FORUM PHYSICS AND SOCIETY

Report from the FPS meeting, CERN, Switzerland, 28-29 March 2012

European Physical Society

more than ideas

PHYSICISTS IN THE MARKETPLACE

The Forum Physics and Society (FPS) of the European Physical Society (EPS) aims to support a more active EPS role in the relationship of physics to society, taking seriously the challenge of maintaining a strong and critical dialogue between physicists and decision makers. Workshops and meetings organised by the FPS bring together decision makers and physicists to discuss issues related to physics and society.

EPS Report

PHYSICISTS IN THE MARKETPLACE

The **fifth** Forum Physics and Society took place at CERN, 28 – 29 March 2012. The meeting brought together 45 physicists from universities and industry as well as economists and political scientists from 18 countries. The forum discussions focused on "physicists in the marketplace", emphasising three themes: (i) opportunities and threats of being a physicist, (ii) the global challenge and (iii) scientific social responsibility – is physics prepared?

Invited keynote speakers from the "marketplace" supported the discussions by in depth analyses of selected issues. Invited speakers included a physicists involved in policy making on the national and European levels, physicists with experience in industry, health, and finance as well as management and business experience.

After the presentations of the three topics, including lively debate and discussion, working groups drafted recommendations that contained a common core of issues to be considered by EPS. Overall, this workshop identified concerns deriving from future global trends and their impact on the physicists of tomorrow. In particular, it is worth considering how such trends can be integrated into future PhD programs, so that students are correctly prepared for the realities of the world that they will encounter when they launch their careers after many years in the educational system.

Trends

The following trends were considered as deserving special attention by the Forum:

1. The growing importance of anticipating, analysing and addressing global challenges in such areas as health, energy, environmental protection, food security. Characteristically, these issues are complex and multidisciplinary, combining phenomena that are in the realms of the natural sciences (*e.g.*, physics, biology) and the behavioural sciences (*e.g.*, sociology, economics).
2. The evercloser connection between basic and applied research, with industrial enterprises seeking to take advantage of cutting edge science and technology (*e.g.* materials, algorithms) for creating new products via accelerated processes of world-wide innovation and competition.
3. The increasing competitiveness, diversity and unpredictability of individual career paths, allowing (or forcing) individuals to take more responsibility in planning and managing their personal and professional lives.

Overall recommendations

FPS *recommends* that national physical societies and physics institutions focus on issues where they themselves have responsibility and thus adopt a more proactive role.

The traditional physics curricula at European and North American universities, which evolved throughout the twentieth century, are not well suited to a world that is strongly affected by the above trends. Accordingly, a well thought out process of adaptation should be undertaken, with the participation of all concerned stakeholders, including physicists' professional societies. The Forum has identified the following elements of desirable educational and curriculum reform:

- **a.** More emphasis on the study of complex, open, dynamic systems – either purely physical ones, or those combined with engineering, social and behavioural sciences (*e.g.*, "smart" electrical power grids, urban environments, climate models, ecosystems).
- **b.** Greater exposure to complex problems in areas other than physics (*e.g.*, chemistry, biology, economics, sociology).
- **c.** More exposure to the industrial and commercial world in preparation for employment. Experience in industry should be long and intense enough to increase skills for teamwork, communication, innovation and user- oriented solutions. Better understanding of general engineering skills, including best practice in patenting, copyrighting and licensing procedures should be encouraged.
- **d.** More international experience, including multi-month residence in diverse cultural and linguistic settings.
- **e.** More attention to early career counselling, planning and management, especially on the part of faculty advisors and university administrators.

The physicist in the market place

Physicists perform comparatively well in the market place. According to data on Italian physicists, this is due to the quality of the students in physical sciences (including their good educational and socioeconomic backgrounds, their strong intrinsic motivations) as well as to the quality and selectivity of the curricula in physical sciences. The high learning potential of physicists means that they are **flexible** and well suited to enjoy the fruits of lifelong learning. Thus, physicists' skills are effective in a wide range of job opportunities, *i.e.* jobs outside basic research and education that graduates tend to favour.

