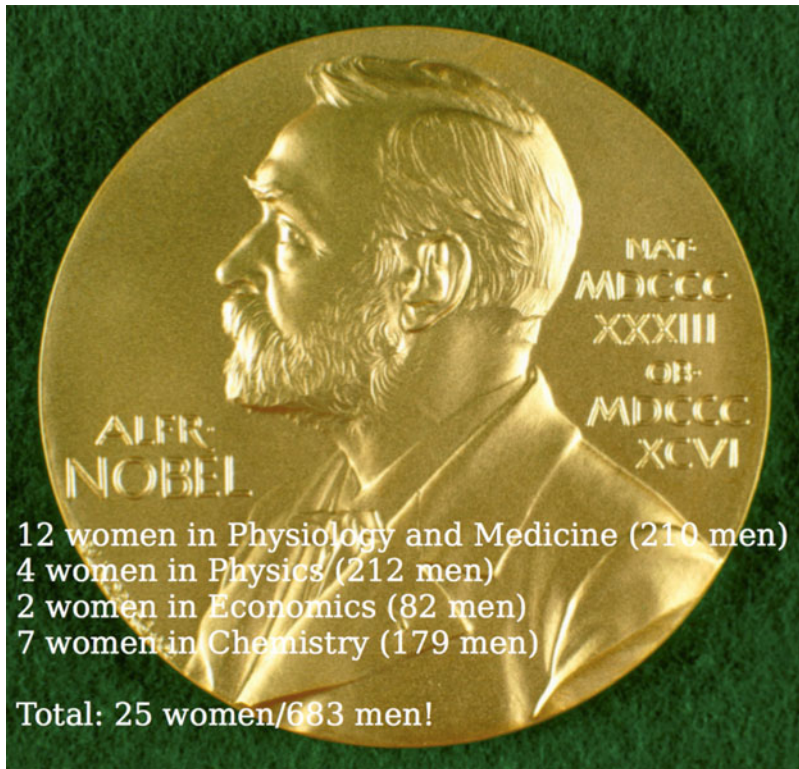
Look, for example, at the Nobel laureates in science. To date it has been awarded to: 12 women in Physiology and Medicine (out of 210 men), 4 women in Physics (out of 212 men), 2 women in Economics (out of 82 men) 7 women in Chemistry (out of 179 men). In total it has been given to 25 women in sciences out of 683 men! See Fig. 2

And in mathematics, the Fields Medal was awarded to only one woman (Maryam Mirzakhani) among a total of 60 and the Abel Prize to one woman (Karen Uhlenbeck in 2019) among 20 recipients. This is really striking and shows that, as a society, we are evidently facing a problem which we must face as a whole.

## 2. Discussion

Do we need to change this situation? In that case, why? some would ask. Maybe women have different preferences, maybe we think differently, maybe we have a different brain? According to several reliable publications on this topic, there is mounting evidence that the brain is not gendered, “not more than the heart, the kidneys or the liver” [Elliot (2019)]. It is a well installed myth that women’s brains are wired for empathy and intuition, whereas male brains are supposed to be optimized for reason and action. We don’t even know what consciousness is, how we reason, how we store information, and we are looking for differences between men and women’s brains? This has been dubbed neurosexism [Rippon (2019), Elliot (2019)] by Gina Rippon in her book *Gendered Brain: the new neuroscience that shatters the myth of the female brain*, where she states that only a gendered society will produce a gendered mind.

Others argue that we have different perspectives and that it is important to have more women scientists to increase diversity. Of course diversity and the inclusion of different perspectives is good for science, however there is more diversity between men stemming from different cultures than between men and women en general. So this argument is a valid one when discussing the cultural reach and inclusion of modern science, but not for



**Figure 2.** Nobel Prizes given to women in the scientific fields as compared to those given to men (updated to Dec. 2020).

gender issues. There is no reason whatsoever there shouldn't be an equal participation of women and men in science and technology, in all fields. The fact that there is such an enormous gap is a strong warning that we still have serious cultural, social, economic and political biases. And the burden should not be put on women's shoulders but on society in general, on our culture, on our political structures.

