Session 5 Panel Discussion

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I represent here the community developing particle accelerators, which are the **tools of the trade** for most of the applications that have been mentioned during these two days. I come from CERN, which is the largest particle accelerator laboratory in the world. However, this is only the most visible element of a wide community of large and small laboratories, universities and industries that have decided to define common programmes for the development of their instruments, for the benefit of science and of society. These partners are joining their efforts in large multi-laboratory projects for common R&D on accelerators supported by the Commission under the Horizon 2020 programme; the last example being the ARIES project - Accelerator research and Innovation for European Science and Society. Particle accelerators are a **European excellence**, and our projects are building on this excellence to bring more outcome to the society.

Accelerators have been originally invented for the needs of particle physics, and particle physics is still the main driver for their development, the place where physicists and engineers find new and exciting challenges. However, particle accelerator technology has seen a huge development in the last years, with a manifest **transition** from basic science to applied science and to applications with a direct benefit for society. The increasing expansion and accessibility of accelerator technologies, together with the emergence of smaller, compact designs, are fostering their spread across a wealth of applications in fields as diverse as health, industry, energy, security, and the environment. Our **vision** is to extend the use of particle accelerators from scientific laboratories to hospitals, to industry, and to other applications outside of the scientific world. All these accelerator applications share a common drive to move beyond the traditional chemical approaches used in medical and industrial processes to those that rely on interactions at the atomic and subatomic scale, thus opening up new opportunities in terms of novel products, industrial processes, and techniques addressing societal problems. These include improving cancer treatment and medical diagnostics, reducing air pollution and treating radioactive waste. Our priority is twofold: to develop specific accelerators to meet societal challenges, and to identify new fields where accelerator technology can be applied.

What are the main obstacles that prevent a larger spread of accelerator-based technologies to society? Here I want to enumerate three major issues.

The first problem is related to public acceptance of technologies that are connected with radiation, and to the **perception** that the general public has of radioactivity. To give an example I can mention the case of electron beam treatment of crop seeds against fungi and bacteria, which has many difficulties in being accepted while in fact replaces standard chemical treatments that are potentially much more dangerous for the health and for the environment. It is clear that we need to work together in the education of the people, to prove that radiation risks are well understood and mastered in modern technology and that scientists and users of radiation technologies are well aware of potential risks in the tools that they are using. Communicating on radiation technologies should be part of higher-level programmes, beyond the strategy of individual research institutions, which could be part of a wider mission to restore the public confidence in science.

The second problem relates to the **time constant** of particle accelerator technologies. Our society is used to a fast return from investment, while particle accelerator technology is based on high technology and sophisticated hardware with long return time. The life cycle between initial idea, prototyping, industrialization, and final licensing – i.e. going from the scientific laboratory to the user

- can last many years or even decades. During this long innovation process, the scientists have to be supported and the technologies need to be proven, often by expensive prototypes. The return on investment is very long, and the consequence is that few are ready to invest on this technology. To solve this problem, we definitely need long-term vision and planning, and a long time support to technology development. The reality is that scientific institutions in Europe operate with short term objectives and often do not have the interest to invest in accelerator technologies. In a similar way, private investors show little interest in long-term commitments and long returns.

In this respect, the EC can play an important role. On the one hand, it can provide a long-term vision and commitment via multi-annual multi-national programmes. On the other hand, the Commission can promote specific tools to support the critical phase going from early prototyping to industrialization. Support schemes for innovation are already available but they are more directly aimed at industrial products; an additional problem to be faced is that that the strong sectorization of the Commission is not well adapted to multidisciplinary instruments like particle accelerators. Accelerator technologies for society are presently developed within the Research Infrastructure section of the Research and Innovation programmes, with the goal of demonstrating the innovation potential of Research Infrastructures. After this initial exploratory phase, the technological follow-up and implementation are left to the support of other Directorates that hesitate in supporting transversal tools with applications covered by different programmes like Health, Energy, Mobility, Environment, etc. An example in this sense is a recently developed compact proton accelerator design that has with applications in medicine (production of radioisotopes), cultural heritage (analysis of artwork), industry (on line analysis of surfaces) and security (neutron production for nuclear interrogation) but does not belong specifically to any of the development lines of the Commission.

Third point to be underlined is the importance of **cooperation** and the role that in this respect can be covered by the Commission. To move forward our technologies we need more cooperation, between research centers, with the final users and with the European Commission. Radiation technologies is a major example of a rapidly developing field pushed by a community sharing common goals and common concerns, which reaches to different sectors of the European society.

In this sense, this Conference is a significant example of interdisciplinary meeting on a key European technology, grouping its main actors: scientific institutions, medical recipients of the technologies, representatives of different sectors and Directorates of the Commission, and representatives of civil society. My sincere thanks go to the Organizers for setting up this seminal event and to the Commission for inviting me to contribute.