Report on Gender Activities of the COST Action MP1210
The String Theory Universe.
Working Group 5.

SUMMARY

The main objective of the COST Action MP1210 *The String Theory Universe* [1], which remained in force for four years starting on March 2013 was to exploit complementary expertise of different research groups in Europe to enhance the understanding of String Theory and its applications to Particle Physics, Condensed Matter, Cosmology and Quantum Gravity. Reflecting the real gender imbalance in the field, only a 15% of the participants in the Action were women. Well aware of this huge gender imbalance, different measures were implemented in order to raise the gender issue within the community and try to redress the situation. Among the most significant measures were the starting of a series of workshops on 'String Theory and Gender', bringing together gender experts and string theorists, the launching of surveys on gender activities and a theater performance, based on anecdotes of gender bias in professional situations that were reported anonymously by women participants in the Action. Besides a remarkable scientific output, reflected in the large number of scientific publications and new collaborations, the Action has had an enormous impact in its objective of raising awareness on the gender issues in a community that, in the best of cases, considered it a minor or private issue. It has also set a model for other Actions and grants to include gender issues among their goals. As a plus, it has left a strong bond among the women working in the field and some of their male colleagues. A very successful forum and mailing list *WomenStrings*, with a growing number of subscribers, has been created that will allow to maintain the connection and the benefit for the years to come. A working group including former members of the Action, men and women, as well as representative scientists from other countries, will promote specific measures in gender identified during the Action.

RELEVANCE

The String Theory Universe was the first COST Action in Theoretical Physics, and the first that included in its agenda a strong commitment to deal with the gender issue. Indeed, we estimate that only about a 10% of researchers with permanent positions in String Theory in Europe are women, and this number does not appear to be improving with time. This COST Action has been the largest running network in String Theory in Europe and a reference for most EU scientists working in this domain.

AIMS AND OBJECTIVES

The main goal of the Action was to perform frontier research in the broad field of String Theory, by exploiting and promoting complementary expertise of different groups in Europe. It was also meant to foster cooperation with other areas in Physics to which String Theory has provided crucial applications.

Together with these scientific goals, as stated in the MoU, the Action aimed at promoting specific measures to redress the huge gender imbalance in the field of String Theory and to foster the active participation of junior excellent scientists. Therefore, the outcome of the Action was expected to have a positive impact on both, science and society, at an European level, in line with the strategic priorities of COST.

In the gender front the Action worked in three main different directions:

a) increase awareness,

b) inform about relevant studies in gender,

c) increase the visibility and involvement of women, ensuring fair gender representation at all levels.

A combination of methods was used based on our perception of the general attitude of the community towards the gender problem. Some of the activities were aimed at increasing the knowledge of the community about gender-related studies in Neuroscience, Psychology and other branches. Complementary activities were organized to increase awareness, based on the fact that, indeed, it takes more than statistics or neuroscientific knowledge, with all the rigor guaranteed, to convince people that there is an issue. Many scientists do not often reflect on the education and social atmosphere that influences and determines women decisions, and in many people's minds the question 'If women do not want to go into STEM sciences, why shall we push them?' persists, consciously or unconsciously. But scientists are deeply involved in the education of the new generation, the one that should incarnate the change, and therefore, have a big responsibility also on this matter. Even if all social factors should be involved in the solution of this very difficult problem, it was in the spirit of this Action to never use this argument to dilute responsibilities. This determination is what set our Action into motion, together with the strong conviction that solving the gender problem would only enhance, and never compromise, scientific excellence.

Note that the proposal was written starting from a small group of women, but the final project that was submitted (in first instance) was elaborated by all the women with permanent positions in the field in Europe. Men were asked to join the project after it passed the first selection filter.

METHODOLOGY

The Action was structured in five Working Groups (WG). The first three were devoted to three different specific scientific domains. WG4 was devoted to knowledge transfer between and outside these domains. WG5was dedicated to gender and outreach [2]. All the gender activities were proposed and coordinated by WG5.

The methods adopted, that will be detailed below, consisted in:

a) monitoring the evolution of the female community in String Theory in Europe,

b) including specific gender activities in every conference organized with scientific scopes,

c) starting a series of workshops on 'String Theory and Gender'

d) attracting attention to the gender dimension by innovative activities such as the theater play,

e) participating into gender conferences such as the Gender Summit,

f) launching a general survey,

g) creating and maintaining the online forum *WomenStrings*.

a) Monitoring

a1) Joint Postdoctoral Recruitment: The EU- String Theory community has been functioning in strong synergy and mutual cooperation since the mid-eighties by virtue of different projects funded by the EU (Science, FP6, FP7). One of these common activities, that has been maintained through the years even in the absence of funding, is the Joint Postdoctoral Recruitment process, coordinated by Leuven University (KU). This coordinated application procedure has made possible the monitoring of the number of postdoctoral applications each year. We have indicated in Table 1 the figures for the years with available data. As for the applications, the percentage of women is more or less stable around the 10%. The table also gives an idea of the competitiveness of the field, with an average rate of success of about 10%. This is slightly less for women, with a high variability, due to the small numbers.

a2) Action's organization: The participation of women in the Action's organization has been very high. Both the Chair and vice-Chair of the Action were women, and four out of the five working groups were led by women. In all conferences organized by the Action, the presence of women among speakers and committee members (mostly scientific, since there is less flexibility in local organizing committees) was also high. We reproduce the data below. The reference figure is the 15% of female participants in the Action, with this number being highly peaked around the postdoctoral stage.

- *1st COST MP1210 Meeting and 19th European Workshop on String Theory* in Bern (Switzerland), September 2013.
    - Organizing Committee: 0 out of 2 (0%)
    - Scientific Committee: 4 out of 12 (34%)
    - Invited speakers: 2 out of 5 (40%)
- *2nd COST MP1210 Meeting and 20th European Workshop on String Theory* in Mainz, September 2014.
    - Organizing Committee: 3 out of 6 (50%)
    - Scientific Committee: 6 out of 13 (46%)
    - Invited speakers: 8 out of 31 (26%)
- *3rd COST MP1210 Meeting and 21th European Workshop on String Theory* in Leuven (Belgium), July 2015.

    - Organizing Committee: 0 out of 9 (0%)
    - Scientific Committee: 5 out of 12 (42%)
    - Invited speakers: 2 out of 13 (15%)
- *Final COST MP1210 Meeting and 22nd European Workshop on String Theory* in Milano (Italy), February 2017.
    - Organizing Committee: 2 out of 8 (25%)
    - Scientific Committee: 6 out of 11 (55%)
    - Invited speakers: 2 out of 13 (15%)

a3) Short term scientific missions: Monitoring was also effected on the number of *short term scientific missions* (STSM's) granted by the Action in the various calls. The percentage of STSM granted for women was 11% (8 out of 72), lower than the 15% of participants. The duration of the stay was typically shorter for women: 102 days of 1476 total days of visit, which represents only a 7%. One week stays were largely preferred by women over longer periods, which may point to the usual difficulties with work/life balance.

a4) Women Lunches: Women Lunches were organized at each Annual Workshop. This initiative started long before the Action came into place (*1998),* as an informal way to monitor the dimension of the female String Theory community. At the beginning, a very small group of women were participating (about 5-10 women). At that time, there was much hesitation to confront this subject in a community that was undoubtedly male dominated. The idea was picked up in the conference *Strings at the Millennium* held in Caltech (USA), in 2000. By now, the Women Lunch has become a tradition and it is well attended. It has proven to be very effective in encouraging open talk in a relaxed atmosphere and as an easy way to bring together and foster communication between junior and senior female scientists.

