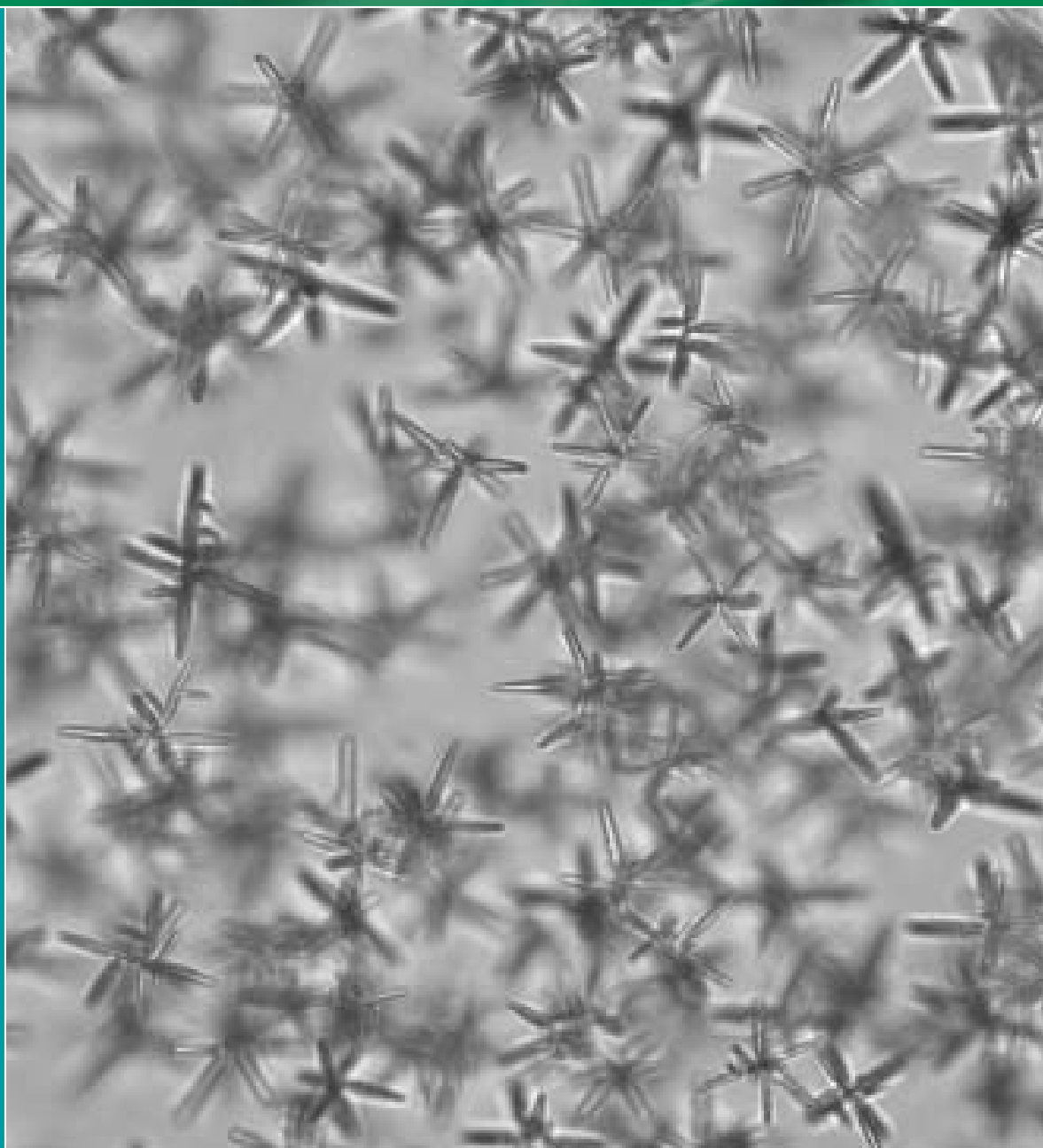


RESEARCH, INNOVATION AND  
DISSEMINATION CENTERS (RIDC)



SÃO PAULO RESEARCH  
FOUNDATION

# MULTIDISCIPLINARY, HIGH IMPACT SCIENCE



2013 - 2024

# RESEARCH AT THE CUTTING EDGE OF KNOWLEDGE



The São Paulo Research Foundation (FAPESP) supports, since May 2013, 17 Research, Innovation and Dissemination Centers (RIDCs) selected for funding for a period of up to eleven years, subject to continuation reviews on years 2, 4 and 7.

Each RIDC is expected to establish a hub of excellent research in its focus area. In addition, each RIDC must actively seek out and develop opportunities to have its research results contribute to commercially and/or socially relevant high-impact applications, as well as contributing to education and dissemination of knowledge.

Funding for the 17 RIDCs will come from FAPESP and the host institutions (funding faculty, technicians, support personnel, and infrastructure). It is estimated that for the eleven-year duration of the program, the total funding for the 17 centers will be more than US\$ 680 million, with US\$ 370 million from FAPESP and US\$ 310 million in salaries from the host institutions. Additional funding will be obtained by each center from industry and government organizations.

The 17 RIDCs bring together 499 scientists from the State of São Paulo and 68 scientists from other countries. The research topics covered by the centers include the following: food and nutrition; glasses and glass-ceramics; functional materials; neuroscience and neurotechnology; inflammatory diseases; biodiversity and drug discovery; toxins, immune-response and cell signaling; neuromathematics; mathematical sciences applied to industry; obesity and associated diseases; cellular therapy; metropolitan studies; human genome and stem-cells; computational engineering; redox processes in biomedicine; violence; and optics, photonics, and atomic and molecular physics.

## THE 17 RESEARCH, INNOVATION AND DISSEMINATION CENTERS (RIDCS)

Food Research Center – FoRC

Center for Research, Teaching, and Innovation in Glass – CEPiV

Center for Research and Development of Functional Materials – CDFM

Brazilian Research Institute for Neuroscience and Neurotechnology – BRAiNN

Center for Research on Inflammatory Diseases – CRiD

Center for Research and Innovation in Biodiversity and Drug Discovery – CIBFar

Center for Research on Toxins, Immune-Response and Cell Signaling – CeTiCS

Research, Innovation and Dissemination Center for Neuromathematics – NEUROMAT

Center for Research in Mathematical Sciences Applied to Industry – CeMEAI

Obesity and Comorbidities Research Center – OCRC

Center for Research in Cell Therapy – CTC

Center for Metropolitan Studies – CEM

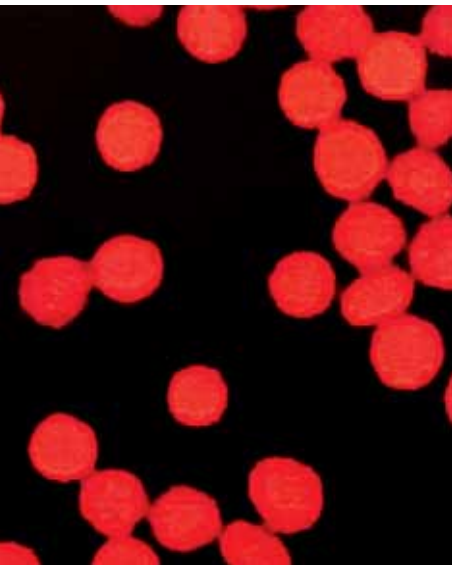
Human Genome and Stem-Cell Research Center – HUG-CELL

Center for Computational Science and Engineering – CECC

Center for Research on Redox Processes in Biomedicine – REDOXOME

Center for the Study of Violence – NEV

Optics and Photonics Research Center – CEPOF



## ABOUT THE RIDC PROGRAM

The RIDC Program, started by FAPESP in 2000, supported 11 research centers from 2001 until 2013. In 2011, a second call for proposals was announced, generating 90 proposals, out of which the 17 awardees were selected. The selection process used 150 Brazilian and international reviewers, an International Committee composed of 11 invited scientists, and FAPESP's internal committees.

The most important feature of the RIDCs is the multiplicity of their missions. In addition to the primary mission of developing fundamental or applied research, focused on specific themes or objectives, the centers must actively seek out opportunities to contribute to innovation by developing effective means of technology transfer. The centers are also responsible for offering extension activities geared towards elementary and high school education and the general public. These include involving high school students and teachers in research activities, teacher training, and science dissemination.



## SCIENTIFIC OPPORTUNITIES IN SÃO PAULO, BRAZIL

São Paulo is the most developed and diversified state in the country, contributing 33% of Brazil's GDP. About half of the research articles published yearly by scientists in Brazil have authors working in the State of São Paulo. The state is responsible for 45% of the doctorates awarded yearly in Brazil.

With 41 million people, it hosts six public research universities, the University of São Paulo (USP), the State University of Campinas (UNICAMP), the São Paulo State University (UNESP), the Federal University in São Carlos (UFSCAR), the Federal University in São Paulo (UNIFESP) and the Federal University in ABC (UFABC), and the Aeronautics Technology Institute (ITA).

The state also funds 19 mission oriented research institutes, such as the Agronomics Institute of Campinas (IAC), the Institute for Technology Research (IPT) and the Butantan Institute, as well as the National Space Research Institute (INPE), the National Center for Airspace Technology (DCTA), and the National Research Center for Energy and Materials (CNPEM), which includes the National Synchrotron Light Source (LNLS).

R&D expenditures in the State of São Paulo reached 1.6% of state GDP in 2011, with 60% of expenditures contributed by the business sector.



