Career situation of female astronomers in Germany

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We survey the job situation of women in astronomy in Germany and of German women abroad and review indicators for their career development. Our sample includes women astronomers from all academic levels from doctoral students to professors, as well as female astronomers who have left the field. We find that networking and human support are among the most important factors for success. Experience shows that students should carefully choose their supervisor and collect practical knowledge abroad. We reflect the private situation of female German astronomers and find that prejudices are abundant, and are perceived as discriminating. We identify reasons why women are more likely than men to quit astronomy after they obtain their PhD degree. We give recommendations to young students on what to pay attention to in order to be on the successful path in astronomy.

1 Introduction

Although astronomy is regarded as more attractive to women compared to physics, the number of women who strive for a career in astrophysics is reduced significantly with each career step, resulting in a high degree of underrepresentation at professorial level. Woman in general do not have a strong presence in science and technology, with the proportion of woman varying widely within Europe. In Germany, women are known to have less interest than men in natural science than in other EU countries (e.g. Ainuddin et al. 2005). The percentage of female students in physics (that provide the pool for future astronomers) at German universities is of 20% since years.

In the past and in the present, women astronomers had and have the choice of blending in with their environment or just accept to be different. Many of us were wondering for a good fraction of our career if our experiences, for instance in feeling as the odd-one-out during an opening address like “Good morning Sirs” or by aiming for quality rather than self-assertion, are singularities. Should we just learn to adjust, and become less thin-skinned when being confronted with degrading comments and prejudice because this is what happens when climbing the hierarchy? Do we have to work harder in order to be promoted? Are we really confronted with discrimination or just too sensitive when meeting a bad-tempered person – one out of so many brilliantly intelligent, helpful and supportive colleagues of both genders?

Factors that affect the hiring of female faculty candidates and career barriers in natural sciences have been mainly studied in the US (e.g. Greene et al. 2011). To quantify the status of women in astronomy in Germany and of German women abroad the AstroFrauenNetzwerk (AFN) in Germany has conducted two surveys over the last two years. The AstroFrauenNetzwerk was founded in 2007 as an independent network for female astronomers who hold a PhD in Germany or have obtained their PhD in Germany. Its aim is to connect women astronomers, to collect and share relevant information and to help its fellow members in and from a country where women are traditionally underrepresented on managerial levels not to mention the professorial level. Meanwhile the AFN has 73 regular members of various nationalities working in or originating from Germany plus 3 associated international members. Two of the founding members of the AFN now hold permanent posts outside Germany.

In a first study in 2010, a sociologist worked with the AstroFrauenNetzwerk evaluating the gender distribution in astronomy in Germany. Data were collected from German astronomy institutes and their web pages, and the annual reports of the Astronomische Gesellschaft. The percentage of women in German astronomy was found to be about 20% among students, which is comparable to the proportion of physics in general. There is an increased number of female PhD students compared to graduates in astronomy, mainly due to the recruitment of international students. At postdoc level the percentage of women drops to 17.2% and becomes fractional at professorial level with 3.8%.

In a second step, we used our own, independent pool of women astronomers to produce statistics regarding the
status of women in astronomy in Germany and of German women abroad and indicators for the career development of these women. Here we report the latest results of a comprehensive survey conducted in autumn 2011.

Before presenting our results, we are sketching the bigger picture of German women in natural sciences and astronomy as it emerges from recent statistics of the German Research Foundation (DFG), the International Astronomical Union (IAU), the Max Planck Society (MPG), the German Physics Society (DPG), the American Institute of Physics, and the University of Heidelberg.

According to the DFG statistics that is based on material from proposal evaluations, between 2005 and 2008 only 6.8 % DFG proposals for individual grants in astrophysics and astronomy were submitted by women in Germany. The statistics for the year 2010 published by the DFG show that for all natural sciences the funding rates for all branches was somewhat lower for women (42.9 %) than for men (45.8 %). The principle investigator-ship (PI) of women in DFG research units (Forscherguppen) proposals was 8 % in natural sciences and 8.7 % for PI-ship in the framework of the Excellence Initiative of the German universities. The numbers from the DFG statistics refer to submitted applications only. The question here is: Are these numbers representative for women in the respective scientific level?