Year	# Candidates	# Women candidates	Taken in our institutes			
			# Total taken % Total taken/ Candidates	# Women % W taken /W candidates	#Men % M taken / M candidates	% Women taken/Total taken
2005	239	22 (9%)	18 (8%)	1 (5%)	17 (8%)	(6%)
2006	207	26 (13%)	33 (16%)	6 (23%)	27 (15%)	(18%)
2007	186	19 (10%)	20 (11%)	3 (16%)	17 (10%)	(15%)
2008	226	26 (12%)	25 (11%)	3 (12%)	22 (11%)	(12%)
2009	354	41 (12%)	24 (7%)	4 (9%)	20 (6%)	(16%)
2010	400	35 (9%)	34 (9%)	3 (9%)	31 (8%)	(9%)
2011	411	41 (10%)	25 (6%)	1 (2%)	24 (6%)	(4%)
2012	416	55 (13%)	35 (8%)	2 (4%)	33 (9%)	(6%)
2013	365	35 (10%)	40 (11%)	0 (0%)	40 (12%)	(0%)
2014	438	50 (11%)	54 (12%)	7 (14%)	47 (12%)	(13%)
2015	412	47 (11%)	39 (9%)	3 (6%)	36 (10%)	(8%)
2016	476	37 (8%)	44 (9%)	3 (8%)	41 (9%)	(7%)
2017	416	55 (13%)	40 (10%)	7 (13%)	33 (9%)	(18%)

Table 1. Evolution of post-doc contracts in String Theory in Europe since 2005.

b) Gender activities during regular conferences and workshops

Besides women lunches, one talk on gender issues was included in the program of all COST Annual Workshops. This talk was delivered by either a gender expert or a Physics researcher. The goal in the second case was to reach the String Theory community through a talk especially cut to meet its general interests. In spite of some attempts to do otherwise, the speakers have all been women.

- ***1st COST MP1210 Meeting and 19th European Workshop on String Theory*** in Bern (Switzerland), September 2013. Being this the first meeting of the Action, a discussion session was set as a startup.
- Workshop ***Black Holes and Quantum Information***, Weizmann Institute (Israel), January 2014. Prof. Hagit Messer-Yaron (Israeli Council for Higher Education) was invited to give an overview on the latest data for women in science.
- ***2nd COST MP1210 Meeting and 20th European Workshop on String Theory*** in Mainz (Germany), September 2014. WG5 leader, Prof. María A. Lledó (U. Valencia), gave a talk *'On gender, science and all that*'. This was a talk especially designed to meet the interests of the String Theory community. It touched upon the main aspects of gender discrimination in our field and had a very strong impact.
- ***3rd COST MP1210 Meeting and 21th European Workshop on String Theory*** in Leuven (Belgium), July 2015. Prof. Conny Aerts (KU Leuven) gave a talk *'Work-life relation as an astromama and some gender tips'*. As a very accomplished and respected scientist, Prof. Aerts explained to us her own experience on work/life balance and the circumstances that helped her to 'survive'. For example, she acknowledged that, without the possibility of a five year fellowship in her postdoctoral period, she would not have succeeded. This type of fellowship is not common in our area and often it comes after the post-doc pilgrimage. Having a scientist of her category raising this point so clearly was certainly an invaluable contribution.
- ***Final COST MP1210 Meeting and 22nd European Workshop on String Theory*** in Milano (Italy), February 2017. WG5 leader gave an overview of the main gender activities organized by the Action, followed by a theater play that we describe in item d). This was followed by a lively discussion session with the intervention of Prof. Cristina Messa, Rector of the Università di Milano-Bicocca.

On general grounds, the talks prepared by a Physics researcher had a higher impact than those delivered by a gender expert. As an example, after Prof. Aerts' talk, the sensitive issue of paternity/maternity leaves at the postdoctoral stage was discussed. These discussions revealed very different sensibilities among men and women.

c) Workshops on String Theory and Gender

The idea of a joint workshop on String Theory and gender came out as a way to expose string theorists to relevant studies in gender in the fields of Neuroscience, Psychology, Sociology, Economy… Still, half of the workshop was dedicated to the dissemination of interesting developments in String Theory. This initiative revealed

itself as a powerful way to attract the interest of string theorists towards gender. More women than men attended these workshops, but the participation and involvement of men increased very satisfactorily from the first to the third edition.

Three such workshops have already taken place. :

- ***Valencia (Spain) July 2015*** **[3].** 40 participants registered. This was the first workshop of the series. We shall mention the opening talk by Prof. Giorgina Rippon, Chair off the Cognitive and Neuro-imaging Laboratory at Aston University *'Sex, science and the brain'* that made a profound impression in the community. She lectured about the false dichotomy of the male/female brain, and explained the bias that underlies the 'scientific' studies that claim that male brains are better suited for abstract and mathematical reasoning than women brains. . This is in fact a widespread believe in our society that is at the root of the lack of encouragement that young females with skills in mathematics receive from families and mentors, and it creates the persistent insecurity that females have (on average) about their mathematical skills. These attitudes are at the core of the gender imbalance problem in the STEM sciences. In her talk, Prof. Rippon demolished the myth. Prof. Capitolina Díaz, from Valencia University, gave a very inspiring and encouraging talk on the different gender policies in the EU scientific grant system. A very successful popular talk '*Observar el Big Bang'* was delivered by Prof. Ana Achúcarro (Leiden University and Universidad del País Vasco). She incarnated a successful role model for young students and shared with the general public the goals of the workshop.
- ***Paris (France), June 2016*** **[4].** 65 participants registered. Following her success at the first *String Theory and Gender* meeting, Prof. Rippon was again present in this edition, this time with the talk *'Unsexing the Mind; how plastic brains could break through glass ceilings.*' She reported recent results in Neuroscience showing that brains are plastic enough so that adult people can rewire their early conditioning to change the state of things. Prof. Rosella Palomba (Institute for Research on Population and Social sciences in Rome) lectured on how '*Gender, excellence and responsible science*,' undistorted by gender stereotypes or creeping discrimination, is still a far-away dream. Prof. Loukas Balafoutas (Faculty of Economics and Statistics at the University of Innsbruck) discussed in his talk '*Affirmative action policies for women: Lessons from the economic laboratory'* about efficient policy suggestions (quotas being only one example) that could be made by studying the differences in competitive behavior between men and women. In general, women are less likely than men to enter a competition, with this effect being more pronounced if men are also involved. In an 'economic laboratory', it was studied what kind of asymmetric conditions (like giving some advantage to women) could persuade them to enter the competition. Multiple aspects of *'Women in Physics*', in the past and present–current situation in different European countries– and the impetus of the European Union for gender equality, was the subject of the talk by Prof. Claudine Hermann, Emeritus Professor in Physics at École Polytechnique and vice-president of the European Platform of Women Scientists. A post-workshop survey [5] was answered by 25 participants, 17 women and 8 men (68% and 32%

respectively), and the overall evaluation was very positive: 96% found the workshop (and similar events) very useful; 90% were in favor of organizing more events directed at educating the scientific community and rising the awareness of gender issues.