## FAPESP

### MORE THAN HALF A CENTURY SUPPORTING SCIENCE IN SÃO PAULO

The São Paulo Research Foundation (FAPESP) is one of the major funding agencies for scientific research in Brazil. Its mission is to foster scientific research in all fields of knowledge by awarding fellowships and grants to investigators in higher education or research institutions in the State of São Paulo, Brazil. Proposals are selected through a stringent peer-review system.

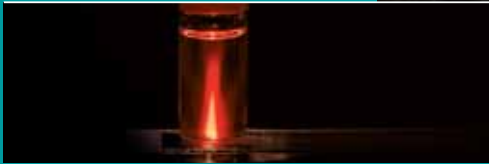
Since 1962, FAPESP has granted more than 110,000 fellowships (from the undergraduate to postdoctoral level), supported nearly 100,000 research projects, and contributed remarkably towards improving the research infrastructure and the social and economic development of the State of São Paulo. In 2012, FAPESP received 21,600 research proposals.

In addition to funding investigator-initiated research in all fields, FAPESP fosters special research programs in strategic areas for Brazil and for the State of São Paulo, such as biodiversity, bioenergy, global climate change and neuroscience.

The Foundation maintains cooperative agreements for co-funding research with national and international research funding bodies, foreign institutions of higher education and research, and private companies.

The State Constitution mandates the appropriation of 1% of the State's tax revenues to FAPESP. FAPESP's bylaws establish that the Foundation cannot spend more than 5% of its budget on administrative costs. FAPESP works in a regime of administrative and financial autonomy, and distributed US\$ 525 million to support scientific research in 2012.





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The Food Research Center (FoRC) is an initiative by scientists from the University of São Paulo for the creation of the first research center focused on food and nutrition in Brazil. The FoRC is based on the concept that food and nutrition studies present a multidisciplinary character, and professionals with different backgrounds can study different aspects of the same subject. The main goal is to address key global challenges and develop internationally ranked fundamental, strategic and applied research, benefitting Brazilian agribusiness, consumers, policymakers and regulatory agencies, and causing a great socio-economic impact on the country.

The research projects can be clustered into four pillars. In Pillar 1 (*Biological Systems in Foods*), foods are characterized for their biodiversity and composition in macro and micronutrients and other compounds with potential health benefits. The molecular mechanisms that regulate the biosynthesis and catabolism of these compounds are elucidated using advanced *omics* tools. In Pillar 2 (*Food, Nutrition and Health*), the impacts of food components on the nutritional status of population groups and their potential to reduce the risk of disease are evaluated. Applications of nutrigenomics, metabolomics, new physical principles and clinical assays are explored to study the relationships between diet and health. In Pillar 3 (*Food Safety and Quality*), safety and quality of the food supply are evaluated through risk assessments for a range of microbial pathogens and chemical contaminants along the whole food production chain, in a “farm to fork” approach. Lastly, in Pillar 4 (*New Technologies and Innovation*), innovative processing technologies are developed, focusing on new ingredients with specific functionalities, design of novel nutritive and safe foods and new packaging systems that will fulfill consumer demands for safe and health promoting foods. The evaluation of environmental impacts of food processing is also a target of this Pillar.

The education and knowledge dissemination action plan addresses the challenge of communicating the achievements of the FoRC

# FoRC

## Food Research Center

through a number of activities, focusing on all segments of society. The educational role of FoRC is fulfilled by use of proper tools (courses, web, TV, press) to disseminate knowledge generated by the research conducted at the center to the scientific community, to food and nutrition professionals (industry, laboratories, government), to policymakers and to society in general. To achieve this, the FoRC partnered with several experts in communication and is developing an interactive website, where access to databases of different levels of complexity and detail will be available, including educational materials for basic and intermediate students. The development of highly qualified scientists is assured, as most research projects and other activities at the FoRC are carried out with the participation of undergraduate, Masters and Doctoral students, and post-doctoral fellows.

Technology transfer is an important goal of the FoRC, as conversion of research findings and academic knowledge generated by the food scientists into practical applications will cause substantial benefits to the country, impacting health, industry, trade, development, and, ultimately, standards of living. Cooperation with the food industry, government and other sectors of the society is accomplished with the assistance of the USP Innovation Agency, also responsible for the marketing and commercialization of the Intellectual Property generated by the FoRC. Workshops, seminars, open houses, and other activities organized in conjunction with interested parties, will create opportunities for new beneficial partnerships, adding value to the research conducted at the center.

**Host Institution**

University of São Paulo (USP, campus São Paulo)

**Associated Institutions**

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São Paulo State University (UNESP)

Institute of Food Technology (ITAL)

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The Center for Research, Teaching, and Innovation in Glass (CEPIV) aims at mapping the glass “genome” and developing new active glasses and glass-ceramics with promising applications through fundamental research on structure-property relations using complementary simulation, spectroscopic and functional characterization methods. The core group of the Center consists of 14 researchers at the Federal University of São Carlos (UFSCar) and the University of São Paulo (USP) – São Carlos campus – experts in engineering, chemistry and physics of vitreous materials, glass crystallization and a wide range of structural and functional characterization techniques. They supervise approximately 50 post-docs and students engaged in glass and glass-ceramics research and are embedded in a large Brazilian and international network of collaborations.

CEPIV will research and develop new glasses and glass-ceramics presenting new or improved functionality, such as high mechanical strength and electrical conductivity, biological, optical or catalytic activity, and/or combinations of these properties. A fundamental understanding of these properties will be sought based on the structural organization of these materials on different length scales. The center will apply state-of-the-art NMR, EPR, EXAFS and vibrational spectroscopy to characterize local and medium-range order, as well as the full resolution range of optical and electron microscopes, XRD and microanalyses for elucidating nano and microstructures. Molecular dynamics simulations will complement this comprehensive experimental approach. Using this experimental modeling strategy, the RIDC will further seek a fundamental understanding of glass sintering and crystallization in terms of mechanisms, thermodynamics and kinetics of viscous flow, as well as crystal nucleation and growth, enabling the Center to exercise control of these processes

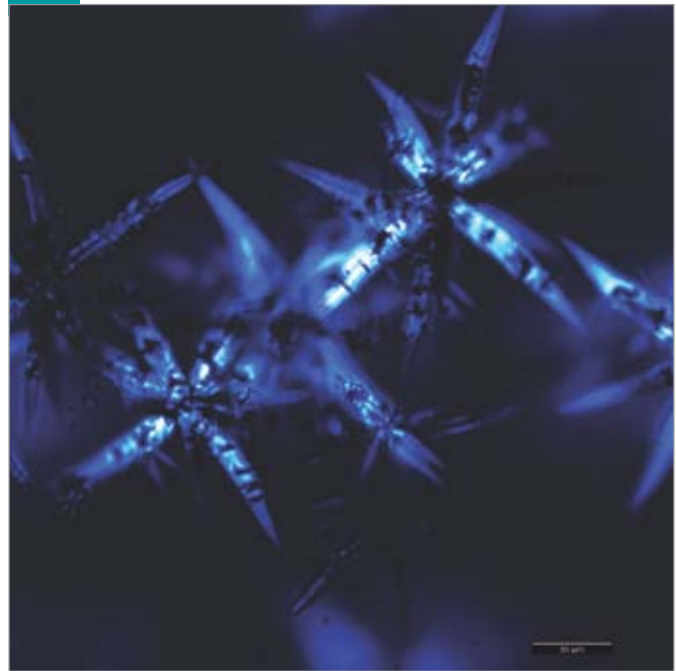


Photo by Vladimir Fokin

*Orchid-like crystals in the interior of CaO-Li<sub>2</sub>O-SiO<sub>2</sub> glass. The crystals are microcracked due to thermal expansion mismatch with the residual glass phase. Polarized optical microscopy.*

*E.D. Zanotto. Cristais em vidros - Ciência e Arte. EdUFSCar, 124 pags. Dez. 2011.*

by developing appropriate forming process and thermal treatment protocols.

In a concerted effort, the participating laboratories will jointly investigate a number of important benchmark systems, which are deemed particularly promising for applications either as structural reinforcement materials (dental and bioglass-ceramics), optical materials (laser glasses), materials for electrochemical energy storage devices (electrolytes high-temperature seals), and catalytically active systems.

This research agenda will be complemented by continuous education and outreach activities at different levels, as well as by technology development and transfer.



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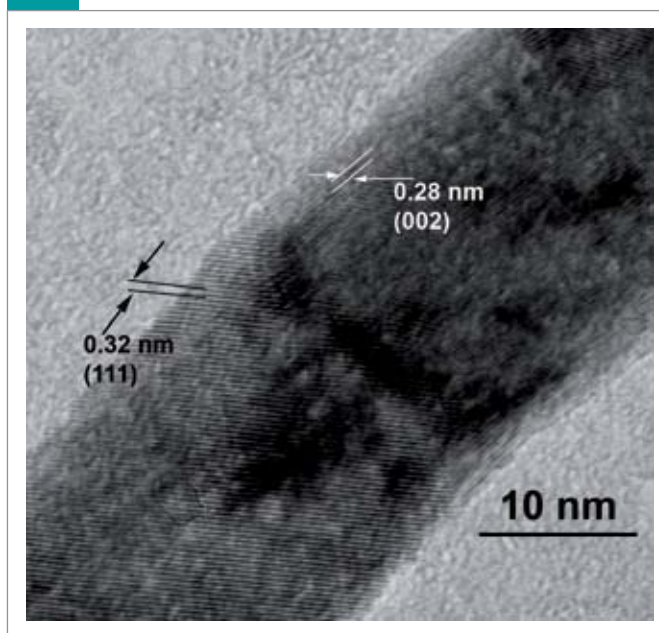
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The Center for Research and Development of Functional Materials (CDFM) is an evolution of the Multidisciplinary Center for the Development of Ceramic Materials (MCDCM), which received FAPESP funding in the first phase of the RIDC program. At the core of the MCDCM was the ability to synthesize materials with controlled chemical composition, microstructure, and morphology.