Main strengths of being a physicist:

1. strong skills in problem solving and modelling
2. strong intrinsic technical and cultural motivations
3. effective skills in "conventional" as well as "non-conventional" occupations *e.g.* in policy making, business, consulting, *etc.*

Main weaknesses of being a physicist:

1. "Cultural barriers" in pursuing and appreciating job opportunities outside research and education; two reasons for this were identified: (a) the educational system has biases relating to the perceptions of what it means to be a "physicist", and the individual's aspirations for her/his career path; and (b) information on the wide spectrum of potential jobs is lacking.
2. Graduates in physical sciences possess comparatively poor transferable (soft) skills (*i.e.*, team work, communication, business and entrepreneurial skills).
3. Academics are not very willing to spend time and effort to interact with the outside world and to decode their research in terms of potential industrial applications (the ivory tower syndrome)
4. Underrepresentation of women in the profession.

How can these recognised weaknesses be addressed without giving up the classical strengths of being a physicist? In other words, how can one improve job opportunities and job satisfaction and, at the same time, highlight the social value of research and physics education. The Forum agreed on the following specific recommendations.

Recommendations and a Proposal to EPS

1. Encourage universities to design appropriate curricula that take into account national institutional, economic and social contexts; the EPS should review these different curricula and disseminate best practice in this area.
2. Encourage universities to offer students opportunities for development of transferable (soft) skills
3. Encourage universities to improve orientation and job placement activities
4. Knowledge transfer to society needs to be more efficient, which requires that universities, researchers and students be aware of the issue.
5. Entrepreneurial skills and opportunities for physicists need to be promoted.

Best *practice* is fundamental for realizing these recommendations!

The Forum Physics and Society therefore proposes that EPS – being the unique platform for this purpose – undertake a review of such best practices together with its member societies throughout Europe.

Recommendations and proposals regarding scientific social responsibilities'

Science is a powerful force catalysing major changes in society. The traditional attitude of academic scientists has been to keep society at arm's length, leaving it to reap the benefits of basic science, and distancing themselves from the discussions on consequences of scientific discoveries. If such behaviour could be defended in the past, the tremendous impact that science currently has on our daily lives requires that research scientists concern themselves with the potential benefits and risks of scientific discoveries.

This has raised the question how scientists (and physicists) can enlarge their fields of study to respond better to society on issues like:

- the general public and the societal return of investment in science
- the science educational challenge (young students, their parents and gender issues)
- the need for innovation, which is the basis of a flourishing economy and job creation
- general public issues, such as the scarcity of resources, environment, economic and political stability, education, aging and population growth, *etc.*)

The general public hopes and expects that physicists can help in solving global challenges. Generally physicists have not been responsive enough, hiding behind the long-term contributions of basic science to the economy.

Unfortunately, outreach activities undertaken by some outstanding scientists are not fully appreciated, either by their peers, or by their institutions..

- **The public funding agencies as well as the physics community itself must learn to value such outreach activities and recognize the importance of these activities in the public understanding of physics.**

Added to this is the low interest in studying science, particularly for physics (as the studies are long, career opportunities are not well explained, physics is viewed as a difficult discipline, …). Physicists need to be made aware that outreach activities are essential to attract the next generation of physicists and the way they communicate about physics needs to change.

- **Physicists should stimulate educational and outreach actions like "La main à la pâte" in France, where parents are encouraged to be more open to the wide choice of scientific studies for their children.**

Concerning the other main "payback" mechanism to society, industrial innovation plays a central role. Physicists who have traditionally focussed on basic science must engage more deeply in the innovation process and demonstrate the specific benefits of physics. Clever physics students and graduates should be encouraged to bring their analytical abilities to the market place. Ties between academic and industrial physicists should also be strengthened.

Another element of scientific social responsibility deals with the image of physicists – still coloured by the past atomic and nuclear events (bomb, nuclear power plants accidents). Unfortunately physicists might partly be blamed for accidents like Chernobyl and Fukushima, and the public cannot fully understand these events without explanations from the scientific community. As individuals and members of the profession, physicists should take responsibility (obligation) to change this image through specific actions directed in particular towards young people. Actions of this type must comprise a "physics point of view", suitably blended with a keen understanding of societal complexity. Changing the public's perception would also help physicists working in other fields *e.g.*, in health care, energy production and distribution, information technologies, nanotechnology, insurance and financial analysis and last but not least in education.

- **To stimulate such developments and get a better vision on scientific social responsibility, the Forum recommends establishing an Ethics commission within EPS with participants from various fields.**
- **Physicists should engage with the media and undertake Public outreach activities to enhance the image of physics and its contribution to society.**

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