- ***Southampton (UK) March 2017*** **[6]**. 45 participants registered. This workshop was already outside the Action framework. Prof. Wim van Saarloos, Director of the Dutch Physics Foundation (FOM) 2009-2015, was involved with FOM's program to support and retain women in physics. It was pushed at a national level the goal of at least 20% of Dutch professors being women by 2020, *20 in 2020*. He gave recommendations based on policies taken in The Netherlands that had good impact in increasing the presence of women in STEM. Prof. Mike Childress (Lecturer in the Astronomy group at Southampton) gave a very inspiring lecture exploring the causes of the 'leaky pipe' of women in physics and astronomy: unconscious gender bias, stereotype threat, privilege, micro-aggressions, mansplaining and gaslighting, all of them present in our professional lives. He explained that in Physics, the presence of women is concentrated at the postdoc stage of the academic career, and that progress towards increasing the percentage of women academic staff is really very slow; male academics are promoted faster than female ones in all STEM sciences. He discussed how the differences in the education that girls receive in school diminishes their attraction to STEM disciplines already before college. Prof. Valerie Gibson (leader of the Experimental High Energy Physics group at the Cavendish Laboratory in Cambridge) is also the Equality and Diversity Champion for Physical Sciences in Cambridge and spearheaded the Cavendish's Athena SWAN Gold Award in 2014 (a distinction given in the UK to university departments that support and foster the careers of women). She again showed figures showing how statistics of women in STEM are peaked at the postdoc stage and then decline very fast at the professorship stage. At the current rate, we could only achieve 35% of women academic staff by 2050 (in the UK). She explained that under the Athena SWAN and Juno programs in the UK, the number of women academics in Cambridge increased by 64%, and that "scaffolded" questions in exams improve the performance of both genders, but especially women. At the end of each gender session participants formed groups of 7 or 8 people to discuss what they considered the most relevant aspects of the talks. The aim was to start analyzing specific measures that could be implemented in our field. A final document was then elaborated [7]. We will return to it later, in Section *What next?*

In all String Theory and Gender meetings the discussions and round tables were quite lively. The overall experience is that, after the first ice was broken, people started to express their opinions, pose questions to the experts and share their own experiences. Seeing the more senior women taking the issue seriously and opening up to a more personal level encouraged the more junior women to also participate and express their views.

We can conclude that the attendance to these workshops has been very fruitful. Most initiatives of gender experts and policy makers are not reaching the STEM community in the desired way. For example, well-known facts such as the 'unconscious bias' were completely unknown to most people in our community,

even to those with reckoned experience as committee members. The *String Theory and Gender* meetings have contributed to filling this gap. Considering that at the time the first workshop was organized a large fraction of the community was incredulous and even jockey about the sole idea of mixing 'Strings' and 'Gender', we have covered a long way. Many members of the community acknowledge now the big change that these meetings have implied in their views on the gender issue. The fourth *String Theory and Gender* meeting is already being organized in Italy next year. Other possible ways to reach the fraction of the scientific community still reluctant to attend this type of meetings should be devised.

d) The play

The play was a highly innovative activity aimed at increasing awareness. The idea was to confront men with typical experiences of women in their work environments. Women in the Action were asked to submit anonymously a description of episodes of microsexism they had experienced during the course of their scientific careers. A play was then written by a professional scriptwriter based on these anecdotes. This is an excerpt from the letter sent to the women:

It is about situations happening in everyday life that, like a little but constant drop, end up making a hole in our self-esteem or embittering to a certain degree the relation with our colleagues. They are just comments or attitudes that are repeated and transferred by imitation. Bringing them to the light could help stopping them. As with the unconscious bias, sometimes the situation barely appears in the fringe of our own consciousness; sometimes only an uneasiness is felt and the woman 'learns' that she is not well adjusted.

The anecdotes reported constitute their own significant data showing that there is indeed a gender issue in the field. The idea was that in the form of a theater play the message could be transmitted more clearly.

Anecdotes with common patterns easily appeared:

- being mistaken by a secretary or, even if they know you are not, being expected to take care of administrative details,
- in a collaboration, being expected to type the paper,
- raising a point in a discussion that nobody acknowledges and, after a while, a man coming up with the same idea and being congratulated for it, or worse, being yourself explained about it and asked whether you now understood it,
- asking a question in a conference or in a group with other colleagues which is dismissed (without answer) as irrelevant, sometimes including a joke and laughs,
- referring to certain work as the work of a man (or several) even if there was a senior woman in the team too,
- giving a talk and somebody in the public addressing his questions to your male colleague (also in the public), or your male colleague directly answering a question directed to you,
- being patronized, even by junior colleagues,
- dealing with supervisors that rate their male students higher by default,

- being given the role of chairperson in a conference and a speaker or somebody in the public disregarding your indications,
- impatience, or worse, accusations of lack of professionalism when you are not available because you have some important issue with your children,
- undervaluing your independence as a researcher, for example, being asked 'with whom do you work?', even if you have already written a number of works taking the initiative,
- hearing complains about the 'politic correctness' required in the work place,
- hearing complains if the gender issue is raised in committees, often relating it with 'non excellence',
- suffering disrespectful or even offensive treatment from students with no consequences for them (except perhaps some little talk from the head of the department),
- being scrutinized and criticized for the way you dress,
- being questioned as a researcher or criticized at a personal level because you devote some time to gender issues, have expressed your opinion or have taken particular actions,
- being told that women that do well in physics have a 'male brain'.

Other anecdotes, not mentioned here, simply qualified as blatant gender discrimination and not only as microsexism. Even anecdotes about harassment emerged, but several women that in private would confess having suffered harassment found too painful or frightening to share their experiences in this 'public' way. This is indeed a problem that should be approached with extreme care. In the paragraph e) on the gender survey we will come back to this issue.

Some of the episodes described above were the basis of the theater play, prepared as a surprise for the final conference in Milano. A professional writer, Fabio Scamoni, examined the material and produced a script. He proposed a monologue by an actress playing the woman scientist, intertwined with several sketches with two supporting actors. Themes like not being valued, not being listened to in scientific discussions, and the eternal issue of work/life balance were reflected. The performance was made available in streaming [8].

The play had a strong impact among the participants, and motivated a long discussion where many issues were raised. One of the most polemic points centered around quotas and affirmative action policies. Some young men manifested that with some time and a new generation taking over, things would naturally get better, without any need of pushing for a concrete solution. Most women disagreed with what they considered an over optimistic view of the problem.

The play culminated the Action's efforts towards raising awareness in the field. It received many positive comments, including those of our Action's COST officer, Ms. Fatima Bouchama, also present in the session. It was the subject of long discussions during all the afternoon, already a victory.

e) Participation in *Gender Summits*

As they define themselves:

The Gender Summit is a platform for dialogue where scientists, policymakers, gender scholars and stakeholders in science systems examine new research evidence showing when, why, and how biological differences (sex) and socio-cultural differences (gender) between females and males impact on outcomes. The aim is to reach consensus where improvements to science knowledge and science practice are needed and who should take action.'

The participation in *Gender Summits* allowed to get in contact with gender experts and to learn about the many initiatives and interesting studies that are being developed. Even if most of these are aimed at improving the situation of women in STEM, we were completely unaware of them. This fact made very evident that stronger efforts are needed to effectively reach the scientific community. The Gender Summits also served as a platform were the Action's initiatives in gender were disseminated.