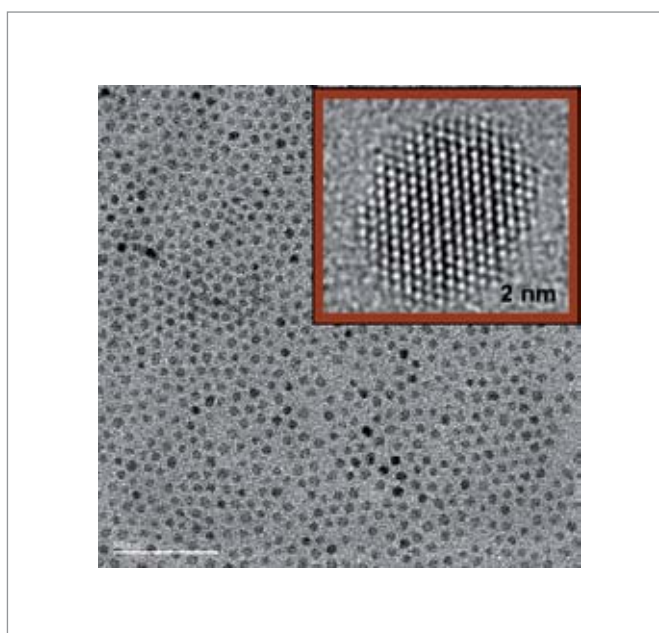
Since then, in pace with the accelerated transformations that have already occurred in this century, global needs have changed drastically. Currently, three main concerns are emerging to address those needs: renewable energy, health and the natural environment. During the same period, the materials science community has been engaged with the research and development of functional and nanostructured materials that can be useful for meeting these new societal needs. Therefore, CDFM will use its skill in research and development of functional and nanostructured materials with tailored properties to solve problems related to renewable energy, health and the natural environment.

In terms of innovation and technological transfer, the new RIDC will be directly connected to the basic research program and will act in the following areas: 1) Pilot plants for functional nanoparticles, 2) Development of new applications for functional materials, and 3) Generation of spin-off companies.

Concerning activities related to education and training, a preferred target audience will be high school teachers, to whom the Center will offer extension courses geared to the use of information and communication technology in science education. The Center will also offer teaching strategies aimed at improving teacher performance in the classroom. The conceptual mapping technique, which allows teachers to build and relate concepts, to represent knowledge in a hierarchical way, to share knowledge meaning between teachers and students and to facilitate learning and scientific reasoning, is one of the main tools that will be used. Moreover, a specialized course in science journalism is planned.



Synthesis of nanocrystalline ceramics: HRTEM image of CeO<sub>2</sub> nanobelts obtained by the oriented attachment (OA) mechanism



HRTEM image of ZrO<sub>2</sub> nanocrystal processed by solvothermal process

## Host Institution

São Paulo State University (UNESP, campus Araraquara)

## Associated Institutions

University of São Paulo (USP)  
Federal University of São Paulo (UNIFESP)  
Federal University of São Carlos (UFSCar)  
Federal University of ABC (UFABC)  
The Energetic and Nuclear Research Institute (IPEN)  
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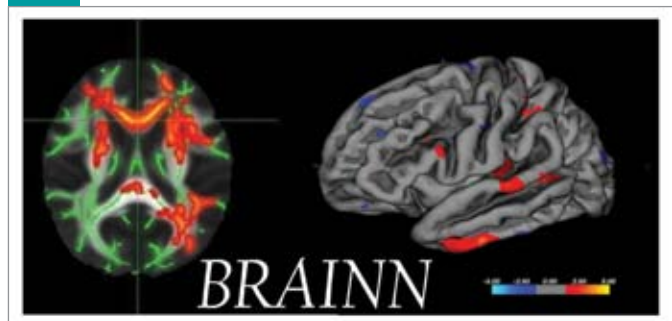
The Brazilian Research Institute for Neuroscience and Neurotechnology (BRAINN) focuses on the investigation of basic mechanisms leading to epilepsy and stroke, and the injury mechanisms that follow disease onset and progression. This research has important applications related to prevention, diagnosis, treatment and rehabilitation and will serve as a model for better understanding normal and abnormal brain function.

The main motivation of this RDIC came from the necessity of approaching these relevant and complex biological problems by combining the expertise of research groups with distinct and complementary backgrounds.

One of the multiple aspects that demonstrate the characteristic complexity associated with research on epilepsy and stroke is the fact that such conditions are not uniquely defined, which means that these conditions cannot be traced to a single disease or a unique syndrome. Therefore, there is a need for collaborative research by scientists with different areas of expertise, driven by solid scientific theories and social needs, to provide relevant applications in the real world.

This research aims to be clinically important, realistic and scientifically highly original, combining genetics, neurobiology, pharmacology, neuroimaging, computer sciences, robotics, physics and engineering. The results will benefit patients with epilepsy, stroke and other prevalent diseases and will contribute substantially to ongoing scientific discussions within neurology, psychiatry, and cognitive neuroscience. The proposed collaborations between BRAINN and other major neuroscience groups will further advance knowledge directly relevant to all people suffering from these devastating neurological conditions.

The field of neurotechnology presents great potential for innovation and technology transfer. The challenges related to neurotechnology are the production of complex equipment and software systems for aiding diagnosis and treatment of neurological diseases such as epilepsy and stroke. This will include the development and construction of functional brain imaging systems



*Areas of abnormal neuronal fiber connections in patients with frontal-lobe epilepsy (left image – axial view of the brain; group data using 3-T diffusion tensor imaging) and areas of cortical atrophy 6 months after a stroke (right image – a reconstruction of the brain's cortical surface from structural 3D-MRI with statistical data superimposed)*

using infrared photons; the design and microfabrication of neuroprobe targets for innovative research and clinical use; the development of optimized software for medical image processing; the development of fast diagnosis techniques based on gene identification; the design and construction of brain-computer interfaces (BCI) for assistive technologies; and the development of rehabilitation systems.

In the area of treatment and rehabilitation, the Center will work on the remote monitoring of patients. For example, a highly portable video-EEG system can be deployed at home, allowing patients to avoid long waiting periods of hospitalization. In this area, the Center also aims to develop remote-controlled devices (e.g. mobile robots) that allow physicians to interact with patients outside of hospitals.

In addition to a formal graduate student program in neuroscience, there is a plan for diffusion of knowledge and education that embraces the creation of websites, TV and web-radio broadcasts; the creation of specific social networks, blogs, and microblogs; the expansion of an existing lay magazine; and the publication of BRAINN books to help disseminate neuroscience in the community. The Center will create a course for schoolteachers on education in neuroscience, as well as a continuing educational program about scientific journalism. There is also a schedule of events for meetings and workshops every year.

In summary, the goal is to develop new methods and techniques to improve our knowledge for treating and preventing debilitating diseases and conditions affecting the brain.

#### Host Institution

State University of Campinas (UNICAMP)

#### Associated Institutions

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Center for Information Technology Renato Archer (CTI)  
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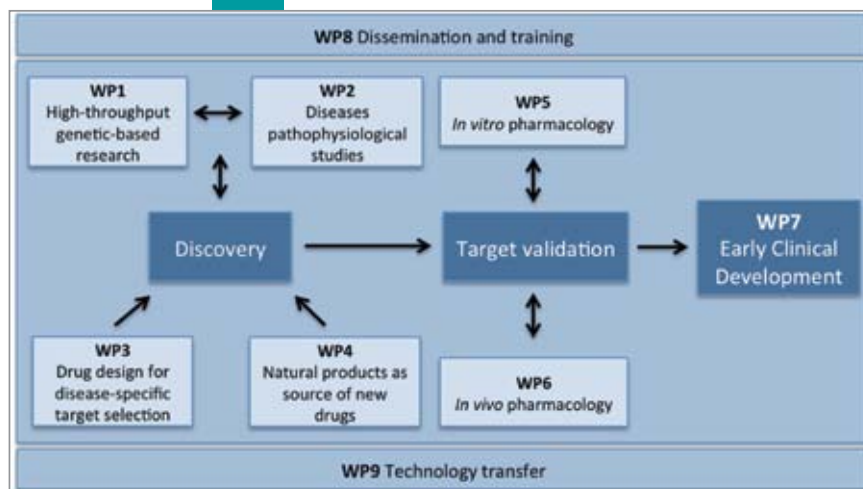
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Inflammatory diseases are a complex and heterogeneous group of diseases that affect more than 10% of the world population. The current options for the treatment of inflammatory diseases are still limited and in some cases, ineffective due to limited understanding of the mechanisms underlying these diseases. The development of translational research by a center that can generate scientific knowledge and identify new therapeutic targets for inflammatory diseases is imperative. The Center for Research on Inflammatory Diseases (CPDI) will be created to fulfill this goal. The Center relies on the expertise of researchers from various biomedical fields, integrating basic (geneticists, molecular and cell biologists, immunologists, pharmacologists, pathologists), and clinical (rheumatologists, clinical immunologists, infectologists, dermatologists) researchers, as well as investigators from the fields of computational medicinal chemistry, chemical synthesis and bioinformatics. The general objective of the CPDI will be to perform integrative and translational research to identify, validate and target known and novel biological pathways involved in the induction and resolution of inflammation. As a result, we expect the development of innovative therapeutic strategies and drugs that effectively target inflammatory diseases. The project will involve high-throughput genetic screening, *in vivo* and *in vitro* models of diseases, modeling and chemical synthesis, as well as the discovery of new natural molecules from plants and arthropod saliva. After selecting the potential drugs and bio-drugs, the CPDI will protect its intellectual property and, after partnerships with private companies, coordinate pre-clinical toxicological studies and early clinical trials. The specific goal of the CPDI will be to advance the understanding of the physiopathology of inflammatory diseases (infectious, autoimmune and vascular atherosclerotic) to accomplish the



