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Summary of the report

This report documents the outcomes of the analysis of interviews carried out with physicists working in GENERA Consortium member and partner institutions. It constitutes the Deliverable 2.3 of the GENERA project.

The goal of interview analysis is to **identify gender balance conditions in physics** through **assessing career paths of successful female and male physicists as well as the major challenges and obligations in their workaday life **and **evaluating the supporting and hindering conditions for their career progress**. Additionally, physicists' attitudes towards gender equality in science - including knowledge and evaluation of as well as support for institutional interventions aiming at counteracting gender inequality in physics - are explored. The idea standing behind the study is to provide recommendations for Gender Equality Plans in physics.

Two separate methods of interviewing have been applied: the semi-standardized interviews and the expert interviews. With the use of semi-standardized interviews, the individual aspects of workaday life of physicists, perceived and experienced gender discrimination and strategies to overcome barriers to career development have been verified. Expert interviews were carried out with physicists occupying leading positions in their organizations The expert interviews were focused on gender discrimination and measures for fostering gender equality.

The members of GENERA consortium conducted 83 interviews, including 67 semi-standardized interviews with physicists and 16 expert interviews with leaders of the researched institutions.

Below we summarize the main findings from the study ordered in 8 major themes covered in the interviews.

Career paths of female and male physicists

- **New emerging career pathways**
  The study reveals the transformation of the scientific pathways of the European physicists - the linear and predictable career model is being replaced by the shattered and precarious pathways of the labour market participation. The access to permanent or at least a bit more stable employment is very difficult. The model implies intensive mobility, short-term contracts, grant-funded positions and little predictability of the career.
- **More holes in the leaky pipeline**
  Reconsidering the popular leaky pipeline metaphor, in the new career model the pipeline has many more potential holes, when women-scientists could leave scientific work.
- **Challenges in family-work reconciliation **
  Family-work reconciliation is more difficult within a new career model. In the context of a

precarious and unpredictable pathways, young female (and male) scientists postpone decision of having children or resign from childbearing. The arguments include most of all unsecure employment situation, but also demand for mobility, competitiveness and pressure of constant work.

Work conditions and environment

- **Physics is a passion which demands more and more working hours**
  Physicists positively evaluate their own engagement in work and often underline personal enthusiasm related to being a physicist. More critical reflection appears in the context of organizational commitment, which includes assessments of own satisfaction with respect to work conditions. While some of the interviewees demonstrate high level of satisfaction when it comes to a type of contract, salary, access to laboratories and equipment, others express rather dissatisfaction concerning:
    1. a new self-financing model impacting both employment policies of a given institution and research;
    2. being flexible when it comes to the demands of the academic labour market (e.g. being open to migration, short-term contracts);
    3. unclear and fuzzy boundaries of work time;
    4. proliferation of tasks and responsibilities and general work overload.
- **Team work matters**
  Physics is perceived as a discipline based on team work, especially when it comes to experimental subfields on the one hand, and conducting research through implementing international projects. Majority of the interviewees is satisfied with their work environment, which they find stimulative and supportive. Critical evaluations concern competitiveness among physicists which is not always based on fairness and clear norms.
- **Physicists as managers**
  In the context of emerging additional responsibilities, related to e.g. administration, project management, teaching, a new role of a researcher has been underlined. Metaphorically speaking, **physicists become managers** responsible for taking of their time, team, career and finances for the research.

Mobility, migration and internationalization of science

- **International means successful **
  International mobility is considered an indispensable element of a scientific career, critical for science development and for improving the functioning of academia. In some physics domains, it remains unavoidable due to needed access to equipment for conducting experiments. Mobility is a tool for developing and intensifying international collaboration, thus limited access to mobility can hinder one's career. It is important to stress here that stage of one's career (being young or senior researcher) can differentiate experiences and barriers related to mobility.
- **The pressure to be on the move as a burden**
  The forced migration in search of job positions constitutes a burden to young researchers faced with temporary job positions availability. The difficulty to reconcile mobility with care obligations is a challenge especially in women's career development, but multiple migration experiences become problematic to both women and men. In double career couples, the need to follow a

partner may cause downgrading or abandoning scientific path.

Evaluation of scientific networks

- **Better to belong - networks as career pushers**
  Among main advantages resulted from participation in the networks, physicists list an access to information and its importance for career development. Scientific networks often serve as a crucial source of information about the newest publications, important discoveries, conferences and events. In a more instrumental understanding of its use they also provide an access to journals and publications. The networks are sometimes perceived as career pushers as they help to gain visibility and make new contacts what may in the future result in new collaboration opportunities or even job offers. Some of them promote gender equality in their structures and among their members what has been noticed and positively evaluated by the respondents.

- **Informal means good**
  Some interviewees express a belief that the best solution to develop one's career and scientific goals is to have an informal, small group/a team of collaborators. In this context formal membership in the networks is not always something desirable by physicists.

- **Women-only networks are important, yet not recognized**
  Women-only networks are not very popular and well-known among physicists. Yet, if a researcher decides to join such structure, usually appreciates the benefits stemmed from it. These networks create a friendly social space for women, who can share their opinions, reflections and experiences with each other outside of sexist culture. Scientific organizations for women contribute to gender equality promotion.