It was in three different occasions that the Action was present at the Gender Summit:

- 2014. GS4 Europe, Brussels. Prof. Michela Petrini (UPMV, Paris), WG2 leader, distributed a brochure among the participants explaining the scopes of the Action.
- 2015. GS7 Europe, Berlin. Profs. Silvia Penati (Milano-Bicocca U.) and Yolanda Lozano (Oviedo U.), Chair and vice-Chair of the Action, presented a poster.
- 2016. GS9 Europe, Brussels. Profs. Anna Ceresole (INFN, Turin) and María A. Lledó (Valencia U.), WG4 and WG5 leaders, respectively, delivered a talk in a parallel session.

Interesting projects with similar scopes in gender were presented in the Summits, remarkably the GENERA project [9]. As they describe themselves,

The Gender Equality Network in the European Research Area (GENERA) is a '*Horizon 2020 project aiming at continuing, monitoring and improving the Gender Equality Plans of Research Institutions and Organizations specifically in the physics research field.'*

This project organizes the *Gender in Physics day* [10],

The experience will produce a long lasting effect: after being in contact with the many initiatives run at an institutional level, it is unlikely that the community goes back to its previous state. We think that it will be very convenient that other people (not necessarily women) could attend *more Gender Summits*.

f) The gender survey

Towards the end of the Action, an informal, anonymous, online survey was run in order to get some feedback about the actions taken, as well as about the degree of acceptance that specific measures to improve the situation could have in the community. A total of 172 people participated in the survey, 112 men, 50 women, 1 'other' and 9 'prefer not to say'. In the appendix, a commented summary of the gender survey is available and the raw data can be found in Ref. [11].

The results show that the majority of the respondents are aware that there is a gender difference in our field (and in science in general). Men and women, though, have a different perception on the issue, women being, in general, more prone to agree or strongly agree that there is a problem concerning gender equality in their professional environments. Even when gender neutral questions were posed about, for example, child care, frequent travel, relocations and so on, women responses reflect that they face difficult decisions on these matters more often than men. Women are also more likely to demand changes in the field related to relocations and long postdoctoral stays and to devote their time and effort to gender equality initiatives.

Three particular significant results of the survey deserve further attention. A wide majority of the respondents (male and female) find the high mobility in the postdoc period overrated and not a merit in itself. Still, some men tend to see the situation as inherent to our type of work and then, difficult or impossible to change. Also, when questioned about equal and non transferable maternity/paternity leaves, most people think it would be a sound measure. One can conclude that the community is better prepared for a change than what one could have expected. The answer to the question about harassment policies in research institutions revealed that many respondents are not aware of the protocols enforced in their own institutions. Many think they could simply learn about them if ever there was such need.

The respondents were given the opportunity of adding comments to each question. The large number of them given provide, besides the statistics, a radiography of the respondents' state of mind about each of the questions.

g) Mailing list *WomenStrings*, to continue after the end of COST

A mailing list including all the women participants in the Action was created in order to share information about gender issues. Many interesting articles and studies have been shared through this list. The list continues to be active and it has been opened to women working in affine areas and other countries.

MAIN RESULTS

The Action has very actively addressed during its four years of duration, the issue of gender imbalance in a field of research where the presence of women is very low. It has raised awareness and opened the discussion in the community. The first step has been taken in an environment traditionally very reluctant to accept any of the premises of the gender bias. The point that the gender issue is of maximal importance, not only sociologically but also in our scientific environment, has been transmitted. Women's visibility has been highly improved, with many women holding key positions inside the Action, and involved as speakers and scientific and organizing committee members of conferences and workshops.

The existing barrier between gender experts and scientists in STEM disciplines (String Theory in our case), main target of the studies and different policies devised by the first, has been trespassed.

The key to success has been the union and coordination of all women in the field. Keeping in mind that in this field women are highly dispersed in different countries and institutes, with most women being the only female presence within a group, this was quite a remarkable achievement.

WHAT'S NEXT?

In the long run, the impact of the Action on the gender issue will rely on the capabilities to keep alive the various initiatives that have been taken. Indeed, we have only started to scratch the surface of a very deep problem.

One of the outputs of the *Third Workshop on String Theory and Gender*, that took place already after the Action ended, was to propose a plan of action for the future. This plan of action includes the following measures:

- Form a Working Group that will take care of keeping up cooperative efforts on the gender issue and enforcing the rest of measures explained below.
- Ensure that women in the field are given the right visibility, promoting their participation as speakers and scientific and organizing committee members, and giving them access to key positions.
- Ensure the continuity of the *String Theory and Gender workshops* (perhaps biannually), coordinated by either the core group itself or by an independent committee.
- Maintain and expand to affine areas and other countries the *WomenStrings* list.
- Create a new web page (or continue the existing one [2]) to share the available resources for gender in Physics and disseminate new activities .
- Ensure that the gender issue is taken due care in ongoing and future collaborative projects.
- Promote the participation of members of the community in the annual *Gender Summits*, exploiting the links already created with neighboring communities and Social Sciences and getting involved in existing gender initiatives (like the GENERA project).

- Ensure that a gender event is organized in large conferences and workshops. This year, for the first time, a gender session will take place at the annual Strings conference, the most important conference in the field. Prof. Marika Taylor (Southampton U.) will be present at *STRINGS 2017*, (June 26-30, Tel Aviv, Israel) and will deliver a talk on the gender situation in the field.
- Keep monitoring the presence of women scientists in EU, possibly in comparison with non EU institutes. A relevant comparative data is that women scientists represent 7% of the CERN Theory Division, and about 17% at Stanford U.
- Write some guidelines on how to deal with gender issues in an ideal Physics Department, upholding the principles of equal opportunity and correct gender balance.

References

[1] Links to the COST Action:
http://www.cost.eu/COST_Actions/mpns/MP1210
http://www.weizmann.ac.il/stringuniverse/

[2] Link to WG5 webpage:
http://www.weizmann.ac.il/stringuniverse/group/outreach-wg5

[3] Link to *First Workshop on String and Gender* (Valencia, Spain):
http://www.uv.es/genderstring/

[4] Link to *Second Workshop on String and Gender* (Paris, France):
https://indico.in2p3.fr/event/12356/

[5] Link to the survey of the *Second Workshop on String and Gender*
https://indico.in2p3.fr/event/12356/material/0/0.pdf

[6] Link to *Third Workshop on String Theory and Gender* (Southampton, UK):
https://indico.cern.ch/event/570671/

[7] Link to the document of proposals after the *Third Workshop on String Theory and Gender.*
http://www.weizmann.ac.il/stringuniverse/sites/stringuniverse/files/3dstag_summary.pdf

[8] Link to the gender session in Milan and theatre play 'Corollaries' (it starts around minute 21):
http://streaming.unimib.it/tcs/#page:recordingList&pageNumber:1&id:5EB39933-C031-4098-9C43-1F3572B532CD

[9] Link to the GENERA project (EU)
http://genera-project.com/

[10] Gender in Physics day 2017
http://www.iac.es/congreso/GIPD2017/

[11] Link to the results of the Gender Survey:
http://www.weizmann.ac.il/stringuniverse/sites/stringuniverse/files/summarysurveygender-onlymalevsfemale_0.pdf

[12] Link to the survey taken by the COST Action MP1403 *Nanoscale and Quantum Optics*
http://www.cost-nqo.eu/wp-content/uploads/2016/10/COST-NQO-Gender-Survey_1010.pdf

APPENDIX. COMMENTED SUMMARY OF THE GENDER SURVEY

Before the final conference, held in Milano 20-24 of February 2017, an anonymous online survey was conducted in order to test the opinion of the Action's participants on gender imbalance in the field, the possible measures that could be taken in order to alleviate it and the impact of the various activities organized by the COST Action.