following: 1) recognize and understand the mechanisms involved, such as molecular (genetic and intracellular signaling), immunological (innate and specific responses), pathological and pharmacological (experimental models) mechanisms; 2) identify new biological targets to develop pharmacological (synthetic and from natural source) and immune (antibody) therapy tools; 3) search for possible diagnostic markers and prognostic clues; and 4) apply this new knowledge to design and synthesize new molecules to treat inflammatory diseases. The new molecules will be tested for their efficacy in experimental models and submitted to conceptual tests in samples from human beings. In the case of potential therapeutic use, we intend to seek patents and perform stability, pharmacokinetic and pre-clinical toxicology trials and coordinate possible early clinical trials. Development of potential drugs will be performed in partnership with public and private companies, which have already expressed interest in partnerships. The Center will also dedicate intense efforts to promotion of knowledge by sharing greater public awareness, transparency and education by letting people know what is being done in the science of inflammatory diseases. Fulfilling these societal objectives of spreading education and generating enthusiasm for science, the plan is to reach the public at large using all available tools. Dissemination actions will be implemented for the scientific community, for the public in general and for patients with inflammatory diseases. The goal of disseminated knowledge will also be met by the coordination of training activities.

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The Center for Research and Innovation in Biodiversity and Drug Discovery (CIBFar) is a joint initiative resulting from existing collaborative research projects involving the Laboratory of Medicinal and Computational Chemistry (LQMC) at the Institute of Physics of São Carlos (IFSC), University of São Paulo (USP); the Nucleus of Bioassays, Biosynthesis, and Ecophysiology of Natural Products (NUBBE), at the Institute of Chemistry, São Paulo State University (UNESP); the Laboratories of Organic Synthesis, at the Institute of Chemistry, State University of Campinas (UNICAMP); the Laboratories of Natural Products and Organic Synthesis, at the Department of Chemistry, Federal University of São Carlos (UFSCar); and the Laboratory of Natural Products, at the School of Pharmaceutical Sciences of Ribeirão Preto, University of São Paulo (USP).

The major goal is to perform basic and applied science as well as technological development in all areas of biodiversity and drug discovery that rely on the state-of-the-art methods of natural products chemistry, synthetic organic chemistry, molecular and structural biology, biological, biochemical and pharmacological assays, medicinal chemistry and drug design.

The specific goals are the bio prospection of the Brazilian flora with a view to the identification of hits with a broad spectrum of biological activities (antiparasitic, antibacterial, anticancer); the selection of promising hits, leading to organic synthesis and structure-activity relationship studies; the use of structure and ligand-based drug design approaches to guide hit to lead optimization; and preclinical *in vitro* and *in vivo* evaluation and optimization of candidate compounds, toxicology and pharmacokinetics studies. The final goal is the development of novel, patentable drug candidates for clinical development (e.g., enzyme inhibitors or receptor agonists/antagonists). To this end, a very high priority of CIBFar is to provide not only solid scientific competency and expertise in all areas of



interest but also to provide a very well organized structure for the integration of modern approaches in biodiversity and drug discovery. Maximum integration and collaboration with the private sector is sought, particularly with national and international pharmaceutical companies and research institutes within the health sectors.

On the educational front, CIBFar also relies on the considerable experience that has been acquired over the last ten years from previous experience as a RIDC-FAPESP. For this proposal, the strong training programs for undergraduate/graduate students and researchers, with an emphasis on modern methodologies used in the fields of biodiversity and drug discovery research will be expanded. Furthermore, CIBFar will work with the Center for Scientific and Cultural Diffusion, at the Federal University of São Carlos, through programs directed towards elementary and secondary students, to further the education of schoolteachers, to extend libraries of experiments for school exhibition and to educate at a distance via the Internet, videos, science fairs and lectures.



**Host Institution**

University of São Paulo (USP, campus São Paulo)

**Associated Institutions**

State University of Campinas (UNICAMP)

São Paulo State University (UNESP)

Federal University of São Carlos (UFSCar)

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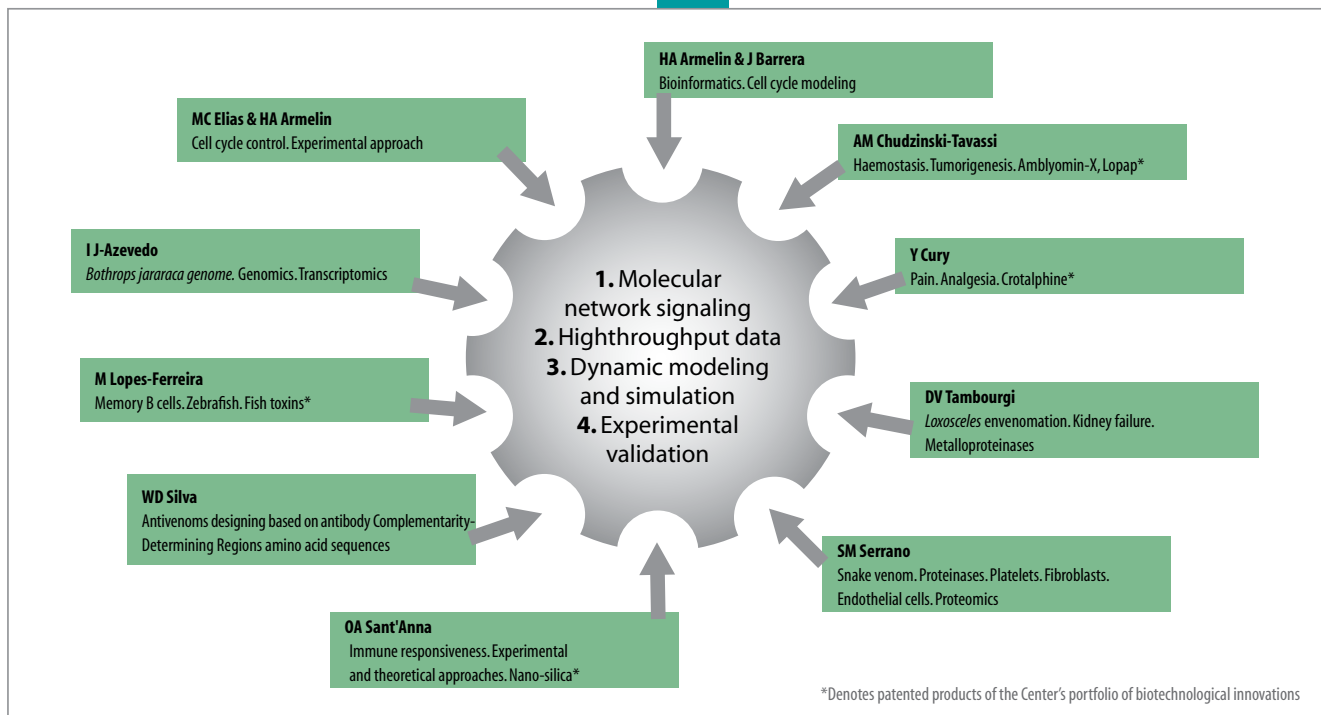


Diagram of the research plan displaying the focused, progressive steps towards which the subprojects converge. The subprojects (green rectangles) are identified by their respective principal investigators and keywords indicating research subjects.

Eleven research leaders of the Butantan Institute designed a plan to establish a new world-class center called the Center for Research on Toxins, Immune-Response and Cell Signaling (CeTICS). This initiative took advantage of the international reputation of the Butantan Institute and the infrastructure recently built by the former Center for Applied Toxinology (CAT), supported by FAPESP in the first edition of the RIDC Program.

Over the last 10 years, investigators of the CAT successfully isolated, chemically characterized and patented several novel protein and peptide toxins from natural venoms and animal secretions, which became promising starting points for the development of pharmaceutical innovations, in partnership with local industries. This emphasis on proteins and peptides led to the development of state of the art laboratories for proteomics, genomics, transcriptomics, molecular biology of recombinant DNA and peptide synthesis. More recently, studies of biochemical, molecular and

cellular mechanisms of potential therapeutic toxins were initiated, aiming to establish proof-of-concept studies based on the analyses of molecular signaling networks. Thus, the CAT progressively moved towards Systems Biology-driven research, making the Butantan Institute ready to house a competitive interdisciplinary center of excellence in toxins, immune response and cell signaling.

