Registration form

This is a registration form for Host Institutions wanting to establish a Dioscuri Centre of Scientific Excellence.

1. Research institution data (name and address):
   Institute of Biochemistry and Biophysics
   Polish Academy of Sciences,
   Pawińskiego 5A, 02-106 Warsaw, Poland

2. Type of research institution:
   Research unit of the Polish Academy of Sciences

3. Head of the institution:
   Prof. dr hab. Piotr Zielenkiewicz

4. Contact information of designated person(s) for applicants and NCN:
   Prof. dr hab. Jarosław Poznański
   General Affairs Director IBB PAS
   e-mail: GAD@ibb.waw.pl; jarek@ibb.waw.pl
   tel: +48 22 592 2145
   Pawińskiego 5a, 02-106 Warsaw, POLAND

5. Research discipline in which the strong international position of the institution ensures establishing a Dioscuri Centre:
Life Sciences: **molecular biology, structural biology, biotechnology**

6. Description of important research achievements from the selected discipline from the last 5 years including a list of the most important publications, patents, other (*up to one page in A4 format*):

The scientific interests of the Institute have evolved over the years from classical biochemistry, biophysics and physiological chemistry towards up-to-date molecular biology. The topics of special attention are: epigenetics and RNA biology, DNA repair, plant molecular biology, structural biology, protein-ligand interactions and bioinformatics. During the last 5 years research at the Institute led to a number of findings which resulted in over 700 publications cited more than 5000 times, and 18/20 pending and 28/29 granted national/international patents. At present, seven TEAM projects are being carried out at the Institute, among them TEAM CORE-TECH (to Prof. Michał Dadlez), TEAM (to Dr. Szymon Świeżewski; DSc) and FIRST TEAM (Dr. Dominik Domański, Dr. Roman Szczęsny; DSc and Dr. Damian Graczyk). Some other prestigious grants should be also mentioned, including SHENG (to Prof. Matthias Bochtler), MAESTRO and STRATEGMED (to Prof. Michal Dadlez) or BIOSTRATEG (to Dr. Anna Sikora).

The group formerly lead by prof. Dziembowski, who focused on the posttranscriptional regulation of gene expression in humans, contributed significantly to our understanding of the mechanisms of RNA maintenance.[1-6] This scope of research is now continued by young researchers originated from Prof. Dziembowski group.[7, 8] The group of Szymon Świeżewski, which focuses on regulation of seed dormancy - a crucial developmental transition in plants, described a novel mechanism of epigenetic regulation based on a cis-acting noncoding antisense transcript,[9-11] and further discovered transcription elongation checkpoints at alternative exons in *Arabidopsis thaliana*.[12] Ewa Świeżewska and Tomasz Sarnowski groups, also working on *Arabidopsis thaliana,* study the mechanism and physiological role of polyprenol

synthesis[13-16] and epigenetic regulation by the SWI/SNF chromatin remodeling complexes,[17-21] respectively. The group of Michal Dadlez is developing application of HDX-MS in studies on protein assemblies,[22-28] with a special afford to Aβ peptide.[29-33] The group of Prof. Jacek Hennig and dr. Magdalena Krzymowska were recently succeeded in the identification of new host-patogen interaction mediated by a protein kinase [cell],[34] while group headed by Prof. Grażyna Dobrowolska has just succeeded in characterization of SNF1-related protein kinases (Plant Physiology, accepted). The group of Prof. Poznański studies thermodynamics of the protein-ligand interactions in the context of thermodynamics contribution of halogen bonding in potential inhibitors of protein kinase.[35-38] The group of Wojciech Bal focuses on biological impact of metals,[39,40] including role of the interactions between the Aβ4-42 peptide with copper ions in the context of Alzheimer's disease.[41,42] The group of Piotr Zielenkiewicz identified novel potent small molecule correctors for CFTR-ΔF508 with great potential for future treatments of cystic fibrosis,[43] and pointed the application of plant miRNA in medicine.[44,45] Finally, scientific and technical knowledge of IBB employees and well established core facilities allowed the Institute to establish numerous international collaborations, some of which resulted in important scientific discoveries.[46-56]