This was an informal survey were people could add comments to every question. It was not intended as a final document for policy making, since many of the opinions have to be contrasted with scientific evidence. Instead, it was devised as a useful tool to explore the level of awareness in the field, as well as the initial level of acceptance that certain measures could have in the community.

A total of 172 people participated in the survey. 112 where male and 50 female, 1 indicated 'other' and 9 indicated 'prefer not to say'. 15 of the participants were PhD students, 44 were Early Stage Researchers and 113 were lecturers/professors.

A survey taken by the COST Action MP1403 *Nanoscale and Quantum Optics* [12], in which women represent 16% of the participants –a figure that compares to ours, which is 15% (87 out of 579)– was closely followed. Some questions were added or adapted. It is an interesting exercise to compare the results of both surveys**.**

The format of the survey consists of 15 core questions. Each of them is a certain statement, and the respondent has five possible answers: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree. The questions are grouped in five subjects: 1) equal opportunities, 2) family and caring responsibilities, 3) gender and work modalities, 4) gender within the COST Action and 5) gender equality in the future. A couple of questions on the gender and professional status of the respondents have also been added in order to implement the analysis.

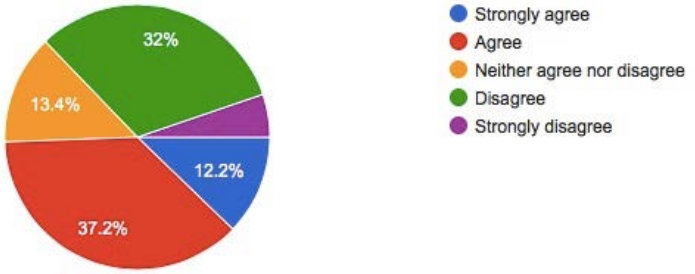
The results show that the majority of the respondents are aware that there is a gender difference in our field (and in science in general). Men and women, though, have a different perception on the issue, women being, in general, more prone to agree or strongly agree that there is a problem concerning gender equality in their professional environments. Even when gender neutral questions are posed about, for example, child care, frequent travel, relocations and so on, women responses reflect that they face difficult decisions on these matters more often than men. Women are also more likely to demand changes in the field related to relocations and long postdoctoral stays. Women are also more likely to devote their time and effort to gender equality initiatives.

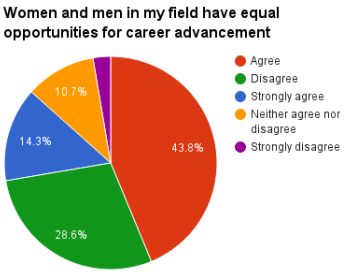
The statistics are presented next, together with relevant comments to each question. The complete list of comments can be found in Ref [11]. The figures show each answer's percentage. In the text below each figure 'agree' indicates the sum of 'agree' and 'strongly agree' and 'disagree' the sum of 'disagree' and 'strongly disagree', in order to facilitate the interpretation. Given the obvious underrepresentation of women in the field and the specific content of this survey, statistics discerning male/female respondents are very relevant and thus they have been implemented. The group of people identified as 'male' is the largest, while the ones answering 'female' is about half the first one and 'other/prefer not to say' is

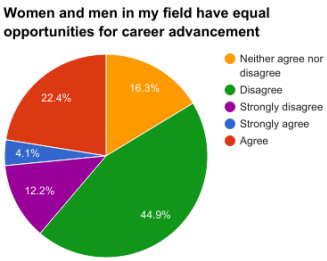
below 10%. The statistics for the total of the respondents are first given and then the answers of male and female respondents are discriminated. The ones classified as 'others' or 'prefer not to say' are taken into account in the general statistics.

Equal opportunities

1. *Women and men in my field have equal opportunities for career advancement.*





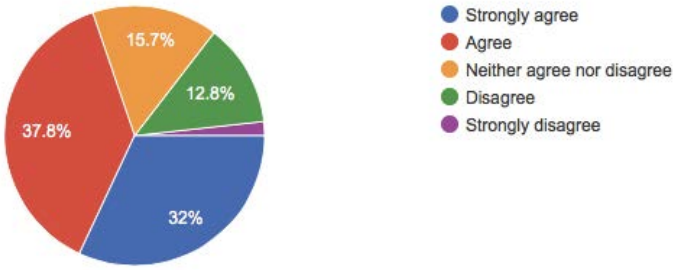


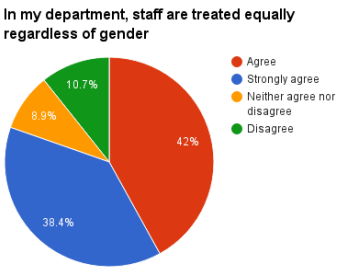
Male: 58.1% agree
31.3% disagree

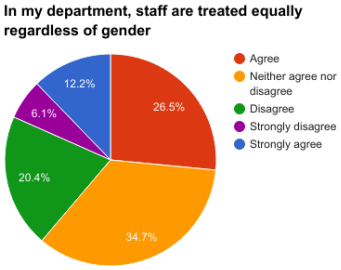
Female: 26.5% agree
57.1% disagree

There is a significant difference in perception between male and female respondents. It is remarkable that, in the comments, several male point out that women are advantaged because of the specific policies to promote them. Most of the comments, though, consider that although 'on the paper' both genders are treated equally, conscious and unconscious biases, pregnancy and childbirth, and difference in social expectations about caring roles are the main sources of differences.

2. *In my department, staff are treated equally regardless of gender.*





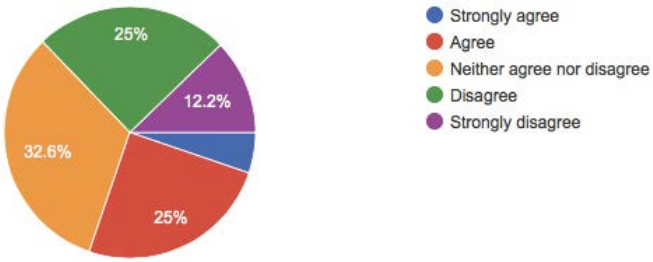


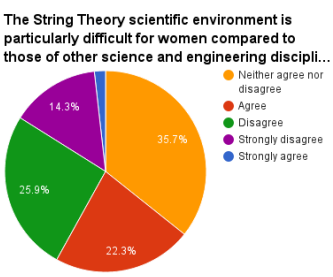
Male: 80.4% agree
10.7% disagree

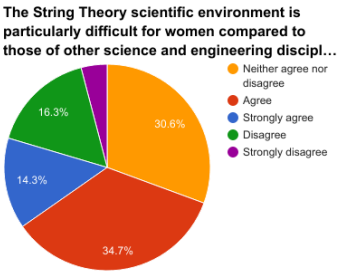
Female: 38.7% agree
26.5% disagree

Again, we observe disparity in the opinions, probably due to the fact that it is women who experience the discrimination and men may easily overlook it. Compared to the previous question, it seems that people are more likely to acknowledge disparity far from their immediate entourage. In the comments, though, some males acknowledge specific situations of discrimination, as for PhD advisors or administrative staff. The male-dominated environment is also seen as a source of problems.