The new CeTICS starts with an ambitious research plan focused on integration of subprojects, some aimed at scientific research and others motivated for technological innovation. This general plan includes guidelines to efficiently transfer research spinoffs to industrial settings by a process mediated by the Technology Transfer Office of the Butantan Institute. Furthermore, it also includes specific objectives for education and knowledge dissemination, with innovative ideas to further explore the educational vocation of the Butantan Institute museums. To achieve all of these goals, the principal investigators assembled a large and diversified team of 70 researchers and students, complemented by a collaboration of 35 external senior scientists from both Brazilian and well known foreign Institutions.

#### Host Institution

Butantan Institute (IBu)

#### Associated Institutions

University of São Paulo (USP)  
Albert Einstein Israelite Education and Research  
Institute (IIEPAE)  
São Paulo State University (UNESP)  
Federal University of Minas Gerais (UFMG)  
University of Glasgow, United Kingdom  
Stanford University, United States  
University of Toyama, Japan  
Université de Montpellier, France  
University of Virginia, United States  
University of Berlin, Germany  
National Academy of Medicine, United States  
Cardiff University, United Kingdom  
University of Lousane, Switzerland

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The Research, Innovation and Dissemination Center for Neuromathematics (NEUROMAT) aims to integrate mathematical modeling with basic and applied lines of research at the frontier of neuroscience. There is an increasing importance of mathematical structures in theoretical neuroscience: the analysis of huge datasets generated by recent experimental developments requires new mathematical tools. Furthermore, the development of suitable mathematical languages and structures is essential to develop theories explaining the underlying phenomena and yielding testable predictions.

Neuroscience is at a crossroads, triggered by an imbalance between prowess in data collection and humbleness in theoretical understanding, a situation that has been nicely described as data-rich yet theory-poor. Mathematics is the bridge that can integrate observations and explanations.

NEUROMAT will put together a first-class team of mathematicians, computer scientists, neuroscientists and rehabilitation clinicians. The research structure is designed to fulfill several requirements: 1) researching must not be reduced to a particular area of mathematics (therefore, the team includes mathematicians with different specialties); 2) leading to models that help to understand actual phenomena, and not just to convenient phenomenological descriptions (here, the objective is to achieve understanding and predictive power in applied areas of neuroscience, therefore, the team includes experts in neuronal data recording and neurological diseases); 3) producing efficient algorithms and procedures that can be put to use on real data (therefore, the team includes a number of computer scientists); 4) leading to products useful for medical professionals



Photo by Juan Ojea

*The Research, Innovation and Dissemination Center for Neuromathematics (NEUROMAT) integrates the development of new mathematics with basic and applied research at the frontier of neuroscience (Photo by Juan Ojea)*

and public health programs (therefore, the team includes specialists in neurorehabilitation and public policies for cerebral stroke patients).

The technological transfer and innovation aspects will focus on products needed for public health programs in neurorehabilitation, including the design and analysis of a standardized data bank and the development of tools to support clinical diagnostics, decision and follow up.

For dissemination, the project includes courses and filmed workshops addressed to students at all levels, public school teachers and journalists.

**Host Institution**

University of São Paulo (USP, campus São Paulo)

**Associated Institutions**

State University of Campinas (UNICAMP)  
University of Buenos Aires, Argentina  
Regional Council on Statistics – SP  
Federal University of Rio Grande do Norte (UFRN)  
Rockefeller University, United States  
Institute of Pure and Applied Mathematics (IMPA)  
Federal University of Rio de Janeiro (UFRJ)  
University of Memphis, United States  
Watson Research Center, United States  
University of San Andrés, Argentina  
University of the Republic, Uruguay  
Harvard Medical School, United States  
Centre National de la Recherche Scientifique (CNRS), France  
Federal University of ABC (UFABC)

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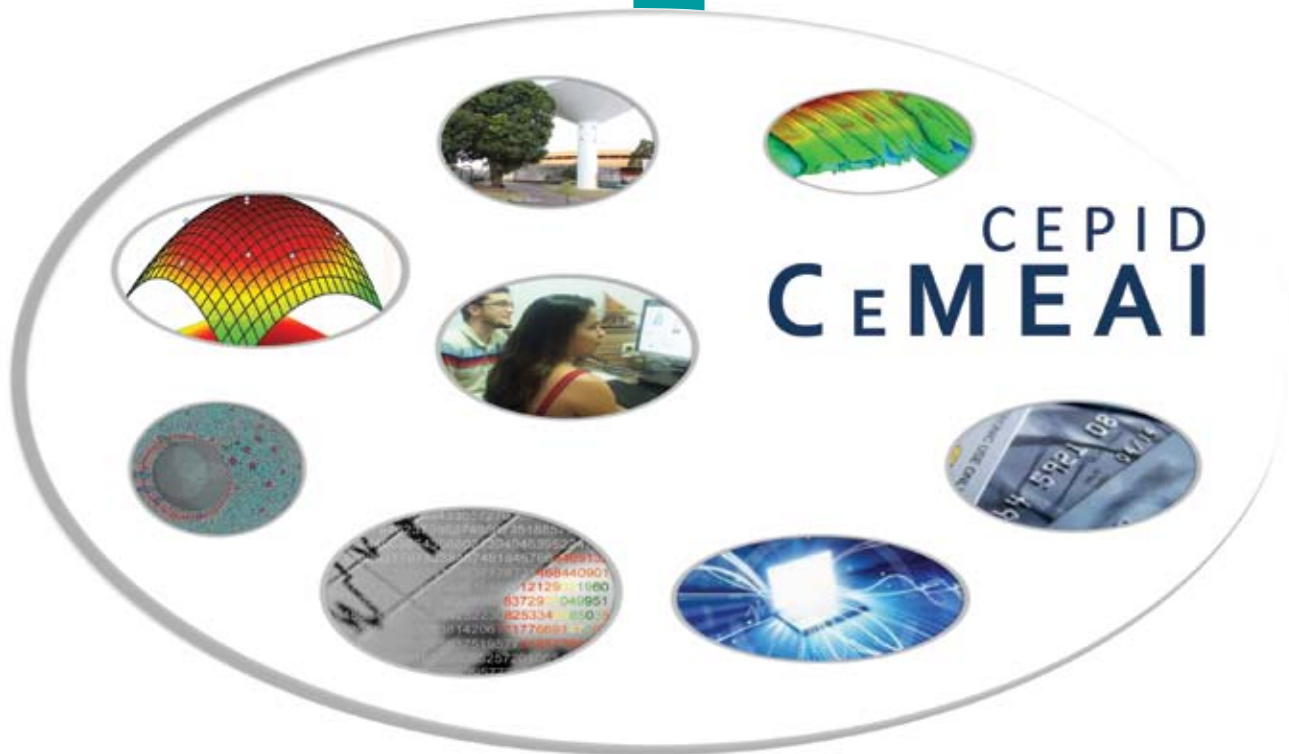
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This proposal focuses on promoting the use of mathematical sciences, in particular applied mathematics, statistics and computer science as an industrial resource. The goal is to do this within an interdisciplinary setting, emphasizing technology transfer, education and knowledge dissemination for industry and government applications organized by a specially tailored Structured Research Center, whose nucleus already exists at USP.

The Center's main strategy is to build a strong infrastructure with regard to human resources, advanced computational equipment, collaboration opportunities and other facilities to promote interdisciplinary cooperation with industry and,

more specifically, with the manufacturing, government and service sectors.

The Center will encourage academic research groups to collaborate on effective applications and produce new scientific knowledge. The core groups in the Center have demonstrated experience in producing academic work of high quality in their areas of activity and also in relevant applications, evidence of which will be provided in the Technology Transfer section of this project. The core groups and their collaborators will continue with their usual scientific activities, enhanced by the interaction opportunities created by the Center, and at the same time, emphasize the critical role that mathematics plays across all industries.

**Host Institution**

University of São Paulo (USP, campus São Carlos)