Regarding the presence of women in the International Astronomical Union (IAU), Germany holds one of the last positions (31 out of 36 national members, Cesarsky & Walker 2010) with 9.1 % women members in 2010. Individual Membership in the IAU is open to scientists holding a PhD and who are “eligible for election as individual members” admitted by a national member (in Germany: Rat Deutscher Sternwarten, in UK: Royal Astronomical Society, etc.). This means to become a member of the IAU the person has to have a certain visibility to be promoted. If women have difficulties with recognition or showing initiative they will be underrepresented in the IAU compared to the female astronomers population in Germany.

The local organizing committee of the annual meeting of the Astronomische Gesellschaft in Heidelberg in September 2011 counted 20 % women among the 430 participants. Out of all female participants approximately half currently work in Germany. 32 % (6 in numbers) of the invited plenary talks were given by women, including a high fraction of international female astronomers.

The Max Planck Society, one of Germany’s leading research organizations, operates nine research institutions in Germany that carry out research in astronomy and astrophysics. These institutions are lead by a total of 32 directors, not one of them is female.

The questions that follow are: where have the female astronomers from Germany gone before reaching top level? Are they (consciously or unconsciously) less promoted after PhD and/or do they prefer to leave either the country or astronomy?

In a survey initiated by the Equal Opportunities Study Group of the German Physics Society (DPG) in 2002 among 1500 male and female physicists and astrophysicists in Germany, men with children were found to receive the greatest opportunities in their profession, followed by men without children and women without children. Women with children were found off the beaten track. The latter suffering reservations on the part of employers (who are on the majority male) fearing caring for a family will affect their performance at work. Moreover, the DPG study found that women were more rarely in executive positions and had lower income than their male colleagues (Könkamp et al. 2002).

A similar but world-wide survey of 15 000 physicists by the American Institute of Physics found that women are less likely than men to report access to various resources and opportunities that would be helpful in advancing a scientific career (international opportunities, invitations to speak, supervisory experiences, serving on committees that have influence, editor of journal, advising students) and are more often assigned to less challenging work by their employer when they became a parent (Cesarsky & Walker 2010, see also www.aip.org/statistics).

A recent study at the Department of Physics and Astronomy in Heidelberg, which is the largest of its kind in Germany, showed that women more often fear failure than men, although no difference in their qualification and commitment for a physics career was found. Reasons are a mixture of missing support and subsequent self-underestimation (Fohlmeister et al. 2010), which is alarming given the demographic challenges Germany is facing in the coming years.

Here we focus on the career status of German female astronomers. Our sample includes women astronomers from all academic levels from doctoral students to professors, working in Germany and abroad, as well as female astronomers who have left the field. In this study we examine the situation of female astronomers and identify important criteria for a career in astrophysics. We investigate private and professional impact factors as well as reasons to work or not to work abroad. We also show the comments and cite three example situations female astronomers are still confronted with, and hope to increase the awareness that comments and behavior like these are discriminating and socially retarded.

2 Survey description

The survey presented here was conducted by collecting data via an online-questionnaire. This questionnaire was designed in preparation of the annual meeting of the AstroFrauenNetzwerk (AFN) in September 2011. The invi-

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3 For more details and additional data see www.dfg.de/download/pdf/foerderung/.
4 See www.iau.org/administration/membership/ for the geographical distribution.
5 http://www.mpg.de/institutes
tation to participate in the survey was sent to all members of the AFN. The members were also asked to forward the invitation to participate to all women astronomers in their respective institutes and to female German-speaking colleagues worldwide. To participate in the survey questions had to be answered online anonymously. Altogether 61 women filled in the questionnaire. No reliable statistics are available on how many German-speaking female astronomers work in Germany and abroad. Comparing the number of participants in this study (61) to the number of all AFN-members (73), we estimate that the participation completeness of this survey is at least 80%. We note that not all AFN members filled the questionnaire and not all women who filled the questionnaire are AFN members.