3. *The String Theory scientific environment is particularly difficult for women compared to those of other science and engineering disciplines.*







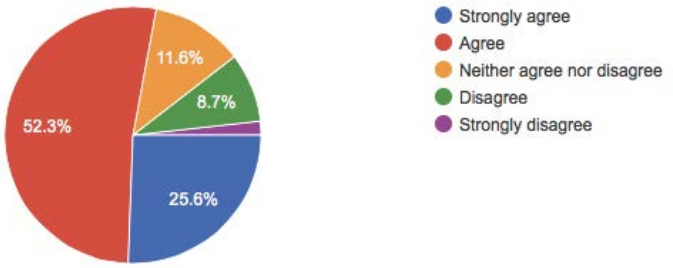
Male: 24.1% agree
40.2% disagree

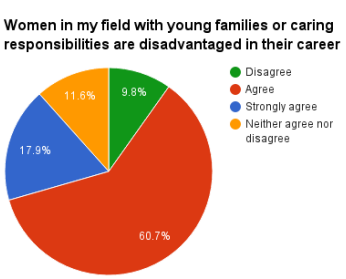
Female: 49% agree
20.4% disagree

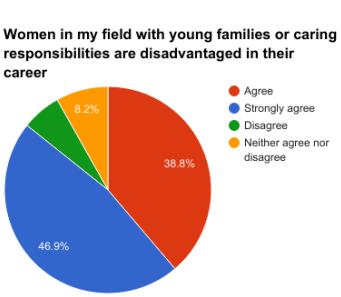
Although, as read in many comments, participants are not likely to have much experience in other fields, this question was intended to identify if some of the procedures followed more often or more intensively in our field could become a target of immediate action. This, apparently neutral, question also provokes different opinions in men and women. The most common answer is the already present disparity, which may psychologically disadvantage women. Other important comments signaled: the long post-doc period, which conflicts with family raising and the lack of experimental tests in String Theory, which resonates with the unconscious bias by giving more importance to some works and undermining others for reasons alien to their quality.

Family and caring responsibilities

4. *Women in my field with young families and caring responsibilities are disadvantaged in their career.*





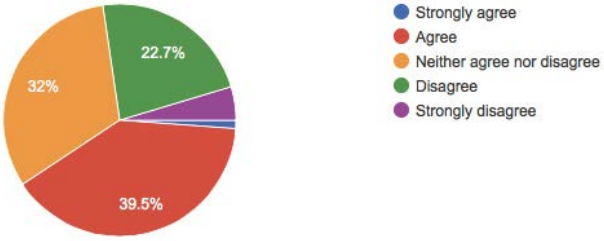


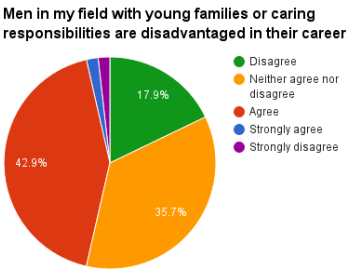
Male: 78.6% agree
9.8% disagree

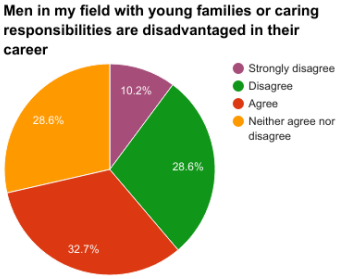
Female: 85.6% agree
6.1% disagree

A high percentage of both male and female respondents agree with this statement, although women agree strongly much more frequently. In the comments, it is highlighted that post-docs and tenure track hiring and grants do not take adequately into account the gaps due to parental leave and the logistics of child care. This is identified to be a problem not specific to string theory. The fact that women usually carry most of the burden is felt as a problem of society, that is probably not homogeneous throughout all countries.

5. *Men in my field with young families and caring responsibilities are disadvantaged in their career.*





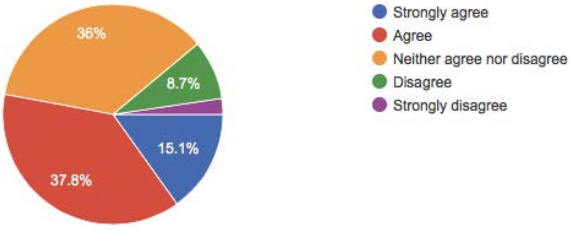


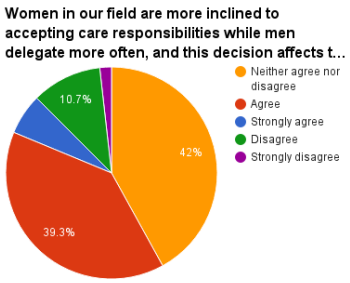
Male: 44.7% agree
19.7% disagree

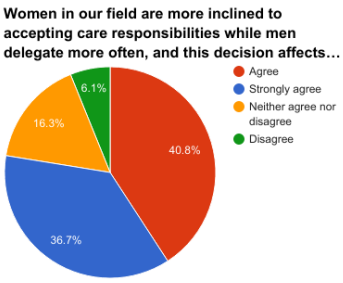
Female: 32.7% agree
38.8 % disagree

There is a clear asymmetry with respect to question 4, although still a high percentage of the respondents think that also men with young families are disadvantaged. 'Physiological' differences such as pregnancy are felt to have an important impact, but the most important issue is, as before, that for women having a young family equals caring responsibility while for men this is not always the case.

6. *Women in our field are more inclined to accept care responsibilities while men delegate more often, and this decision affects their careers.*





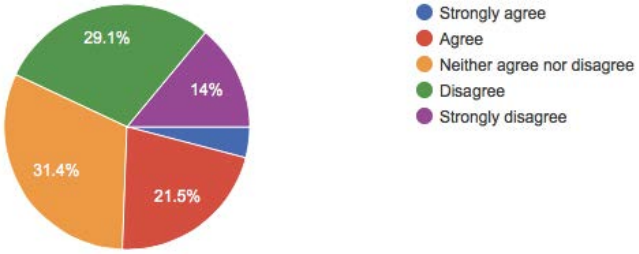


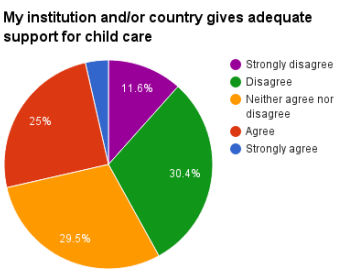
Male: 45.6% agree
12.5% disagree

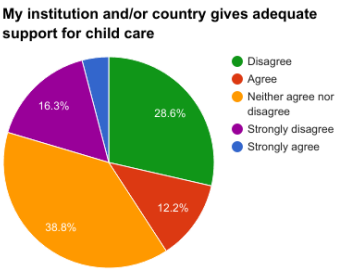
Female: 77.5% agree
6.1% disagree

Many more females, (and more strongly) identify with this affirmation. Curiously, some people agreed while commenting that they do not see it in their environment, which could point to prejudice about the real situation in their institutions.