**Associated Institutions**

State University of Campinas (UNICAMP)  
São Paulo State University (UNESP)  
Aerospace Science and Technology Department (DCTA)  
Federal University of São Carlos (UFSCar)  
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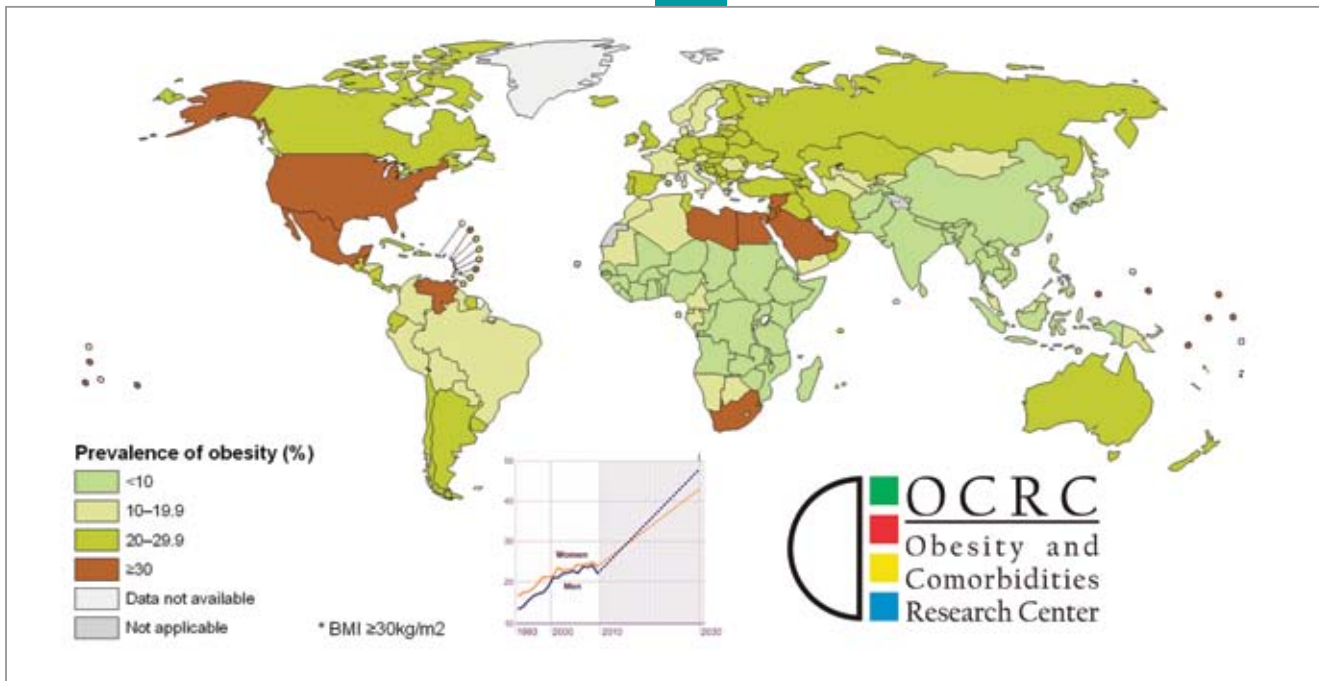
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Obesity affects a rapidly increasing number of people worldwide. The world map depicts the current prevalence of obesity in most countries in the world. The graph in the bottom-middle part of the figure depicts the progression of obesity prevalence for women and men

The Obesity and Comorbidities Research Center's (OCRC) main objective is to coordinate efforts to find solutions for obesity, which is highly associated with a number of diseases such as diabetes, hypertension, atherosclerosis and certain types of cancer. Because of the absolute lack of appropriate preventive and therapeutic approaches to deal with obesity, the overall mortality directly and indirectly associated with this disease is rapidly increasing across the world.

Obesity affects more than 400 million people worldwide, and projections for the next 15 years predict an overall prevalence of up to 20%. In developing countries such as Brazil, the rapid nutritional transition provided by recent economic growth has led to a unique condition in which the malnourished persist in parallel with an increasing number of obese subjects. It is expected that by the year 2020, up to 20% of Brazilians will be obese and approximately 50% overweight.

Obesity results from an imbalance between caloric intake and energy expenditure.

Although great advances were recently obtained in the characterization of the mechanisms that control feeding and thermogenesis, the complexity of the neural circuits that guide these functions and the difficulties imposed by anatomical constraints to study the human hypothalamus have hampered the rapid advance of treatments for obesity. The OCRC has put together some of the most productive Brazilian scientists in these fields to advance the understanding of the mechanisms leading to obesity and its associated diseases. In addition, the search for new pharmacological, nutritional and physical activity approaches to deal with these conditions will be pursued.

The OCRC will invest in the education of high-school students and senior citizens regarding preventive and screening methods for early detection of obesity associated diseases. In addition, the RIDC will foster programs for improving the education of undergraduate students in the field of nutrition and increasing interest for research in these fields.

OCRC staff will be in contact with industry and other potential users of the knowledge and products obtained to speed up the transfer of knowledge to society.



## Host Institution

State University of Campinas (UNICAMP)

## Associated Institutions

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The Center for Research in Cell Therapy (CTC) focuses on advanced basic and applied research on stem cell (SC) biology. The CTC is composed of Brazilian investigators with renowned leadership in the area of Cell Therapy, along with a team of international collaborators.

The scientific project involves an ambitious multidisciplinary program aiming at the study of the molecular, cellular, and biologic features of normal and pathologic stem cells (SCs) and to critically evaluate their potential therapeutic use.

Studies will be conducted on pluripotent stem cells [embryonic (ESCs) and induced (iPSCs)] and on somatic (hematopoietic, mesenchymal, and endothelial) SCs. The intention is to generate Brazilian ESC lineages to be expanded and used in preclinical protocols, as well as investigate the mechanisms involved in pluripotency. To model diseases, iPSCs from patients with dyskeratosis congenita, Fanconi anemia, hemophilia A, and Parkinson disease will be generated to understand the mechanisms involved in the pathologic maintenance of pluripotency and to investigate disease-specific molecular pathways and the process of cell differentiation in affected tissues. Hematopoietic cells will be derived from ESCs and iPSCs, and cell lines will be established from both normal and leukemic SCs for studies on the mechanisms that control normal and neoplastic hematopoiesis. Transgenic animal models of acute promyelocytic leukemia will be produced for basic and preclinical studies. Cancer SCs will be studied to understand the processes of epithelium-mesenchymal and endothelial-mesenchymal transition implicated in the development of metastases; these mechanisms will also be studied in the context of cell reprogramming and in SC generation.

Clinical assays will be conducted using allogeneic mesenchymal SCs in the treatment of insulin-dependent diabetes, severe aplastic anemia, prevention of graft-versus-host disease in hematopoietic SC transplantation, and in haploidentical allogeneic hematopoietic SC transplantation. Finally, processes will be developed for the large-scale production of SCs under good



*Cells cultivated in vitro are differentiated into several tissues for transplant in humans to treat diseases*

manufacturing practice conditions to allow their potential clinical use.

The CTC project encompasses an advanced education outreach program fostering the interaction between (senior and junior) researchers and middle and high school students and teachers. This program is focused on science education and is rooted in the school-teacher-student triad. Teachers and students will be encouraged to engage together in activities based on scientific questions that produce results. They will also be encouraged to visit laboratories and obtain involved in objective scientific experiments under the guidance of our investigators and the “Adopt a Scientist” project, introducing them to the scientific method. The “Cellularium” is an exhibition project that involves an inflatable “planetarium” that invites students for a voyage into the cell, presenting 3D animation movies made by the CTC team. Additionally, the Center will recruit journalism college students to get involved in seminars and courses in sciences to develop their training in scientific journalism.

Finally, the CTC has a solid technology transfer project focused on the improvement of public health. The project involves interaction with the private sector for the generation of new recombinant proteins for clinical purposes and the development of new diagnostic tests for blood transfusion and hematologic diseases. The Center will interact with other medical institutes to develop new laboratories for clinical cell processing. The Center will also work together with government agencies responsible for health policies to expand and improve the National Health System.

## Host Institution

University of São Paulo (USP, campus Ribeirão Preto)

## Associated Institutions

Hemotherapy Center of Ribeirão Preto  
University of Montreal, Canada  
University of Guelph, Canada  
University of Oxford, United Kingdom  
Federal University of São Carlos (UFSCar)  
University of California, United States  
University of Munchen, Germany  
King's College, United Kingdom  
University of Southern California (USC), United States  
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Paris University, France  
Leiden University, Netherlands  
University of Feinberg, United States  
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Wikimedia (Jonathan Olsson)

*CEM develops advanced studies on the role of public policies on individuals' well-being*

The Center for Metropolitan Studies (CEM) intends to be a world-class research center that is also committed to the diffusion of knowledge and technology transfer. Hosted by the University of São Paulo (USP) and the Brazilian Center for Analysis and Planning (CEBRAP), the center is composed of a multi-disciplinary group – demographers, political scientists, sociologists, geographers, and anthropologists – whose research agenda aims at studying contemporary Brazil to better understand the complex effects of public policies and institutions on economic growth, poverty alleviation, and inequality reduction.

CEM's research agenda is organized into four main areas: (i) the relationship between economic and social change, democracy and inequalities in Brazilian history. A large dataset on race, gender, migration, labor markets, income, urban conditions, education, religious affiliation, health, and political behavior spanning 1960 to 2010 is available

for consultation on a free basis; (ii) the independent impact of State policies – in particular education, health, affirmative action, the job market and place-inequality reduction – on social conditions, poverty alleviation, and inequality reduction; (iii) the role of political institutions – particularly voting behavior and law-making processes – on the decision-making of interpersonal and interregional redistribution policies; (iv) forms of governance in urban areas understood as being out of reach of the State, in particular civil-society associations, organized crime, and segregated urban areas.

CEM is also committed to providing data and technical assistance on public policy to policy-makers, the academic community, and high-school students and teachers. CEM guarantees its commitment to scientific and technical independence. Geo-processing tools and a large datasets available on a free basis are at the core of the technology transfer of the Center. Training on Terra View Social Policy – software developed in cooperation with INPE – is also provided on a regular basis.

**Host Institution**

University of São Paulo (USP, campus São Paulo)

**Associated Institutions**

State University of Campinas (UNICAMP)  
National Institute for Space Research (INPE)  
Institute of Education and Research (INSPER)  
Federal University of São Carlos (UFSCar)  
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The new Human Genome and Stem-Cell Research Center (HUG-CELL) at the University of São Paulo raises the scope of the original Human Genome Research Center (HGRC – RIDC I) to a new level. The Center was initiated in 2000 with the aim of improving basic knowledge and diagnosis of prevalent genetic diseases in the Brazilian population. The original center concentrated initially on Mendelian disorders, mainly neuromuscular, craniofacial, and mental disabilities. These activities were expanded in 2005 by introducing stem-cell research to understand gene expression and differentiation in complex genetic disorders such as autism and amyotrophic lateral sclerosis and to evaluate stem-cell-based disease therapy. However, the unanticipated complexity of the transcriptional mechanisms that emerged from the Human Genome, and the modest advances in improving genetic health care have demanded the opening of further fields of investigation.