2.1 Target group for survey

Our data define a representative sample of the German astronomical community. It includes female astronomers from all academic levels ranging from doctoral students to professors, as well as female astronomers who have left the field and work outside astronomy.

The age distribution of the participants is Gaussian, with a peak around 31–35 years. Due to the composition of the AFN (women can become members after obtaining their PhD), the fraction of postdocs is largest within this survey. It also includes a fair fraction of female junior research group leaders (5 in numbers) and professors (4 in numbers). In this sample the category “professor” applies to all professorial titles, e.g. full professorships as well as German “apl. Professor” (adjunct professor). Their small total numbers among the participants in this survey reflects the underrepresentation of women in the German academic system. Currently only two full university and three associate astronomy professorships are filled with women in Germany. There exist different forms of junior research group positions in astronomy. Only DFG-funded research groups in the Emmy Noether program list the number of female research group leaders in astronomy (currently 5 out of 13 in total).

Out of all women who participated in the survey, more than two third (70%) grew up in Germany, 27% in other countries in Europe and 3% overseas.

3 Survey results

3.1 Current and desired work place

73% of the survey participants worked in Germany when they filled in the survey, 20% in other European countries, several (7%) outside Europe. We were interested if Germany is seen as an attractive work place to perform astronomical research. Therefore all participants in the survey who are not located in Germany were asked, if they would like to work in Germany and why. About one third (27%) answered with “yes” and gave private reasons for their decision such as cultural binding or that they wish to be close to family and friends. About 20% answered with “no”; mainly due to work related reasons, stating that they prefer the better working conditions, having more scientific freedom, working in countries with better research politics, or the teaching approach in their respective country of work. Some of the women working outside Germany dislike German attitude (“Germany is too German”, in USA “weniger Gemiecker” (less nagging)).

The duration of the current contracts of all survey participants shows a flat distribution ranging from 1 to 5 years with a small peak around 3 years (25%). Only 14% of the women who responded hold a permanent position (8 in numbers). Nevertheless, 32% are satisfied with their current job situation and 35% rank their job as “short transitional phase”, 40% as stable phase and 25% as “long-term perspective”.

3.1.1 Finding a job

Our results show that the way of finding a job in astronomy is two-fold in Germany, either by the path of job advertisements or applying to soft money, or else by personal contacts.

This is reflected in the numbers: German-speaking female astronomers find their job mainly due to personal contacts (46%) and/or the classical advertisement on the internet (40%). About 20% have changed their position within the institute. The percentage of women who were personally asked to come for the job is the same as the percentage of those who raised their own money (both 18%).

We also wanted to identify what the most important criteria on which women base their decision for a job are. The survey participants decided for a position mainly based on how interesting a project appeared (Fig. 1). The second most important factor is vicinity of family (this includes spouses and all kind of relatives like parents or children), followed by working conditions or the reputation of the institute. Job safety, the salary, a desired change of location or the offered prospect of promotion are among the less decisive factors.

3.1.2 Satisfaction and contentment

We asked about the satisfaction and how content the women were with different job aspects (see Fig. 2). Most female astronomers are happy about the possibility of carrying out their own ideas, the availability/amount of travel funds, their scientific projects and working conditions. These match the above selection criteria in Fig. 1.

On the other hand, female astronomers are less satisfied with their promotion prospects and job-safety. We note that these two points were not decisive for choosing the job. Other criteria like professional training, work life-balance, working time, equipment and family support, and salary are neither ranked very high nor very low.

