

## **Entanglements of gender cultures and disciplinary cultures in physical sciences: Resonance and damping**

[Short paper version]

Martina Erlemann,  
Freie Universität Berlin, Dept. of Physics, Working Group Science Studies  
Arnimallee 14  
14195 Berlin  
Germany  
martina.erlemann@fu-berlin.de

### **Introduction**

Although the decrease of women among the academic personnel with each career step holds for all disciplines, the underlying processes that lead to this problem are closely related to the particular disciplinary culture. Thus when asking for the gendering of academic careers in scientific research and higher education, it is indispensable to take into account that the gendering of sciences differs between different disciplines (c.f. Beaufaÿs 2003; Heintz, Merz & Schumacher 2004) – and moreover also within an academic discipline, depending on the particular subfield. Gendered academic careers are influenced by the gender cultures in the respective research institution and its working place cultures as has been demonstrated for the case of physics in a Europe-wide comparison of different national cultures of physics (c.f. Hasse & Trentemøller 2008).

Drawing on an ongoing ethnography in non-university research institutions within the frame of the project “genderDynamics”<sup>1</sup>, in this short paper, I will sketch entanglements of gender cultures and disciplinary cultures for the case of different physical sciences in Germany, among them solar energy research and astro-particle physics.<sup>2</sup>

Apart from the university research, non-university research institutions form an important part of state-funded research in Germany. Each of these research institutions is member of one of four umbrella organizations: The Helmholtz Association of German Research Centers, the Max-Planck Society, the Fraunhofer Society and the Leibniz-Association. Three of these umbrella organizations are represented in the project “genderDynamics”: one Fraunhofer-Institute, two Helmholtz-Institutes and one Max-Planck-Institute. Two institutes are dedicated to rather applied research, as renewable energies and photovoltaics, a third one does experimental astro-particle physics and the fourth field institute deals with theoretical astrophysics.

## **Gender in discursive and material practices of physics**

In the course of the fieldwork as part of the ethnography it became apparent that one can differentiate heuristically three levels on which gender cultures become relevant:

Firstly, there is the day-to-day explicit talk about „gender“, mostly in the context of gender equality. As from the moment I am entering the field, it pops up in the first instance and becomes a topic for the institute's researchers when the people in the institute get to know me as a social scientist whose project is named "genderDynamics".

In addition to this, a recent policy trend towards more, though relatively soft, regulation of gender policies in science aims at increasing the percentage of women in STEM-fields. This has repercussions on the actual day-to-day research culture, e.g. when equality measures like special fellowships dedicated exclusively for women to apply for, are discussed in informal communication. Some male researchers feel excluded by such initiatives supporting women and are problematized. In these debates some male informants see their gender even as a hindrance for a career in physics.

On a second level it is crucial how social interactions between the actors in the field are gendered in the sense of their 'doing science as doing gender' (West & Zimmerman 1991). It becomes particularly relevant for the physicists' career in interactive settings among the team members when it comes to be judged as being excellent or not, as being able to 'make it' in physics or not, as being the one who gets a position, further support or being offered career opportunities. For the processes of being ascribed a good performance, a reward-worthy reputation or strong achievements, Ridgeway and Correll argue that expectations of who might be acknowledged with these appraisals, are biased by gender beliefs and, in the result, lead to supporting predominantly men (Ridgeway & Correll 2004).

In order to examine how these processes are entangled with disciplinary cultures it makes sense to explore inasmuch research contents co-constitute communication and interaction settings and thus may construct gender cultures.<sup>3</sup> The different fields of physics under examination in the project are solar energy research, astro-particle physics and theoretical astrophysics. They differ concerning their research interests, methods and argumentation strategies as well as, partly, their epistemological groundings that co-construct daily research practices, epistemic, material as well as communication practices. While in solar energy research laboratory work is central, it is computing and programming which is dominant in astro-particle physics, whereas calculating with pencil on paper or on the blackboard constitute daily practices in theoretical physics. This leads to different forms and meanings of teamwork. In the observed solar energy research groups the single working steps are small-scaled – i.e. concrete, short-term, quickly emerging and completable – and are processed by different people. For instance, in manufacturing procedures of solar cells or fuel cells, probes

are handed over from one person to the other. These procedures lead to strong dependencies between the people in the group and on the group leader who is in charge of directing the procedures.

By contrast, in the observed astro-particle physics groups most of the researchers work alone at their desktops in their office. They get into contact with each other when they have problems to discuss, but their particular research tasks are rather independent from each other, compared to the solar energy groups. These differences in the distribution of research-work entails a different organization of communication settings: In astro-particle physics disciplinary discussions within the team are incited via group meetings in which participants are invited to present their work to each other or based on informal relationships. By contrast, in solar energy research, due to their strong dependencies from each other, communication about research contents is activated by the daily work in the laboratory and does not need to be incited through group meetings.