Accordingly, this revised project has been expanded to include research on the genetics and genomic instability associated with aging and degenerative diseases, epigenetic mechanisms involved in disease manifestation and phenotypic variability between individuals with identical Mendelian disease mutations. In addition, the “over 80 project” will compare genome variation and brain functioning (MRI) of healthy Brazilian individuals older than 80 with a group older than 60 without prior selection based on good health in old age. To address these questions, the Center will use state of the art approaches, particularly next generation sequencing and sophisticated cell sorting; incorporate a much broader base of scientific expertise; and optimize inter-group synergy, including national and international research collaborations. The plans also contribute to translational medicine, particularly to stem-cell therapies in preclinical studies using different animal models and therapeutic trials for particular genetic disorders.

The transfer technology project is based on the great number of patients with different genetic disorders that have been ascertained and



*Stem-cells culture for investigating genetic disorders and cell therapy*

registered at the Center, the largest in Latin America. The ethnic variability of the Brazilian population provides a rich foundation for the proposed studies. Molecular diagnosis and genetic counseling has been offered to the population by our genetic services division. Accordingly the plan is to develop new kits for the diagnosis of rare diseases using genomic technologies and the information on Brazilian genetic variation and to establish partnerships with start-up biotechnology enterprises. It is anticipated that the knowledge gained from these activities will have an important impact on genetic health care in Brazil.

The diffusion/education project aims to make science, and particularly genetics, more accessible to society. This includes high-school education and activities to the general public that have already reached thousands of students since 2000. In the new project, specialized courses in genetics for professionals from health and media areas will be offered. Programs to assist teachers and students inside public high schools aimed at motivating students to study science and improving their genetics knowledge will be mediated through various activities including: scientific exhibitions, implementation of short term travelling laboratory classes and maintenance of centralized repositories of instructional materials that can be loaned to schools. Additionally, the HUG-CELL center is part of a large new national project, “Adventures in Science”, involving the creation of science kits for young students aimed at motivating and teaching fundamental scientific concepts in a clear and precise way.

## Host Institution

University of São Paulo (USP, campus São Paulo)

## Associated Institutions

Federal University of São Paulo (UNIFESP)  
Albert Einstein Hospital  
Fleury S. A.  
Zerbini Foundation  
Utrecht University  
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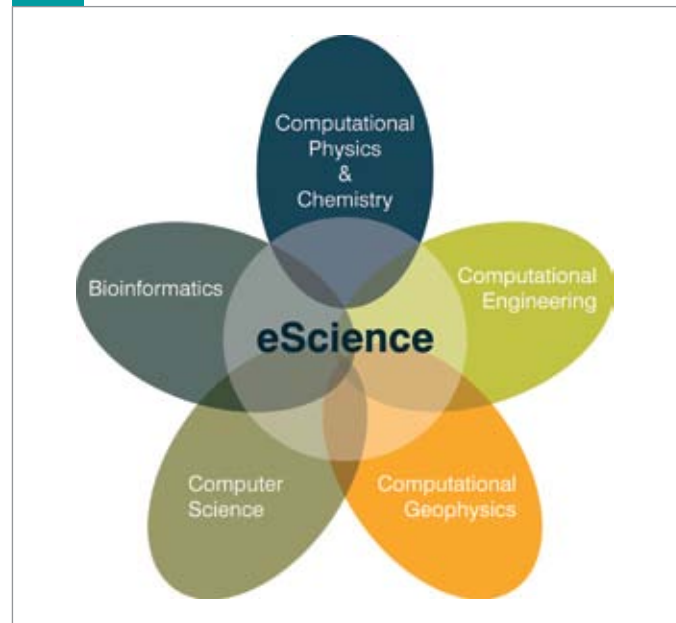
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The Center for Computational Science and Engineering (CECC) aims to develop and apply advanced computational modeling techniques to solve problems at the frontier of computational engineering and sciences and to promote substantial advancements in technological innovation, education and dissemination of knowledge in the broader area of eScience.

The Center brings together highly qualified scientists from the institutes of Biology, Computer Science, Physics, Mathematics, Chemistry, and School of Mechanical Engineering at UNICAMP, as well as distinguished scientists from the universities of Texas and Yale (United States), Graz (Austria), and Buenos Aires (Argentina). The Center finds its unifying scientific focus in the field of computational modeling and high-performance computing.

It is expected that the Center will be able to address and solve a variety of problems at the forefront of science, including nanomaterials; complex biomolecular systems of interest to human health and bioenergy; bioinformatics; particulate materials, porous and continuum media; and computational geophysics. All of these scientific areas involve the development of advanced techniques in parallelism extraction, multi-core architectures and management of big data. The Center is expected to implement a selective program to attract well-qualified students and post-doctoral researchers to work at CECC and to maintain an active agenda of international scientific cooperation.

Is part of the mission of CECC to promote and create a means for stronger interactions between academia and industry and the dissemination of knowledge and education. The Center will harbor a Science Education and Dissemination unit, which will be responsible for organizing and implementing activities based on the development of eLearning materials directed toward teachers and students of the Brazilian public school system.



*The eScience Center at UNICAMP will constitute a world-class interdisciplinary research center dedicated to the development and application of advanced high-performance computer simulations, modeling, big data management and massive computation in general to a variety of problems ranging from geophysics to molecular sciences*

Science Education and Dissemination unit will also implement a program to promote greater visibility of the Center's research activities. In particular, the organization of a strong program of seminars, courses, and summer schools dedicated to various aspects of computational modeling and computer science. The Center will also harbor a Technology Transfer division that is expected to interact closely with the University's Innovation Agency (Inova) to create opportunities for transferring new technologies and methodologies developed by the Center to industry, government, and the general population. Through its Technology Transfer core, the Center will promote increased networking between its researchers and industry. Its data infrastructure will be developed to support cooperation among the Center's researchers, foster cooperation with other scientists, and disseminate the Center's scientific and educational achievements.



**Host Institution**

State University of Campinas (UNICAMP)

**Associated Institutions**

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Yale University, United States  
University of Buenos Aires, Argentina  
Graz University, Austria  
Biocelere Agroindustrial Ltda. (BIOCELERE)

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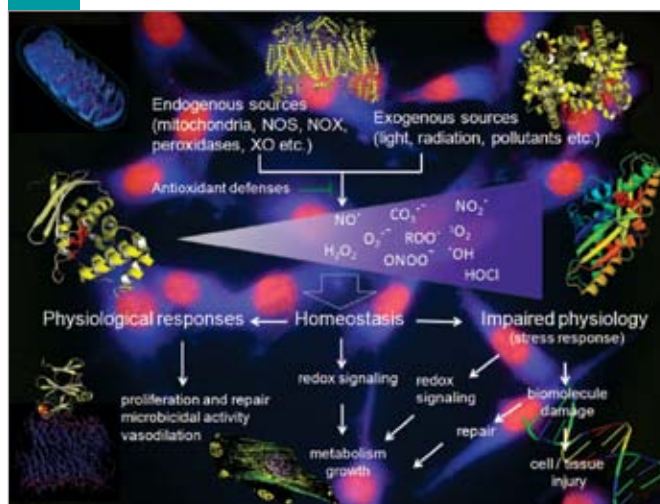
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The Redox Processes in Biomedicine RIDC (Redoxome) is a multidisciplinary network of investigators focused on a concerted approach to investigating redox processes. These processes involve electron transfer reactions via free radicals or non-radical intermediates, and have a unique potential to elucidate biochemical pathways underlying cell and organ (patho) physiology, as well as to disclose disease mechanisms and therapeutic targets. This enormous potential has not yet been fulfilled, mainly because of insufficient basic mechanistic knowledge. The Redoxome Center will address issues relevant to overcoming such limitations to allow the design of effective antioxidant strategies and biomarkers of oxidative stress. Specifically, we will investigate: 1) reactive oxygen species (ROS) generation and control in biological systems; 2) chemical reactivity of ROS in biological environments and consequent changes in the structure and function of biomolecules; 3) mechanisms and networks involved in redox signaling processes relevant to human disease; 4) diagnostic and therapeutic applications of redox processes. Such investigations comprise a coherent set of interconnected studies expected to bridge meaningful conceptual gaps in the field and to allow technological and educational advances.

The pervasiveness of redox processes in the environment opens many possibilities for technological applications. Several public and private industrial sectors will benefit from new technologies developed by the Redoxome Center, varying from those in which Brazil has already acquired international leadership (personal care, fragrances, cosmetics, bioenergy) to those in which industries are emerging but are still not competitive in the national and international markets (pharmaceutical, medical devices, diagnostics, ecological services). The main goal is to innovate in these industrial sectors. In addition, the aim is to implement a core laboratory (Redoxoma Analysis Platform – RAP) at USP to provide state-of-the-art



*Schematic and simplified overview of the multiple roles of radicals and oxidants as mediators of physiological and pathophysiological circuits*

analytical tools for the evaluation of redox processes, which will be open for use by clinical and basic researchers. Redox state markers should favor early detection of risk factors for a number of diseases, allowing the design of adequate interventions and maximizing the chances of correcting these conditions.