42% of the female astronomers in our sample state that they want to continue research in astronomy in the long
Fig. 1  “Why did you decide for your current position?” Percentage of women who selected above factors (multiple answers were possible), sorted by frequency of mention. The only not work-related reason of choice, “vicinity of family”, is ranked second highest.

Fig. 2  (online colour at: www.an-journal.org) “Are you happy with your ...?” Left is “very happy”, right “not at all”. Average contentment of all survey participants with different job aspects.

term, 55 % if possible. Only 3 % say they “don’t need to”. One woman stated: “Under current circumstances my answer is: yes, if possible, but not at any cost. With just a slightly better perspective for a permanent position I would say: yes, absolutely- dream job. The result above might also be biased in the sense that woman who do not want to stay in astronomy did not participate in the survey.

3.1.3 Salaries

The average monthly net income summarized here can be treated as an orientation on what young females should expect as a minimum in astronomy in Germany. Global surveys suggest a note of caution as they show that men have generally higher incomes. We note that the average numbers from our sample do not reflect the individual salaries, which strongly depend on the source of funding, the employer and regional differences. For PhD students the average monthly net income in the sample is 1255 EURO, for postdocs 2080 EURO and for staff astronomers 3210 EURO. We note that the salaries of female astronomers who work outside academia show an extremely broad range. This also holds for female professors, depending on successful negotiation.

3.2 Private life

About 77 % of the female astronomers in our sample have a partner. Out of these, every second woman is engaged with an astronomer or physicist. The spouses of the remaining participants work outside sciences (44 % out of 77 %) or in the minority (6 % out of 77 %) doing other science than physics or astronomy. So, if female astronomers choose a partner, every second woman goes for a “colleague”. Other scientists than astronomers or physicists are the exception. In 90 % of all cases in our sample the partner lives in the same city, 10 % have long-distance relationships.

3.2.1 Motherhood

Being mother applies only to one third of our sample, nevertheless 90 % would like to have at least one child in the future. Reasons for not having children yet are a mix of job-related and private reasons. 60 % of these women refer to the uncertain job situation. Around one third states the lack of right partner or that they do not see how to arrange work and family, or that the work-load is too high. About 10 % do not want to have children. Those who became mothers feel very restricted in mobility and point out that it is harder to combine job and family. However, mothers feel generally more balanced and motivated.

3.3 Career development

We asked how many stays abroad for more than 3 months have been carried out. Despite the career importance of working abroad, 29 % of the female astronomers in the sample never had a stay abroad so far. All female staff, professors and astronomers with permanent positions in this survey had at least one stay abroad for more than 3 months.

More than 40 % of the female astronomers in our sample have been supported by a mentor, mainly male mentors (70 %) and state that having a mentor was very helpful for their career (Fig. 3). Note, that these numbers do not refer to a professional mentoring scheme.

It was consensus (see Fig. 4) that the most important factors for a career in astronomy are networking, the number of papers, to work on a hot topic, the quality of research, and a regular presence at conferences. Networking and regular presence at conferences were favored by all female professors.
Fig. 3 (online colour at: www.an-journal.org) Left is “Mentor was not important”, right “extremely helpful for the career”. Percentage of answers (on top) and mean value (red bar) of all female astronomers who had a mentor.

Fig. 4 (online colour at: www.an-journal.org) “What are the most important factors for a career in astronomy?” Percentage of women who selected above factors (multiple answers were possible), sorted by frequency of mention. “Networking” and “regular presence at conferences” are the favorites in the subgroup of female professors.

3.3.1 Contentment with current job

The contentment with the current job situation of female astronomers is good and even shifting from okay to very good with each career advance (Fig. 5). Nonetheless only 17% would recommend to young female students to strive for a career in astronomy (Fig. 6). Most (77%) say “every student has to decide for herself”, only 7% say “no”. This seems to be in contrast to the fact that more than 90% state that they would like to continue astronomical research and their overall contentment. It can be explained with the insecure funding situation, long-term perspective and mobility constraints or just that for some women both statements reflect independent issues.

