2017 NATURAL AND EXACT SCIENCES INSTITUTES COMPETITION

Recommendations of the Program Committee in Natural and Exact Sciences

Taking into consideration the grades of the New and Continuity Proposals submitted to the **2017 Natural and Exact Sciences Institutes Competition**, as well as the results of the in-person interviews carried out between **October 16th and October 19th 2017**, the Millennium Science Initiative Program Committee recommends to the Advisory Board the following ranking for the awarding of both types of proposals:

1) RANKING OF THE PROJECTS RECOMMENDED TO BE AWARDED ACCORDING TO THEIR MERITS

1. **Millennium Institute for Research in Optics; Principal Investigator Aldo Delgado**

   The project is highly focused on optics and yet broad enough to cover the important areas within the field. Quantum mechanics and light entanglement, optical communication photonic patterns and novel light sources are envisaged as topics, areas that hold an enormous potential for future application in communication as well as in analytical domains, such as atmospheric science. The researchers have a proven record in the various area considered. This is a well thought through project with concise topics and excellent methodological approaches to solving the posed problems. It is multidisciplinary in bringing together experiment and theory, physics and chemistry.

   In the opinion of the committee the development of optics in the specified areas envisaged would represent an important point for the scientific competitiveness of Chile. Indeed, if realized, the results of this project would lead these laboratories to be at the top level in the world.

   The committee considered this an outstanding proposal that should be funded without reservations.

2. **Millennium Institute for Integrative Systems and Synthetic Biology; Principal Investigator Luis Larrondo**

   This is a very well-articulated proposal that emerges from the fusion of two extremely successful MSI nuclei in the areas of fungal and plant systems and synthetic biology. This Institute does not promise to deliver "more of the same" but rather it promises to explore new scientific directions that emerge from the combination of their complementary expertise. The cutting edge science proposed will generate knowledge relevant for important areas of the Chilean economy such as the agriculture and food-producing areas. This institute articulates a vision of high value strategic research within a very competitive area of plant-fungi interactions that represent a great challenge for a more sustainable agriculture across the world. The Director and Alternate Director have truly international stature, demonstrated by the fact that they have been selected as Howard Hughes International Scholars, an extremely prestigious distinction of high international profile. The Director and

Alternate Director have assembled a superb young team whose energy and enthusiasm were clearly on display during the presentation. Of note is the imaginative proposal for outreach activities, which are seamlessly integrated into the life of the Institute. The "Open Source" approach for developing tools and reagents is also exemplary and will greatly contribute to raising the profile of the Institute in the international arena.

3. **Millennium Institute for Foundational Research on Data; Principal Investigator Marcelo Arenas**

This project deals with fundamental aspects of data science (modeling, knowledge extraction, storage, data mining, etc.) and applications to governmental data infrastructure and sociopolitical effects of data. It is built upon a very successful Nucleus which has been just renewed, and to which it adds important new directions. It is multidisciplinary in bringing together computer scientists, statisticians, experts in political science and sociology.

The scientific level of the group in general, and of the Principal Investigator in particular, is very high. Given the originality of their propositions in terms of research and training, the importance of the field of data science and the expected impact on the Chilean society, the committee considers it as one of the very best projects. As a consequence, the Program Committee recommends that the proposal be funded. Nonetheless, despite the excellence of the group, their accomplishments and their potential, the proposal failed to articulate a sufficiently persuasive argument to transform a recently renewed nucleus into an institute.

4. **Millennium Institute of Ecology and Biodiversity; Principal Investigator Lohengrin Cavieres**

The previous accomplishments of the group are stellar in terms of research, education, and outreach, and reflect a strong transdisciplinary approach with excellent collaboration. In addition, the group has developed a sound plan for leadership transitioning between the current institute and the proposed renewal. The renewal is unique compared to other extant institutes because of its focus on terrestrial biodiversity. Finally, the relevance of the proposed research to Chile and the world is quite high. As a consequence, the Program Committee recommends that the proposal be funded for a renewal.
Nonetheless, compared to the other proposals that were also recommended for funding, the potential advancements derived from another 10 years of support to IEB would not be as strategic to the evolution of the involved disciplines or as instrumental to the formation of human capital. Moreover, there was considerable heterogeneity in the opinions of the ad hoc reviewers about the future scientific trajectory of the project as outlined in the proposal.
Because the institute has been integral to a number of significant thrusts involving the Ministry of the Environment in the past, and because the proposed continuity of the institute would without doubt contribute to the success of the Ministry in attaining its long-term goals, we strongly encourage and hope that support from the Ministry of the Environment can be leveraged to continue the research, education and outreach activities of the institute into the future.