In terms of education and knowledge diffusion, the Redoxome center will target students from all levels (primary education, high school, undergraduates, graduate), teachers and the general public. The actions are structured around four main axes: 1) courses: development of courses for graduate and undergraduate students, and for teachers continuing their professional development; 2) didactic resources: development of curriculum materials to complement science classes and experimental activities at a website; 3) scientific diffusion: a permanent exhibition at a science museum and the development of a website; and 4) educational projects: scientific research initiation at high school level supervised by teachers. In addition, the entire context of this plan and the actions derived from it will be used as research material for academic research in Science Education.

## Host Institution

University of São Paulo (USP, campus São Paulo)

## Associated Institutions

São Paulo State University (UNESP)  
Federal University of São Paulo (UNIFESP)  
Butantan Institute (IBu)  
Centre National de la Recherche Scientifique (CNRS), France  
University of the Republic, Uruguai  
University of Milwaukee, United States  
University of Madrid, Spain  
Emory University  
Liverpool John Moores University, United Kingdom  
Koç University, Turkey  
Boston University, United States  
University of Rochester, United States  
Harvard University, United States  
Aarhus University, Denmark  
National Institute on Aging (NIA), United States  
Atomic Energy and Alternative Energies Commission (CEA), France  
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The Center for the Study of Violence (NEV/ USP) aims to explore how the legitimacy of key institutions is constructed or jeopardized in the contact between citizens and civil servants.

Since 1990, NEV has analyzed aspects of the intertwining of democratic consolidation and the persistence of violence. Recently, the research program focused on the study of the quality of democracy from the perspective of human rights and violence. Successive expectations and predictions about democracy have failed so far: there has been no regression, but democratic rule of law remains a distant goal. How well institutions perform while applying the law, or implementing programs dictated by laws will reflect on their legitimacy. This in turn should reflect on the legitimacy of laws and on the strengthening of rule of law.

In this new phase, the center will carry out research focusing on local institutions: the municipal administration; the local school, health center, labor courts, police services, and local justice centers. Emphasis is given to new innovative legislation and programs. The NEV will explore how macro and micro phenomena come together and impact each other. This will be done from the perspective of the citizens, as well as the civil servants, involved.

The study will take the form of a longitudinal panel with multiple contacts over a period of time. International comparisons on specific issues will take place through similar topical studies that will be carried out in Mexico City and Johannesburg (the police and courts); and in New Delhi, Cape Town, and Berkeley (housing, land use, use of public space, among others). Cut crossing issues are law enforcement in the frontiers with Ecuador, Mexico and South Africa (Johannesburg). In all settings, gender and vulnerable age groups (youth, children and the elderly) will receive special analyses.

In terms of knowledge transfer, NEV will partner with institutions for strategic exchange of information, work methods, and common projects, such as the Brazilian Forum for Public Security; national media such as newspapers, television and radio; local and international non-



governmental organizations; and public opinion leaders in the public sector, in particular policy makers and legislators. Workshops to discuss specific forms of knowledge and information exchange will be organized with the aid of knowledge transfer experts who will evaluate our past strategies and suggest the best ways to optimize our new activities. An international seminar will be organized to discuss how to improve the “translation of scientific results to the public at large, in particular those with little access to scientific information.”

The objective of the educational program is to develop human resources to carry out interdisciplinary research related to democracy, violence and human rights. The activities will include the organization of a Centre for Permanent Debate on Violence, Human Rights and Democracy in urban settings, designed to stimulate new approaches to such issues in a critical way; an on-line Forum, which will foster debate; and interdisciplinary undergraduate courses. Some of the themes proposed for the courses are Democracy and Authoritarianism, Health Care and Human Rights, Anthropology and Law in Contemporary Brazil, Violence in the Brazilian Culture, and The Authoritarian Discourse. An interdisciplinary course on Innovation in Management applied to the police and the criminal justice system is to take place. The courses are aimed at university students, schools, local governments and non-governmental organizations.

## Host Institution

University of São Paulo (USP, campus São Paulo)

## Associated Institutions

El Colegio del Mexico, Mexico  
Latin American Social Sciences Institute  
Indian Institute for Human Settlements (IIHS), India  
University of Columbia, United States  
University of California, United States  
University of Cape Town, South Africa  
Centre for the Study of Violence and Reconciliation,  
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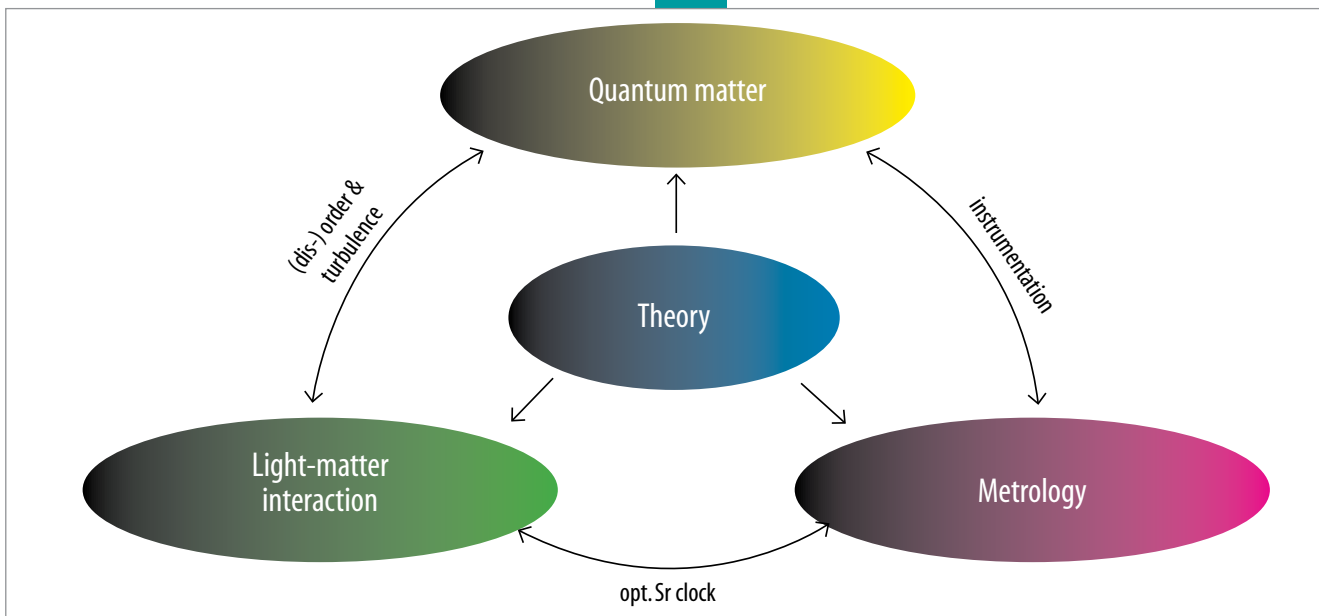
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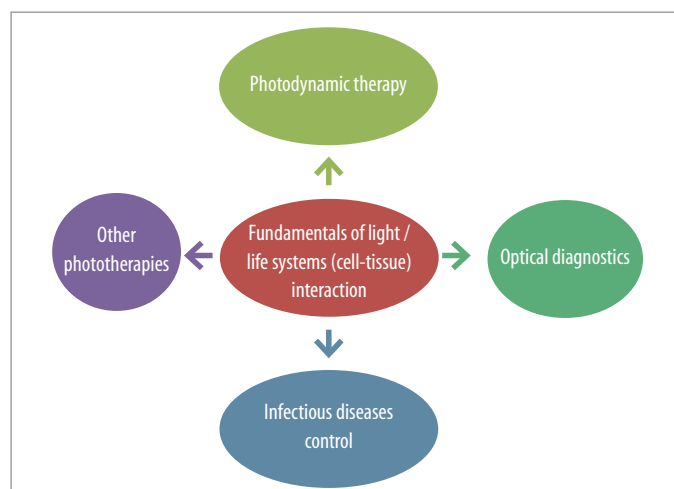
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Interconnection between atomic and molecular topics

The Optics and Photonics Research Center (CEPOF) aims to be an RIDC in which cutting-edge fundamental and applied research in the field of optics and photonics can advance together. The research program comprises three main thrusts: cold-matter physics, plasmonics and biophotonics, fields that are linked by the common theme of light-matter interaction. In parallel, the Center will advance fundamental knowledge and develop innovative, practical applications. Turbulence in quantum gases, light-matter entanglement of photons and cold atoms, and optical methods for precision time-and-frequency metrology define the focus of cold-matter physics. Nanoplasmonics takes optics beyond the diffraction limit, opening new perspectives for confinement and transport of quantum gases and the development of ultrasensitive, rugged biosensors. A modern nano-fabrication facility will provide support for all scientific and technological projects. In biophotonics, our studies focus on the diagnosis and treatment of diseases using purely optical techniques. Technological innovation, benefiting from new scientific insights achieved in basic research activity, will develop new products, establish start-up enterprises, and collaborate



Synergetic action between basic and applied science

with existing companies. The science dissemination and outreach effort employs a TV channel, operating 24 hours a day, with a diverse range of active programs covering all educational levels, bringing the excitement of science to students from preschool to adults. The ambition is to create a world-class, internationally recognized Center. The CEPOF will promote international exchange and interaction by recruiting talented students and postdoctoral fellows from all over the world and establishing cooperative agreements with other high-level, globally recognized research centers.

## Host Institution

University of São Paulo (USP, campus São Paulo)

## Associated Institutions

State University of Campinas (UNICAMP)  
Barretos Cancer Hospital (HCB)  
Federal University of São Carlos (UFSCar)  
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