This snapshot of disciplinary differences concerning the social and epistemic function of team meetings point to differences in the day-to-day interaction patterns at the working place and thus can lead to different gender cultures as will be further explored in the project.

On a third level it is an issue if and how epistemic practices are gendered, if they can bear a gendered meaning for the individual or for a social group. What does it mean for physicists doing the actual research practices, e.g. standing at the workbench in the laboratory or sitting in front of the computer and calculating or programming or analysing data? Can these practices constitute a form of gendering that can be performed through doing physics? How, then, is gender inscribed in physical practices, by whom and for whom?

It was feminist authors who asked for gender in the contents and knowledge of science for the first time. Starting with the bio-sciences as the first disciplines under scrutiny, there can be found nowadays numerous studies that focus on the gendering of knowledge of the biological sciences. This focus may not be surprising since the biological sciences produce knowledge on gender, e.g. in biological reproduction theories. Since in physics gender is no explicit part of research contents, there are less accounts so far that deal with the gendering of the material sciences such as physics (for an overview see Götschel 2011). But also scientific findings in which gender or gender differences are not an explicit object of inquiry are in no way gender neutral. Feminist science studies scholars have drawn their attention towards the gendering of epistemic knowledge-producing practices in physics (Lucht 2004; Pettersson 2011; Traweek 1988). From these studies it can be concluded that forms of masculinity can be performed via many physical practices like calculating, handling with machines, designing and constructing experimental devices. Thus physical practices allow practitioners to perform a sort of masculinity via doing research in physics. For the notion of masculinity resp masculinities I refer to Raewyn Connell (Connell 1995; Connell &

Messerschmidt 2005). In her approach, masculinity is not an inherent property of the person that would be shared by all men in the same way, rather there are multiple forms of masculinities that are historically variable and that emerge in practices underpinned through institutionalisation and cultural orientation patterns.

Other forms of possible gender performings in physics beyond the male-female binary were found in a study by Anna Danielsson (2012). She concluded that some women in physics may perform a ‘female masculinity’ when doing physics, as a kind of constructively positioning themselves in a community that is dominated by a masculine research culture, while rejecting expectations to perform a traditional femininity (Danielsson 2012, 37). Her findings demonstrates that the options for gender performings of masculinities through the doing of physical practices are not restricted to men.

But beyond these (constructive) genderings in physics, also discontinuities, instabilities and tensions in the genderings of doing physical sciences play an important role and are not to be ignored, as has been suggested by Dagmar Lorenz-Meyer in an ethnography of mass spectroscopy (Lorenz-Meyer 2014)<sup>4</sup>.

### **Resonances of doing physics and doing gender**

Borrowing the notion of ‘resonance’ from physics, which is meant metaphorically here, the studies show inasmuch doing gender and doing physics can resonate with each other and under which circumstances resonance cannot occur.

Resonance in a physical sense describes the phenomenon when even small driving forces of the particular resonance frequencies produce large amplitude oscillations of waves.

The retelling of the narratives of becoming a physicist as Traweek (1988) has carved out or the handling of big machines as Pettersson (2011) has observed, resonate in ‘resonance frequency’ with a masculine gendering of heroism or craftsmanship which is associated with physical strength for many of the men in Pettersson’s and Traweek’s study. Via some other genderings that are performed through practicing physics, this kind of mutual amplification might not be experienced. These persons rather have to reject the normative framework of a ‘traditional femininity’ or to resist heteronormativity, as in the example of a woman physicist in Danielsson (2011, 36) who rejects a ‘traditional femininity’ on the one hand and resists heteronormativity on the other hand when she constructs her concept of being a physicist through ‘laddishness’ and playfulness. Within the metaphoric frame of ‘resonance’ her doing physics as doing gender can be conceived as being ‘damped’ by normative frameworks of gender.

In the project “genderDynamics” the investigation of gender performings and their relations to practices of doing physics is still to be further explored. Within the fieldwork it might be approached by the exploration of the informants’ affects that emerge in the doings of physics

and the role for their self-understandings, self-conceptions as a physicist and the negotiations with perceived normative frameworks in the gender cultures and disciplinary cultures of the respective field.

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<sup>2</sup> For the notion of disciplinary cultures see Arnold and Fischer (2004) as well as Huber (1991).

<sup>3</sup> Apart from communication settings of formal interaction settings like colloquia, group meetings, there is a lot of informal communication in coffee breaks, leisure time or ‘shop talk’ which is part of the gender cultures. This is not to be ignored but does not stand in the center of this argumentation of the entanglement of disciplinary differences and its dominating formal institutionalized communication patterns.

<sup>4</sup> In this study, gender is conceived as a situated assemblage with particular sedimented histories. It explores the discontinuities, instabilities and tension within and between different gendering apparatuses of bodily production.