3.3.2 What was helpful for your career?

All women in the sample were asked for their experience on what was helpful for their career in astronomy as a recommendation to younger women.

Helpful is/was

– a motivating, encouraging, acknowledging boss/supervisor who was a good mentor and trusted in abilities, and who helped getting hands on excellent data and who introduced into networks,
– finding projects as well as self-motivation and working independently,
– having role models for different topics and life phases,
– attending and giving talks at conferences, colloquia and seminars,
– successful applications for grants, observing time and soft money,
– stays abroad and flexibility, and
– colleagues who helped to advance.

3.3.3 What was/is harmful for the career?

We asked all participants to describe their experience on what is harmful for a career in astronomy. The answers, although very different for individuals, show the contrary of the above recommendations.

Harmful is

– unreliable line-managers/supervisors,
– bad advisor/no strong mentor/no strong group (resulting in bad PhD, PhD/habilitation takes too long, lack of papers, no collaborations, no counseling, lack of support, no networking),
– change of PhD-advisor,
– not being able to plan freely/choose a job anywhere (due to partner or children, maternity breaks),
– no/not enough stays abroad (after PhD!),
– working too much in teaching/management/service,
– staying too long at same place, being old,
– lack of self-promotion,
– not working on a hot topic,
working in big collaborations (depending on the authorship policy).

3.4 A backward time-dilatation of German society?

This part of the survey was meant to seeing gender issues less dead-serious. Unfortunately, the examples that were collected are more embarrassing for our society as a whole, above all. After a long discussion whether these comments should be published, the participants in the 2011 AFN meeting in Heidelberg decided to do so. Our goal is not to shock or make fun of individuals, but rather to show what female astronomers are still confronted with. By publishing these remarks, we hope to increase the awareness that comments like these are perceived as discriminating.

The examples fall in three categories:

1. General designation (unconscious or conscious prejudice):
   1.1. I know you would like to work, but if all women would stay at home, we would have much less unemployment.
   1.2. For a woman your seminar was good.
   1.3. You must be the secretary.
   1.4. Female scientists are more masculine than normal women.
   1.5. Special programs for women discriminate men.
   1.6. Good morning gentlemen.
   1.7. Dear Sir.
   1.8. Ha ha, that is the alibi/quota woman!

2. Women are not treated independently of their partner:
   2.1. The husband of this (female) applicant has a better position, so she does not need a job.
   2.2. Why you want more money? Your husband is working!
   2.3. Will you stop your PhD education now that you married?

3. Pressing into the mother-role:
   3.1. You have a diploma [i.e., M.Sc. degree], why do you also want a PhD? Now you can go home and have children.
   3.2. Women who give birth don’t come back.
   3.3. To a woman with children:
   \[ \text{The permanent position is for mister XY, he has to support his family.} \]
   3.4. She wouldn’t come anyway (for a job) due to the children.
   3.5. It is better for the children if the mother stays at home.

Since the above statements represent a collection of comments from our survey, we do not know in which context these have been verbalized. Some comments have been repeated several times and perceived as more unfair with each repetition. Even if some of those comments were not meant to be serious we conclude that role stereotypes and unconscious bias are still at work.

3.5 Example situations

In the following we list three example situations from German universities and research institutes that have been reported to us. These examples illustrate, why female astronomers are less likely than men to proceed with a career in science after the PhD. Names and places are not given in order to protect individuals who shared their experience.

a) Selection committee for a full professorship at a German university: This university has five full professorships in astronomy, none of them filled with a female astronomer. The female applicant gives her science presentation and is interrupted by the head of the selection committee shortly after the beginning. The interrupting person turns to the audience saying: “Nobody believes that anyway.” During the following interview, the equal opportunity officer discredits the applicant in a similar manner by stating that the respective university did not have any gender issues.

b) Equally qualified female postdoc works at the same institution as her husband: He has a full contract including health insurance for not employed family members, and she was told to content herself with a stipend. In contrast to a regular contract, the stipend does not entitle her to retirement benefits, unemployment compensation, or parental allowance. Knowing that she is bound to the place due to family issues, the employer put her on a project position where she can perform scientific research only in a very limited frame, this way pressing her out of track.

c) Female scientist with children working at a German university: She negotiates with her supervisor to work partly at home to use her time more efficiently. As a result, she is pressed to accept a part-time contract. Male colleagues with children in the same research group spend less time than her at work, but are fully paid without any inquiries.