[1] NAR 44, 10437; [2] Cell 174, 1537; [3] Nature 560, 238; [4] Genome Research 25, 1622; [5] Cell Reports 10, 178; [6] Nature Comm. 8, 619; [7] Nature Comm. 9, 2558; [8] NAR 47, 7502; [9] PNAS 113, E7846; [10] Embo Rep. 18, 2186; [11] Molecular Cell 73, 1066; [12] Embo J. 34, 544; [13] Plant cell 29, 1709; [14] Plant Physiology 174, 857 [15] Prog. Lipid Res. 63, 70; [16] Plant Cell 27, 3336 [17] Plant cell 27, 1889; [18] NAR 45, 3116; [19] Plant Cell 27, 1889; [20] Trends in Plant Science 21, 594; [21] Amer. J. Cancer Res. 7, 2275; [22] JBC 291, 24931; [23] Open Biol. 6. [24] Plos One 8. [25] JMB 428, 1180; [26] NAR 46, 4752; [27] Current Biology 24, 2526; [28] Open Biology 7. [29] JMB 407, 110; [30] Plos One 13; [31] Plos One 9; [32] JMB 426, 2871; [33] Sci. Rep. 9; [34] Frontiers in Plant Science 9; [35] SciRep 9; [36] Plos One 12; [37] BBA 1854, 1553; [38] Plos One 9; [39] Coordination Chemistry Reviews 327, 166 [40] Inorganic Chemistry 55, 7829; [41] Angewandte Chemie 55, 8235; [42] Angewandte Chemie 54, 1046; [43] EMBO molecular medicine 5, 1484 [44] Int. J. Mol. Sci. 18; [45] Int. J. Mol. Sci. 19; [46] Science translational medicine 8, 325ra318; [47] Nature 524, 485; [48] Molecular cell 54, 751; [49] Blood 123, 4002; [50] PNAS 110, 105; [51] Nature Comm. 7, 10433; [52] Nature chemical biology 9, 264; [53] Nature Comm. 9, 3963; [54] Nature Comm. 10, 4102; [55] NAR 47, 4751; [56] Embo Molecular Medicine 11, e9561.

7. List of no more than 3 important research projects from the selected discipline awarded in national and international calls to the institution in the last 5 years (title, name of PI, source of funding, amount of funding):

- In the years 2009 to 2015, the Institute was one of the partners of worth 100 mln € infrastructure consortium project of the Center for Preclinical Research and Technology granted by Ministry of Science and Higher Education. The project was the largest biomedical and biotechnological enterprise in Central and Eastern Europe. The aim of the project was to establish a vibrant scientific center in Warsaw, consisting of closely collaborating biomedical research centers, which would conduct research on the most common civilization diseases, in particular: cancer, neurological diseases, cardiovascular diseases and aging diseases. This cooperation is ongoing.
- In 2018, the Institute become the bioinformatics/chemistry partner site in the EU-OPENSCREEN consortium (ERIC - European Research Infrastructure Consortium), capital value of which exceeds 80 mln € (http://www.roadmap2018.esfri.eu/projects-and-landmarks/browse-the-catalogue/eu-openscreen-eric/). The primary objective of EU-OPENSCREEN is to create a distributed research infrastructure to support scientists in order to better understand how basic molecular processes affect biological functions at various levels – from the pathway up to the whole organism. EU-OPENSCREEN integrates screening platforms in Europe that share a rationally selected collection

of compounds, including those commercially available or collected from international chemists.

- H. Arctowski Polish Antarctic Station is a medium-sized all-year station that has been continually operating for over 30 years and has extensive technical and scientific infrastructure. The station conducts research in the field of oceanography, geology, geomorphology, glaciology, meteorology, seismology and above all biology and ecology, and continuous monitoring observations: ecological, glaciological and meteorological. In three years the new, fully equipped station building will be put into service for the international scientific community.