7. *My institution and/or country gives adequate support for child care.*





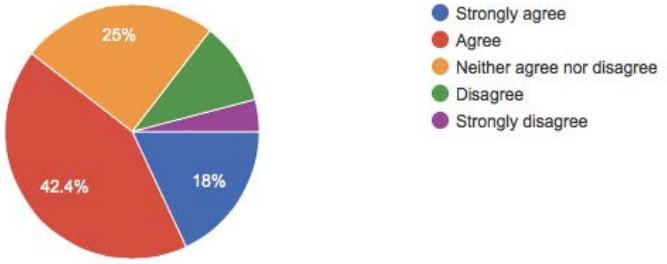


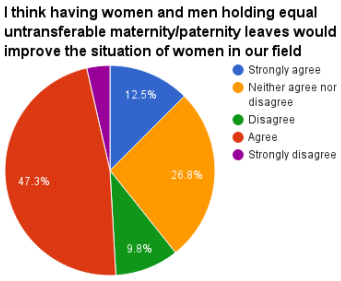
Male: 28.6% agree
42% disagree

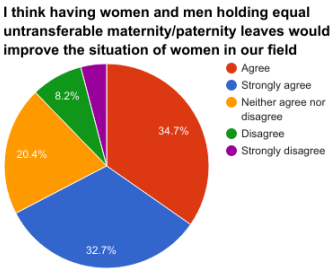
Female: 16.3% agree
44.9% disagree

This question is gender neutral, so one could expect agreement, but, symptomatically, women feel the lack of help from their institution or country more often and more strongly, which may point to the fact that they actually carry more burden than their male colleagues. In several comments, the difference in maternal and paternal leaves is mentioned.

8. *I think having women and men holding equal non transferable maternity / paternity leaves would improve the situation of women in our field.*







Male: 59.8% agree
13.4% disagree

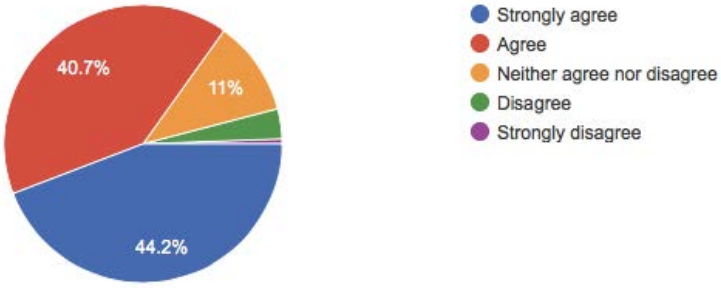
Female: 67.4% agree
12.3% disagree

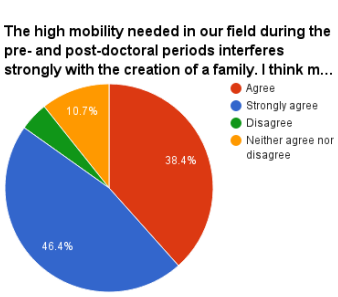
There seems to be a widespread opinion that this could be a good policy, and women feel it more strongly. There are many comments, though, against the non transferability. Some people think that loosing flexibility may not help people with young children. It is also mentioned that, since people can work from home, this could put women with children at an even bigger disadvantage. It is also said that this measure, by itself, would not solve the problem.

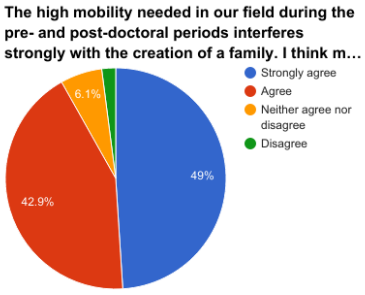
Anecdotally we can point to a man's answer: 'But this could cause a decision against having children'.

Gender and work modalities

9. *The high mobility needed in our field during the pre- and the post-doctoral periods interferes strongly with the creation of a family. I think that more flexibility on this issue is needed.*





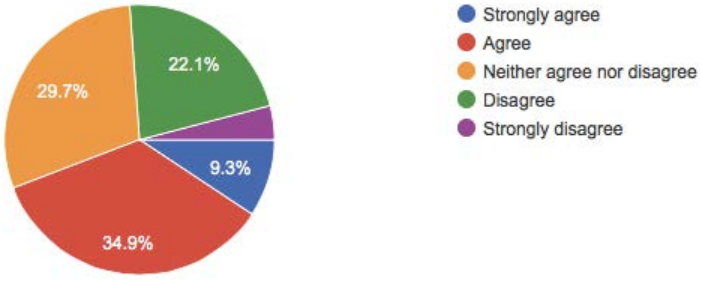


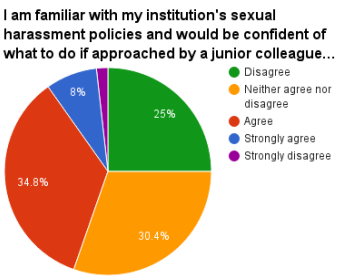
Male: 84.8% agree
4.5% disagree

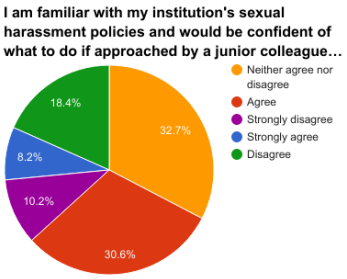
Female: 91.9% agree
2% disagree

The agreement in this issue is overwhelming, among women and among men. In the comments, many people consider that the education and networking done during those periods is very valuable, so they disagree or think that it is difficult to change. On the other hand, many people point out that the word 'flexibility' had not a clear meaning here. In fact, it could mean flexibility when evaluating a CV (no need of such long periods away), flexibility from the institutions (for example by hiring couples) or, on the contrary, flexibility from the researchers. Nevertheless, most people in the comments seem to have, at the end, interpreted the first version, which is what it was intended.

10. I am familiar with my institution's sexual harassment policies and would be confident of what to do if approached by a junior colleague with a complaint.







Male: 42.8% agree
26.8% disagree

Female: 38.8% agree
28.6% disagree

Men declare themselves slightly better at knowing these policies.

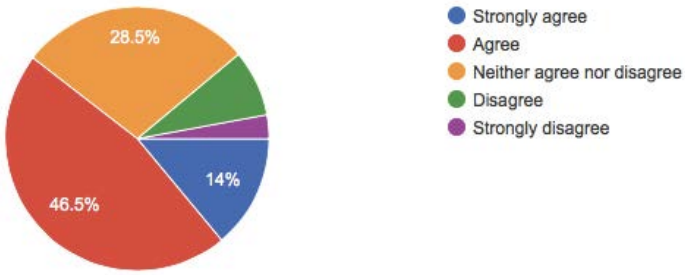
In the comments, some people are very cautious and think that it is a difficult problem to confront and that it is very likely to harm the victim's career. Some people complain that they are the only ones in their departments that know about the policies.

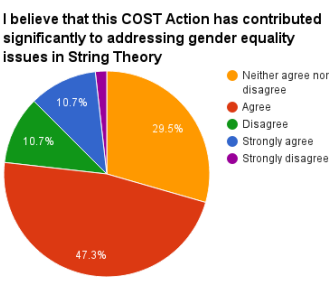
Other people (males) mention that it should be not too difficult to learn about these policies on the spot, if they ever have to. Unfortunately, statistics show that harassment is much more common that people are willing to believe and that many of them do not come out due the lack of support that victims find in their entourage.

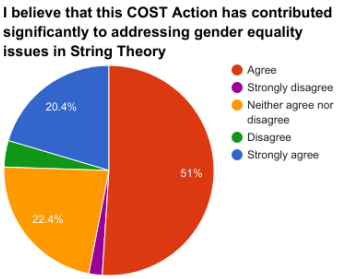
As a conclusion, we could say that institutions are not giving adequate training on this matter to their employees.