Each example reflects individual situations that might not be gender specific. However, these are three cases, that were brought to our attention by female astronomers only. We note that all above institutions have signed commitments to increase the fraction of female scientists at all career stages as well as gender policies that should ensure that qualified female astronomers experience equal opportunities.
4 Conclusion

In this survey we study the job situation of women in astronomy in Germany and of German women abroad and review indicators for their career development. Our main findings can be summarized as follows:

1. Networking and human support are essential.
2. Young students should carefully choose their supervisor.
3. Postdoctoral experience abroad is a crucial factor.
4. Motherhood complicates things.
5. Prejudices are abundant, and are perceived as discriminating.
6. Never trust a (job) promise until everything is fixed on paper and signed by all parties.

Networking is an important part of science and everyday life. Women find networking in professional environments challenging as they usually juggle more than just their jobs and are still confronted with gender prejudice. We recommend young students to carefully choose the group they want to work with and to regularly attend and give talks at conferences. Since surveys (Könekamp et al. 2002, Ivie & Tesfaye 2011, Fohlmeister et al. 2010) have shown that women in general are at risk to receive less opportunities, having a good and trustworthy mentor can be extremely helpful for the advancement (see studies also studies by Tsui 2010, Tyson & Borman 2010). We find that almost every second participant in our survey found their current job due to personal contacts. This means that young students increase their chances by having a good network. Astronomy institutions should put efforts to support female potentials in this respect as history shows that this comes naturally more often only for men. Here we do not want to give the impression that networking is more important than an excellent publication output, successful fund-raising and scientific standing. But nevertheless it is very important for building successful collaborations and social-scientific contacts that help to reach these goals. Many measures for scientific success, as the number of citations or invitations to give talks, also depend on networking.

Most universities and research institutes in Germany have equal opportunities statutes. This includes procedures of international standard, like involving external committees when hiring people on high-level positions, and committees composed of a diversity of members including women. However, there have been reported cases, where written equal opportunity clauses were ignored or the equal opportunity representatives (being sometimes the secretary, undergraduate students or women on short-term contract) had no power to implement them.

Although experience abroad is essential for a career in astronomy, a considerable fraction of young female astronomers seem to prefer to be close to family and friends when choosing a job. When it comes to motherhood women get restricted in mobility. Additionally, they are more often confronted with prejudice. The overall contentment with the work of women in astronomy is good and even improves with each career advance. More than 40% of the female astronomers in the sample state that they want to continue research in astronomy on the long term. Most female astronomers state that young female students have to decide themselves if they want to strive for a career in astronomy; only 17% would recommend it.

While this survey, by design, only covered ‘easily measurable’ issues of career development, including some prejudices and conscious biases, we would like to mention, that the broad field of unconscious biases can be as important or harmful a factor for career development, as the topics discussed here (see Urry 2009 and references therein).

We conclude that in order to make it more attractive for women to stay in astronomy, the promotion prospects, job safety and family support should be improved. A socially evolved working environment including appropriate mentoring schemes should not be underestimated as examples from outside Germany show.

No comparable data exist for male counterparts in the German astronomy society. This makes it more difficult to judge whether certain results are specific to female astronomers and to assess the impact of multiple causes such as being female and having a family. It would also be interesting to study to which extent the career path choices and the private life differ between female and male astronomers. We recommend to collect similar data for a representative sample of female and male astronomers within a larger framework such as the Astronomische Gesellschaft.

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