8. Description of the available laboratory and office space for the Dioscuri Centre (*up to one page in A4 format*):

Half the floor at one of the buildings of IBB PAS consisting of three laboratories (18m^2 and two 36m^2) with the adjacent 9m^2 offices, two separate offices, 9m^2 each and 18m^2 cold room will be provided for the Dioscouri Center at IBB PAS. If required, additional space could be available.

9. List of the available research equipment for the Dioscuri Centre:

Equipment at the Laboratory of Recombinant Proteins:

- AKTAxpress chromatography system designed for automated, multistep protein purification. The protocols developed by us enable multistep purification of 6 proteins at the same time.
- The set of collaborating devices that use light scattering to determine the molecular weight, mass uniformity (polidispersity), size (hydrodynamic radius) and absolute molecular weight of macromolecules in solution, such as nanoparticles and proteins. The system includes three units: device for measurement of multi-angle light scattering (MALS), device for measurement of light refraction co-efficient for precise determination of concentration and device for dynamic light scattering (DLS).
- ITC calorimeter, used for determination of heat and equilibrium constants of macromolecules and ligands reaction.
- DSC Calorimeter enabling determining the temperature and energetics of phase transitions.
- Potentiometric set, enabling very precise measurement of stability constants in low molecular system.
- Circular dichroism spectropolarimeter providing structural information and reaction constants for chiral molecules.
- Spectrofluorometer, enabling measuring the strong reaction constants of fluorophores containing molecules, among others the proteins.
- Set for measuring of retained flow, used for determination of reaction kinetics.
- Two spectrophotometers enabling determination of molecular bonds constants of chromophore molecules in wide range of electromagnetic spectrum.
- Apparatus for microscale thermophoresis (MTS) and the the next one for the label-free MST, innovative devices enabling direct measurement of bond constants for a wide range of macromolecules and biological structures.
- Prometheus system designed for medium-throughput screening for protein-ligand interactions.
- RT-PCR hardware, some of which may be also used for DSF measurements.
- A few plate readers supporting a wide-spectrum of screening experiments.
- HPLC and FPLC, IR microspectrometer for molecules purification and for determination of their concentrations.

Equipment at the Bioinformatics Unit:

- For all calculations the NVIDIA cluster solutions (24 Tesla K20 Graphic Cards) and INTEL co-processors (24 Xeon Phi511OP Graphic Cards) are used. It ensures over 50Tflops of theoretical computational power, placing our cluster in one line with the most efficient solutions in the country. Basing computational resources on expansion board technology made it also possible to save electrical energy consumption by 280% compared to standard solutions.
- Visualisation is provided by three stands equipped with workstations with NVIDIA Quadro and Tesla cards. Each of them is equipped with specially designed glasses with active LCD shutter and 3dConnexion manipulator .
- Data storage is provided by three dedicated database servers comprising efficient SSD disc with DiSCuS system installed on it, developed in Bioinformatics Laboratory of IBB PAN. The system is designed for storage and serving chemical data and sharing experimental results and *in silico* analyses. In addition, we have also database space on Hitachi AMS2300 matrix, where the publicly available and commercial screening data are kept. In view of the fact that introducing the
- drug to the market, from designing phase to registration process, takes usually ca 15 years, the laboratory has also tape silo for safe archiving of data that are not used currently, but must be kept for various reasons (e.g. patent related data).

Equipment at the High-Throughput analyses of siRNA Unit:

- Automatic pipetting work station JANUS.
- siRNA library covering the entire human genome.
- Auxiliary equipment: incubators, laminar chambers, and centrifuges.