2) PROJECTS NOT TO BE AWARDED (RESERVE LIST)

5. **Millennium Institute MI Institute for Seismic Risk; Principal Investigator Raúl Iván Madariaga**

   Chile is one of the most seismically active regions of the world and prone to be affected seriously by major earthquakes (and related phenomena such as tsunamis and landslides). The study of the causes and consequences of such extreme events is hence mandatory to improve the resilience of cities and related lifeline infrastructures. For these reasons earthquake research should be one of the top research priorities in Chile and the principal investigator, Prof. Madariaga, is worldwide one of the most highly regarded scholars in the field of seismology with the experience required for leading an institute of international stature.
   Although the Associate Researchers are talented with specialized knowledge in different fields required to have a truly interdisciplinary team to tackle the complex problem of hazard preparedness and risk reduction, the committee considered that the different disciplines were not optimally integrated. The latter became particularly obvious when questions related to the communication and translation of specialized geophysical knowledge to society in general and to executive institutions in particular were raised by committee members. Effective communication and outreach (and related societal and political aspects) are crucial for the effective reduction of seismic risk (a key goal intended to be reached by the proponents), but were not addressed convincingly in sufficient depth. For this reason, the committee decided that this otherwise excellent project did not rank among the top four proposals of this year's competition.

   However, this team has the capacity to produce results of international visibility and given the relevance of the subject, should be encouraged to continue to seek funding. This is especially so, since the recent deployment of state-of-the-art seismic instrumentation networks has produced a wealth of data that still require detailed analysis, which in turn is needed to better understand the structure and dynamics of the subduction zone along Chile.

6. **Millennium Institute for Conservation and Sustainability of Coastal Ecosystems (IMCoast); Principal Investigator Sergio Navarrete**

   The accomplishments of the group are very good in terms of research, education, and outreach, and reflect a multidisciplinary approach to science with a solid record of collaboration based on outcomes from the Nucleus with which many of the current senior researchers were involved in the past. Moreover, the relevance of the proposed research to Chile and the world is quite high. As a consequence, the Program Committee recommended the group for consideration during the second phase of review for new Millennium Institutes.

   Nonetheless, compared to other proposals that were recommended for funding, the current project had a number of short-comings. The mathematical or statistical approaches for advancing the proposed research were not particularly well developed, especially those related to the socioecological domain of the project. In addition, the conceptual model for considering response to natural and anthropogenic disturbances would have benefited from an explicit consideration of

issues of vulnerability and altered ecosystem states. Similarly, the project would have been enhanced by a clearer articulation of the operational definition of "sustainability", with an explicit assessment of tradeoffs in values among ecosystem services, stakeholders or segments of society, as well as across generations. Finally, the sixth project (complexity) was rather vague and difficult to evaluate the likelihood of success.

7. **Millennium Institute of Computational Astrophysics; Principal Investigator Patricia Tissera**

The Program Committee was extremely impressed by the standard of the presentation, and the collaborative spirit displayed by this team. The Committee was persuaded that by working together as an Institute, these 7 researchers could accomplish so much more than by working in isolation. MICA would be a powerful complement to the existing Millennium Institute for Astrophysics and its focus on observations, and enable Chile to fully exploit the capabilities of the next generation of telescopes and survey facilities. The plans for Transfer of Knowledge, both of technology and via outreach, were well-developed.

The goal of exploring synergies between simulations on scales ranging from stars, to black holes, to cosmology is unprecedented in its scope, as even the best-resourced computational astrophysics research centers elsewhere tend to focus on just 1 or 2 such topics. Following the interview the Committee considered that it would be premature to make a decade-long commitment to an initiative like MICA without a clear demonstration of such synergies, and the transformative science that can flow from these.

8. **Millennium Institute Corrosion Sciences and Protection of Materials; Principal Investigator Maritza Páez**

The general goal of the application for creating a Corrosion Science & Protection Institute is to gain and promote a better scientific knowledge of corrosion-related phenomena and of the technologies needed for its prevention and control. These are major issues with considerable financial and economic implications, and of major relevance for Chile. Corrosion is a multi- and inter-disciplinary subject, and requires knowledge from chemistry, electrochemistry, mechanics, metallurgy, materials science, biology and surface science as well as an appreciation of engineering constraints and applications.

The interdisciplinary approach required to address such complex problems is very nicely provided by the diversity of researchers and institutions identified in this proposal. The main themes that have been identified in the proposal are clearly described and interrelated, and reflect well the importance and complexity of the subject.

The proposed Institute Director, Maritza Páez, is considered to be one of the most outstanding corrosion scientists and electrochemists in South America, with an established international reputation and track record. The proposed Alternate Director, Francisco Melo, with considerable expertise in the physics of materials, is clearly of outstanding international caliber. The other researchers cover the

competencies required for such an ambitious target. Almost one third of them are female, which is particularly noteworthy in this area of science.

The establishment of a national activity in this area, the bringing together of so many researchers, and the goals of generating a specific and highly desirable PhD program and promoting Master level education in corrosion and electrochemistry are exciting prospects for the training of the next generation of scientists. Furthermore, the numerous outreach activities should also have an impact on enacting legislation in these matters. All these aspects and the planned outreach activities were considered as very positive.

The oral presentation was very informative and the investigators effectively fielded the questions raised by the Committee. Nevertheless, the PC members considered that the potential synergies between the groups and the specific scientific areas where the applicants could make an impact worldwide were not sufficiently articulated. Moreover, the milestones and deliverables should have been made more explicit as it pertains to fundamental science.

In view of the very intense competition for Millennium Institutes, the PC was unfortunately not able to recommend this proposal for funding.

