Questionnaire

ELKH | Eötvös Loránd Research Network

NAME OF THE INSTITUTE: Institute for Solid State Physics and Optics

1. Where do you foresee ELKH in 5 years?

In our experience, chief scientists working in world leading institutes recognized the scientists from the institutes of the Hungarian Academy of Sciences because they knew the prestige of the Academy from their own research system. The reorganization of the research institutes in the frame of the ELKH resulted in the loss of this prestige. It is difficult to build up a new scientific “brand” from scratch. In 5 years, the ELKH must be on a well-defined route to reconstruct a prestigious brand on global scale.

The new ELKH brand should be rooted in the excellence of the research institutes. The targeted level must be ambitiously positioned above that was characteristic in the Academy times. Otherwise, the chances to achieve international reputation is unrealistic in the contemporary research scene which has changed a lot throughout the years. The idea could be to approach the character of the CNR in Italy, the CNRS in France or even that of Max Planck Institutes (MPI) in Germany. These organizations collect “flagship” institutes in their own disciplines. The task of ELKH is to facilitate the conditions to run excellent flagship research institutes in Hungary.

The excellence of the institutes is based on the traditions and on the high quality of researchers. It should be clear to the ELKH leaders and stakeholders that convergence to the scientific standards of MPI or CNRS is conditioned upon convergence in both salaries and research infrastructure quality. For instance, the average salary of research professors at the SZFI is 2.700 euros which is about 50% less than the typical salary of professors of 5.500 euros *after scaled down* by the GDP / person of Hungary and Germany, and is rather comparable with a starting postdoc salary in Germany. The financial scheme and the total budget of the ELKH institutes should be adapted proportionally to those of MPI or CNRS institutes. The competitiveness in terms of salary and research infrastructure should not be compromised.

In turn, the ELKH must stringently require the institutes to carry out a rigorous selection process of chief scientists to raise the standards and to increase the quality of research. By setting this goal, the convergence can be realized in a subsequent 5-10 years that put the Hungarian Research Network to the map of research institute networks in Europe.

2. Where do you see your Institute in 5 years?

Our objective is to be a leading institute in table-top experimental physics in the East-Central Europe, which can be well based on the long-lasting experience of the staff in solid state physics and optics. The research is focussed on light–matter interactions in relation to nonlinear and quantum optics, as well as to material science at the nano- and atomic scale. There is an underlying common denominator of the research methodology rooted in the use of cutting-edge infrared, laser and X-ray spectroscopy, and high-performance computing methods on the theory side. The scientific objectives range from the study of fundamental principles to the applications of phenomena related to quantum information processing,

designed nanostructures, and non-equilibrium statistical physics. In a laboratory-driven research, technology development naturally takes place that can be coupled to the innovation ecosystem. The institute is devoted to deploy its scientific potential and knowledge base in industrial co-operations in the frame of challenging and scientifically demanding R&D&I projects. The institute has a well-defined role as a leading research centre in the higher-education provided by universities in Budapest.

3. In general, what are the main objectives and challenges in your research field internationally and in context to Hungary's Research and Innovation Ecosystem?

SZFI concentrates much of its research efforts on studying the quantum states of matter with various theoretical, computational and experimental approaches. The objective is the perpetual improvement of the control of single quantum objects, photons, electromagnetic fields together with their interaction with matter on many length scales, especially at the nanoscale and molecular level. Each upgrade of the control level results in new measurement methods and applications. The challenge is the very high international competition, since quantum technology, photonics and nanotechnology are undergoing a very fast evolution worldwide. This is, on the other hand, the objective in the context of Hungary's Research and Innovation Ecosystem: SZFI can represent and translate cutting-edge technologies in the country and partake in R&D&I projects. SZFI is already a leading institute of quantum technology in Hungary (consortium leader of the Quantum Information National Laboratory) and photonics (host of the corresponding national excellence programme) which have high potential to revolutionize various industries. For example, one of our objectives is to provide the expertise to connect Hungary to the pan-European quantum communication network, and to place Budapest as an unavoidable hub in this region both physically and in terms of critical mass of experts. The challenge, in this respect, is that the number of top researchers and high-quality engineers working on the highlighted topics should be significantly increased in the institute in 5 years. The critical mass of researchers should be present in the other research fields too at SZFI.

4. Please list 3-4 initiatives / endeavours your team intends to deliver in the next 5 years!

- Controlled quantum bit operations with atomic systems
- Computational and experimental characterization of exotic quantum states of matter
- Ultrafast laser switches in semiconductors for electronics
- Local spectroscopy of molecular nanoobjects

5. Please outline the elements of a "performance evaluation basket" in your field, i.e.: research grants, funding, patents, bibliometric analysis, number of students, succinct statement of the breakthrough research, niche markets in which you have a competitive edge etc.? What would be the key performance indicators upon which your institute should be evaluated? List 4 to a maximum of 6 indicators.

The focus of our research institute is the discovery of novel phenomena in solid state physics and optics. The results are typically evaluated by the quality of publications, which is then also manifested in excellent research grants and collaborative projects (e.g., Horizon Europe funds).

- Number and quality of publications
- Number and quality of individual research grants
- Number of collaborative research, development and innovation projects
- New "schools" established

6. SWOT analysis will help us to define strategic directions:

a) <u>Strengths:</u> What does the institute/center do well that matters to the stakeholders? What are the "core competencies" (those capabilities that the organization does well)? Which, if any, are "distinct competencies" (those capabilities the organization does better than its existing competitors)?

b) <u>Weaknesses:</u> What are the areas where the institute/center either struggles or fails to deliver?

c) <u>Opportunities</u>: Are there any emerging trends or situations that could prove beneficial to either improve a weakness or to further leverage a strength, and in which area your institute/center can be a "premium league" institute in a global context?

d) <u>Threats: Are there any emerging challenges that the institute/center should be aware of in order to better position itself for the future?</u>

a) Strengths

- Tradition of excellence-oriented research
- Well-equipped table-top experimental laboratories
- Expertise in quantum science and photonics
- Expertise in sample preparation and spectroscopy at the nanoscale
- Expertise in theoretical and computational physics
- Large number and high quality of international collaborations

b) Weaknesses

- Lack of critical mass in any sub-fields of our research activity (as compared to leading laboratories worldwide)
- Lack of attractiveness to leading scientists (low salary)
- Geographical isolation from local universities

c) Opportunities

- Focus resources on most promising research groups
- Enhance the functions and improve the services of the KFKI Science Campus which is highly suitable for high-quality experimental research

d) Threats

- The lack of stability and clear perspective and expectations
- The high challenges in securing a sufficiently high-quality next generation of group leaders and researchers
- The lack of continuous upgrade and maintenance of research laboratory equipment