- **Weak points of the networks - lack of recognition, sexist culture, fees**
  Given the diversified experiences of the physicists, several weak points of the networks should be also mentioned. Firstly, their goals and benefits coming from membership are not always known and recognized by physicists. This aspect is related to both female-only networks and more universal structures and organizations. Secondly, the latter are sometimes still perceived as male dominated and not inclusive for women (in terms of sexist culture). Thirdly, being part of official networks often requires paying fees what for some of the respondents was quite problematic as they do not receive financial support from their universities / organizations in this matter.

Mentorship

- **Deficiency of female role models ****
  The GENERA study reveals an important role of mentors and role models in making and sustaining decision about pursuing own academic career. Mentors are defined broadly by interviewees as: -Teachers present in primary and secondary education; -Close relatives and family, providing necessary support during the entire career development; -Supervisors and other researchers; -Role mentors, understood both as famous scientists and important persons from private life. In this context, the lack of female role model is evident. ***Good mentor, good career
  When it comes to roles of supervisors, their involvement in helping to find a job, including young researchers in scientific networks, searching for financial support for the research, building a productive team and friendly atmosphere at workplace, is highly appreciated and sometimes substantial for own development. Sometimes mentors are also positively evaluated

for their personality and high ethical standards at work. Mentorship oriented specifically to women is rarely experienced by physicists, but the need of such guidance was expressed by several interlocutors.

Reasons for domination of men in physics and existing barriers to women's success

- **Growing awareness on gender imbalance in physics**
  The discussion around the gender imbalance in physics turns from “the problem of women with physics” to the “problem of physics with women” indicating for the raising awareness over female low representation or even absence.
- **Social gender norms crucial for the scientific workplace**
  The most commonly mentioned reasons for male domination in physics are located *outside* the field and relate to socio-cultural norms and values. They include processes of socialization and reproduction of gender stereotypes in youth (male figure of a scientist, different predispositions of gender towards scientific work) and the cultural expectations towards women's role within family with priority given to male career. Other determinants for low women representation relate to the *specificity of the field*, with a demand of the full dedication to science, as well work organization - precariousness at the early career stage, demand for mobility, high competitiveness.
- **Masculine working culture carries on**
  Cultural norms and stereotypes clash with international organizational issues create difficult conditions for women's career - cultural norms that work in favor of men, when matched with new principles for work organization can have even more deterrent effect for women's career. This is seen in two areas. First, the cultural norm of men as a scientist creates a masculine working culture, with growing demands for competitiveness and dedication to work. Second, reconciling work and private life becomes more difficult in a more precarious model of career demanding mobility, as well as it brings new challenges for partners in dual career couples to continuing scientific work.

Experience of different treatment - microagression and discrimination

- **Microagression - a common experience**
  Female physicists more often declare being unequally treated in their workplace than their male counterparts. Subtle forms of different treatment - conceptualized here as microaggressions - prevail over the overt gender discrimination. Identified forms of microagressions experienced by a significant part of female physicists include assumption of inferiority, restrictive gender roles, sexist jokes, invisibility and sexual objectification.
- **Microagressions can make female physicists leave science**
  The significance of microagressions is far-reaching: they signal deprecation of professional position of female physicists, evoke negative emotions in women and their accumulation may contribute to leaving science.

Institutional aspects of gender equality

- **Scientific institutions can foster gender equality**

Physicists widely recognize a role of institutions - including research institutes - in fostering gender equality in science. According to most of the respondents the main area of intervention for institutions is the wider cultural environment of science, including educational process.

- **Family should be more welcomed**
  Interviewees see also a necessity to take deliberate actions towards better reconciliation of work and private life. The most desirable solution seems to be childcare facilities provided by the employer.

- **Need for supporting transparent rules of employment, stable jobs and mobility**
  As far as measures in hiring, retention and promotion are concerned the respondents underline a need to assure that the criteria and processes of evaluation are always objective and transparent as well as long lasting. Equally important seems to be acting against precariousness of physicists, understood as insecurity and instability of work due to the dominant pattern of employment through multiply temporary contracts. Facilitation of mobility is also seen as a vital task for institutions.

- **Insufficient knowledge of gender equality measures**
  Many physicists declare that their knowledge about gender equality measures and actions taken by their institutions is limited, which is believed to be the effect of ineffective dissemination of information on the undertaken activities. Additionally, those who affirm awareness of existing gender equality solutions, find them sometimes misguided and ineffective.

- **Ambivalence towards affirmative actions **
  While institutional interventions targeted at pupils and solutions for enabling reconciliation of work and private life are mostly evaluated positively, implemented measures concerning recruitment and promotion meet with various evaluations.
  The most disputable measure for gender equality in science is affirmative action. The majority of interviewees point to negative aspects and side effects of implementing special measures, and especially quotas. These solutions are argued to indeed counteract the idea of gender equality by breeding prejudice against women and being discriminatory for men. Further, they are believed to be harmful to the quality of science by lowering its criteria of evaluation and breed resistance due to their imposed character. The prevalent argument for implementing special measures is the belief that they are the accelerators of desired social change towards gender equality.

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