Of course, there have been women that have challenged the barriers and have made history in science. I'd like to pay tribute to some of those women who have paved the way for other women to follow in astrophysics and astronomy.

### 3. Some conspicuous examples

*Caroline Lucretia Herschel* (Hanover, 1750-1848) was a pioneer of her time: an educated woman who would catalogue stars and nebula and discover comets including the periodic comet 35P/Herschel-Rigollet, which bears her name. She was the first woman astronomer to earn a salary, 50 pounds sterling a year (equivalent to 6,400 pounds sterling in 2020) as an assistant to her brother, the astronomer William Herschel (who discovered Uranus in 1781 which he mistook for a comet), with whom she worked throughout her career. She was the first woman in England to hold a government position, to publish scientific findings in the *Philosophical Transactions of the Royal Society*. She was also the first woman to be named an Honorary Member of the Royal Astronomical Society (1835, with Mary Somerville) and to be awarded a Gold Medal of the Royal Astronomical Society (1828). She was also named an honorary member of the Royal Irish Academy (1838). On the occasion of her 96th birthday in 1846, the King of Prussia presented her with a Gold Medal for Science.



In 1802, the Royal Society published Caroline's catalogue in its Philosophical Transactions of the Royal Society A under William's name. With her brother, she discovered over 2,400 astronomical objects over twenty years. The asteroid 281 Lucretia (discovered in 1888) was named after Caroline's second given name, and the crater C. Herschel on the Moon is named after her. The telescopes they polished and made were the best in those times [Herschel (0000)].

*Jocelyn Bell Burnell* (Dame, N. Ireland, 1943) She discovered the first radio pulsars in 1967 as a postgraduate student. She found a signal which was pulsing with great regularity, at a rate of about one pulse every one and a third seconds. Temporarily dubbed "Little Green Man 1" (LGM-1) the source (now known as PSR B1919+21) was identified after several years as a rapidly rotating neutron star [Bell (1968)]. The discovery was recognised by the award of the 1974 Nobel Prize in Physics. However, despite being the first person to discover the pulsars she was not one of the recipients of the prize. In 2018, she was awarded the Special Breakthrough Prize in Fundamental Physics for her discovery of radio pulsars. She decided to give the whole of the 2.3million prize money to help female, minority, and refugee students seeking to become physics researchers (the Bell Burnell Graduate Scholarship Fund).

*Andrea Ghez* (USA 1965) American astronomer and professor at the Department of Physics and Astronomy, University of California, Los Angeles. Her research focuses on the center of the Milky Way galaxy. In 2020, she became the fourth woman to be awarded the Nobel Prize in Physics, (shared with Genzel and Penrose) for their discovery of a supermassive compact object, now generally recognized to be a black hole, in the Milky Way's galactic center with a mass of Sgr A\* is  $4.1 \pm 0.6$  million solar masses [Ghez *et al.* (2008)].

Using the world's largest telescopes, Genzel and Ghez developed methods to see through the huge clouds of interstellar gas and dust to the centre of the Milky Way. Stretching the limits of technology, they refined new techniques to compensate for distortions caused by the Earth's atmosphere, building unique instruments. These images of the Galactic Center are at very high spatial resolution and have made it possible to follow the orbits of stars around the black hole Sagittarius A\* (Sgr A\*). The partial orbits of many stars orbiting the black hole at the Galactic Center have been observed.

#### 4. Conclusions

There still is an enormous cultural barrier that keeps many girls from science (and also girls and boys, stemming from less advantaged or discriminated sectors of society). We are witnessing an important moment in history concerning women's rights and empowerment, in all fields. However, although the situation has improved somewhat compared to around half a century ago thanks to many proactive actions, there still is a very long way to go. The path must be paved to include all that talent we are dismissing and to allow anyone to choose a scientific career. We definitely need a big cultural change. It is, mainly, a question of justice, non discrimination and equal opportunities.

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