Gender and COST Action

11. *I believe that this COST Action has contributed significantly to addressing gender equality issues in String Theory.*





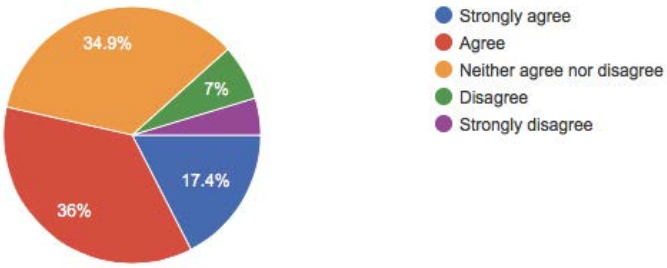


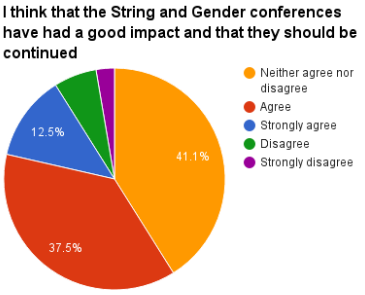
Male: 58% agree
12.5% disagree

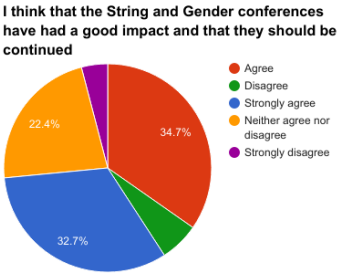
Female: 71.4% agree
6.1% disagree

Majority of agreement, with few people disagreeing. Women seem to appreciate much more the initiative. From the comments, most people understand that one of the main achievements of the Action has been to shed light on the issue and raise awareness. While most people think that this is already a success, some others think that it would be better to take other approaches, not linked directly with String Theory.

12. I think that the String and Gender conferences have had a good impact and should be continued.





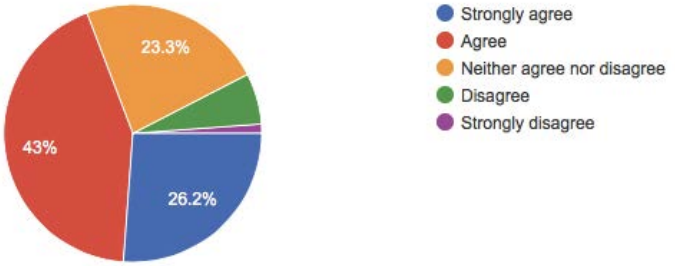


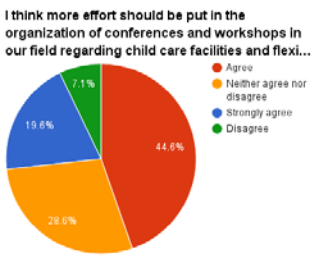
Male: 50% agree
9% disagree

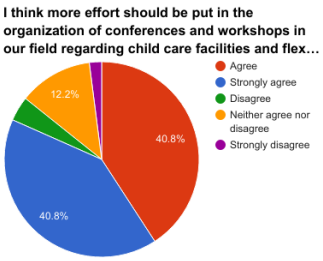
Female: 67.4% agree
17% disagree

The initiative was well received, better appreciated by women (that were the majority of attendants). Many people said they have not participated.

13. I think that more effort should be put in the organization of conferences and workshops in our field regarding children care facilities and flexibilities of stays for extended workshops.







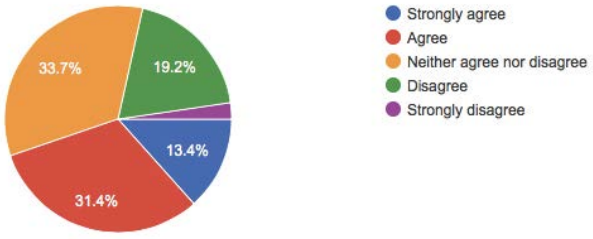
Male: 64.2% agree
7.1% disagree

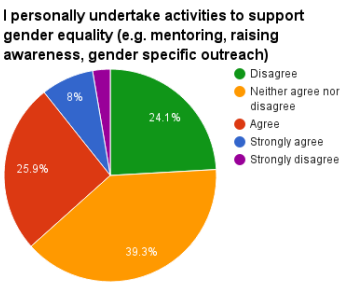
Female: 71.6% agree
6.1% disagree

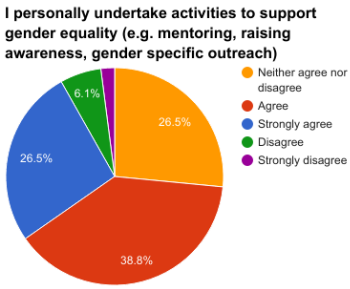
There is agreement that this is an important issue. This is also a gender neutral question, so the fact that more women would appreciate having these facilities at workshops and conferences (and more strongly) already points to the fact that women are more often faced with the problems. From the comments, the uncertainty or lack of funding is the one that is raised more often ('who would take care of those expenses?') while the logistics (very small children, children in school, …) is also thought to be a barrier.

Gender equality in the future

14. I personally undertake activities to support gender equality (e.g. mentoring, raising awareness, gender specific outreach,…).







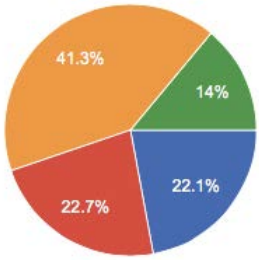
Male: 64.2% agree
7.1% disagree

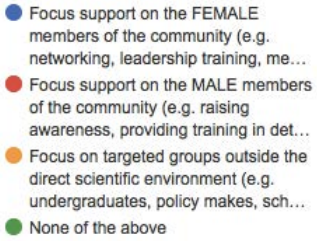
Female: 71.6% agree
6.1% disagree

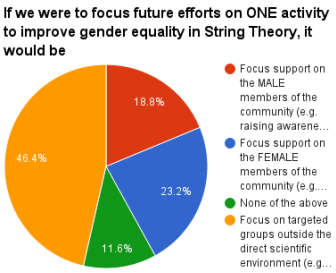
Twice as many women compared to men are involved in this kind of activities.

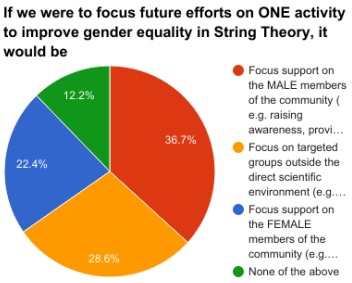
Anecdotally, one man says that doing so would mean harming his career.

15. If we were to focus future efforts on ONE activity to improve gender equality in string theory, it would be









Male: Support on the MALE members of the community 18.8%

Support on the FEMALE members of the community 23.2%

Focus on targeted groups outside the scientific community 46.4%

Female: Support on the MALE members of the community 36.7%

Support on the FEMALE members of the community 22.4%

Focus on targeted groups outside the scientific community 28.6%

The most popular answer is 'focusing on targeted groups outside the direct scientific environment (undergraduates, policy makers,…), which means that people think that the problem cannot be addressed if the society is not involved. Moreover, they think that we can have an impact on society. Nevertheless, women choose this option as much as 'support on the male members of the community'. Perhaps one could interpret that while women see the men members of the community as the ones whose change would make a difference, men do not feel as concerned or responsible and put emphasis on society change.