Equipment at the Organic Synthesis Unit:

- Circulating thermostat.
- Apparatus for melting temperature measurement.
- Microwave synthesizer for organic compounds synthesis

Equipment at the Laboratory of high-throughput drug testing and proteomics:

- Automated set LC/MS for long series of samples Synapt G2.
- Mass spectrometer of ESI LC/MS/MS Orbitrap Velos type.
- Mass spectrometry system of MALDI TOF/TOF type.
- Sets HPLC of nano-LC type, integrated with spectrometers.
- DNA scanner HiSCanSQ, which enables simultaneous analysis of thousands DNA or RNA particles (high-throughput microarray analyses and transcriptomic analyses).

Equipment at the DNA Sequencing and Oligonucleotide Synthesis Laboratory:

- Dr.Oligo Synthesiser
- ABI3730/3730xl sequencer (classical Sanger sequencing).
- MiSeq and NextSeq550 sequencer (next generation sequencing).
- GridION Mk1 sequencer (3^{th} generation sequencing).
- Chromium 10x which enables rapidly and efficiently combines large partition numbers with a massively diverse barcode library to generate >100,000 barcode-containing partitions in a matter of minutes. The Chromium Controller fits on a standard laboratory bench and allows a user to run any Chromium Solution, from genome to single cell analysis.

- Femto Pulse, automated pulsed-field capillary electrophoresis system, for quantify, qualify, and size DNA and RNA low concentrated samples with accuracy and precision.

The Institute also offers on-site: fluorescent and confocal microscopy, green-house, tissue-culture facilities, media preparation facilities, several cold rooms, a number of high-speed centrifuges for preparative analyses and a number of -70º C freezers. Space devoted to the activity of Dioscouri Center will be equipped with auxiliary laboratory equipment.

10. List of the additional benefits (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other) (*up to one page in A4 format*):

Institute of Biochemistry and Biophysics PAS will provide the following, cost-free personal benefits: on-site medical and dental care, multi-sport admission cards to gyms and to the next-door Olympic size swimming pool, accommodation at the Institute's hotel for the initial few months of stay.

11. List of the additional benefits (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other) (*up to one page in A4 format*):

In the last 5 years the Institute organized seven different international conferences: COST meeting *How can plant metabolomics research benefit from the systems biology revolution*? (IX 2014), Inhibitors of Protein Kinases IPK (8th: IX 2014 and 9th: IX 2017, 10th IX 2019 organized as IUBMB Focused Meeting), *Challenges in Molecular Biology, Biophysics, and Biomedicine* (IX 2015), *Virulence mechanisms of bacteria - diverse hosts, common strategies* (X 2015), *Interdisciplinary Polar Studies in Poland* (co-organizer XI 2017) and 9th *Central European Genome Stability and Dynamics Meeting* (IX 2018).

Scientists from IBB PAS have well established, ongoing collaboration with a number of researchers from the well-recognized international institution such as Max-Planck Institute for Plant Breeding Research, Max-Planck Institute for Plant Molecular Physiology, Karlsruhe Institute of Technology, Institute of Biochemistry and Pathobiochemistry, Ruhr-Universität, Bielefeld University, University of Cambridge, University of Oxford, Institute of Biochemistry and Cellular Genetics du CNRS Bordeaux, CNRS/Université de Strasbourg, Institut Le Bel, Radboud University Medical Centre, Braun Laboratories at California Institute of Technology, National Institute of Environmental Biology (NIEHS), Genome Integrity and Structural Biology Laboratory, Research Triangle Park, Laboratory of Genomic Integrity, National Institute of Child Health and Human Development at NIH, University of Texas MD Anderson Cancer Center, Division of Microbial Genetics National Institute of Genetics Japan, University of Queensland, University of Melbourne, University of Saskatchewan, Australian Antarctic Division, Instituto de Ciencias Biológicas, Universidad de Talca and others.

In addition, the Institute administrates a polar station located on the King George Island, off the coast of Antarctica (Polish Antarctic Station Henryk Arctowski), where research is conducted not only by our Department of Antarctic Biology but also by scientists from all over the world.