9. **Millennium Institute of Fish Immunology and Microbiology; Principal Investigator Carmen Imarai**

This proposal intends to establish an Institute devoted to the study of fish immunology, fish microbial pathogenesis, and the role of the fish microbiota in health and disease. It was selected during the initial review phase on the strength of its promise to illuminate areas of science where knowledge is scant, thus offering opportunities to make an impact at the international level. Furthermore, knowledge in these areas could have an impact in economic activities such as aquaculture, which is of increasing importance in Chile. However, although there is enthusiasm for the research topic, the scope of the proposal was deemed to be unrealistically broad covering far too much scientific space. Each of the specific areas described could in essence be developed into a large program. Therefore there is concern that the breadth of the proposed research could jeopardize its depth and impact. In essence the proposal failed to articulate concrete goals that are integrated into a cohesive framework. The proposal presents a summation of research activities that are largely ongoing but does not articulate an encompassing vision that would describe how the linking of these existing research activities would lead to new research directions. While it is good to bring a community of scientists together towards a common goal, if the goals are diffuse as they are in this proposal, the integration of the research plan may be challenging or impossible. The proposal failed to articulate how the combination of the research activities would result in a final product that is more than the summation of its parts.

Final Grade Evaluation Criteria for New and Continuity Proposals

NEW PROPOSALS	%
Written Proposal Grade	50%
Scientific, technical and methodological merit. Clarity and forcefulness of the presentation as well as spoken defense of the proposal will be evaluated, considering the following: - Evaluation of the proposal in regards to the rest of the proposals competing for funding. - Degree of multi and transdisciplinary approach of the proposal. - Focus of the proposal placed in areas relevant to the country and the world, that address a problem where our country has a comparative advantage in terms of scientific research, or that provide some other type of contribution to the society. - Research proposal that differs from those currently covered by the Millennium Centers that are active at the time of application. - Level, solidity as well as organizational and integrated management skills of the group of Associate Researchers. - For Directors and/or Alternate Directors who have held this role in the past, the following will be evaluated: percentage of budget execution and refunding, timely compliance with the delivery of follow-up reports and compliance with the diffusion and implementation of PME.	50%
FINAL GRADE (weighted average)	**100%**

CONTINUITY PROPOSALS	%
Written Proposal Grade	50%
Scientific, technical and methodological merit. Clarity and forcefulness of the presentation as well as spoken defense of the proposal will be evaluated, considering the following: - Previous accomplishments of the Institute - Evaluation of the proposal in regards to the rest of the proposals competing for funding. - Degree of multi and transdisciplinary approach of the proposal. - Focus of the proposal placed in areas relevant to the country and the world, that address a problem where our country has a comparative advantage in terms of scientific research, or that provide some other type of contribution to society. - Research proposal that differs from those currently covered by Millennium Centers that are active at the time of application. - Level, solidity as well as organizational and integrated management skills of the group of Associate Researchers. - Previous managerial performance of the Center: percentage of budget execution and refunding, timely compliance with the delivery of follow-up reports and compliance with the diffusion and implementation of outreach activities.	50%
FINAL GRADE (weighted average)	**100%**

Final Grades - Natural and Exact Sciences Institutes Competition 2017 - Millennium Science Initiative

Name of the Proposal	Type of Proposal	PI	Final Grade			Status
			Written Proposal Grade (50%)	Interview Grade (50%)	Final grade (100%)	
MI for Research in Optics	New	Delgado	160	110	**135**	**Granted**
MI for Integrative Systems and Synthetic Biology	New	Larrondo	153	120	**136,5**	**Granted**
MI for Foundational Research on Data	New	Arenas	149,3	130	**139,65**	**Granted with no funding**
MI of Ecology and Biodiversity	Continuity	Cavieres	152	140	**146**	**Granted with no funding**
MI Institute for Seismic Risk	New	Madariaga	151,6	220	**185,8**	Not Awarded (Reserve List)
MI for Conservation and Sustainability of Coastal Ecosystems	New	Navarrete	154	240	**197**	Not Awarded (Reserve List)
MI of Computational Astrophysics	New	Tissera	155	245	**200**	Not Awarded (Reserve List)
MI Corrosion Sciences and Protection of Materials	New	Páez	158	250	**204**	Not Awarded (Reserve List)
MI of Fish Immunology and Microbiology	New	Imarai	195,5	280	**237,75**	Not Awarded (Reserve List)

The in-person interviews were developed in Santiago from Chile with the participation of all the members of the Program Committee in Natural and Exact Sciences. This document is signed by all members.

E-SIGNED by Pierre Braunstein

Pierre Braunstein

E-SIGNED by Hans-Joachim Freund

Hans-Joachim Freund

E-SIGNED by Jorge Galan

Jorge Galán

E-SIGNED by Jean-Frédéric Gerbeau

Jean-Frédéric Gerbeau

E-SIGNED by Stuart Ryder

Stuart Ryder

E-SIGNED by Claus Siebe

Claus Siebe

E-SIGNED by Michael Willig

Michael Willig

Santiago, October 19th, 2017