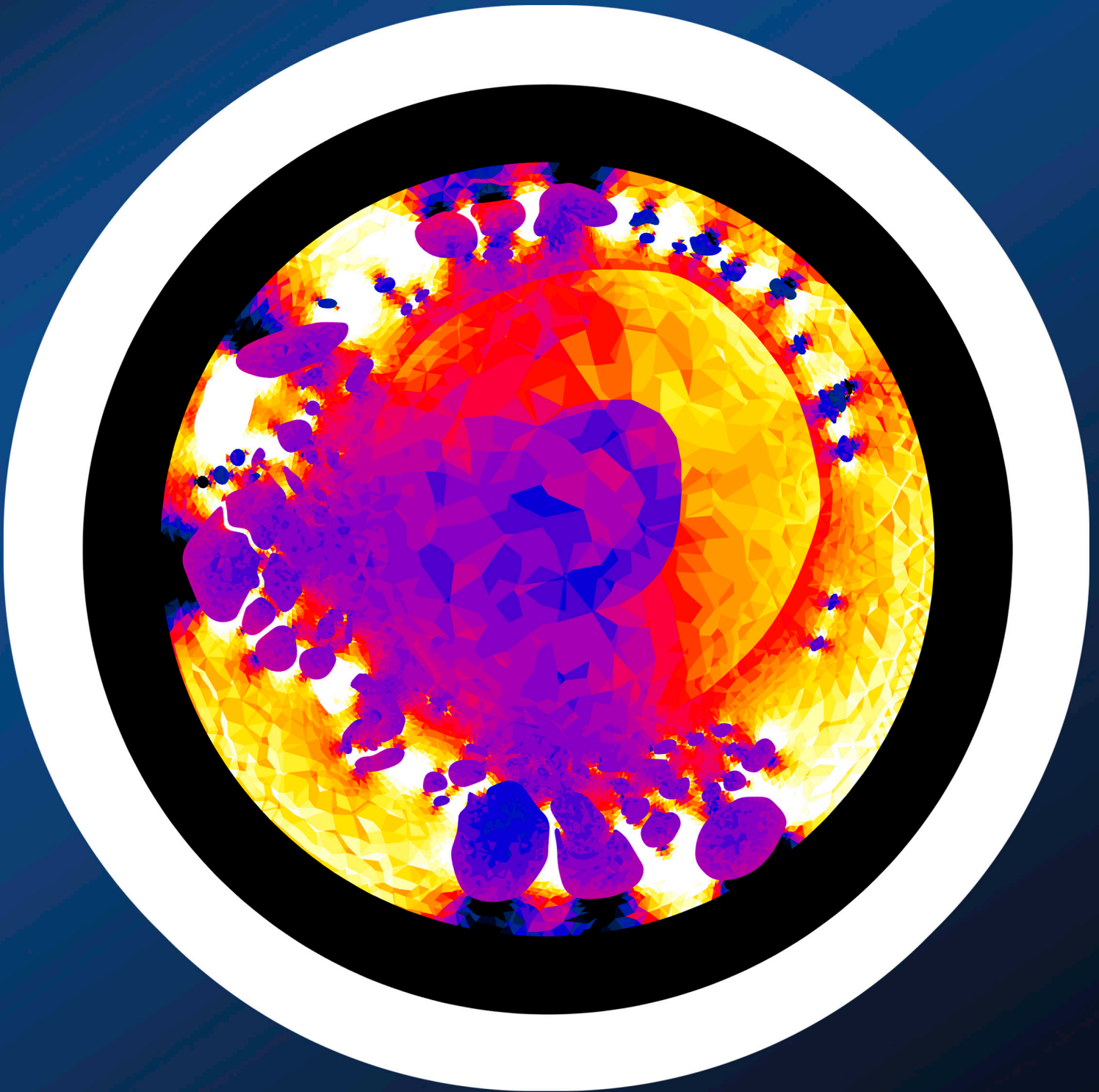


# *IT<sup>IS</sup>* FOUNDATION 2020



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*Cover: Internal electric field of a neurovascular bundle generated by application of a cuff electrode. The gradient of the electric field is due to the large electrical heterogeneity of the bundle tissue comprised of fascicles, connective tissue, and a central blood vessel.*

# 2020 – A PARTICULAR YEAR

The year 2020 will certainly never be forgotten. As for everyone in the world, the COVID-19 pandemic interrupted all of our activities and changed the way we perform our daily work. However, the pandemic also provided unique impetus for effective transformation. In this era of global crisis, IT'IS as well as its Z43 partners – all of them small, dynamic, R&D driven organizations – have been able to quickly adapt to the challenges imposed by the pandemic through the introduction of strict preventive and safety measures, the enabling of remote work for software-related services, and the maintenance of rotas for on-site hardware-related services. IT'IS has also been fortunate in that key research areas – wireless communications and medical simulations – have not been negatively impacted economically by the crisis, and that Switzerland did not impose stringent restrictions on small enterprises.

Paradoxically, 2020 was one of the IT'IS Foundation's most successful years. The severe reduction in the number of travel and social commitments allowed us to focus exclusively on our research agenda, resulting in the publication of a large number of papers (see page 15) and the acquisition of exciting new Projects (see page 12). We have also made great progress with the development of the o<sup>2</sup>S<sup>2</sup>PARC web-based open-access simulation platform (see page 13 on "Emergence of a New Computational Simulation Platform") that will serve as a spring-board for many innovations to come.

Other achievements of the past year include the development of novel (i) low-frequency probes, (ii) source reconstruction algorithms for direct combination of measurement and simulation results, and (iii) high-performance-computing-enabled algorithms that allow field reconstructions to be accelerated by a factor of more than 10. These novel algorithms allowed SPEAG to build a vector-array system with the fastest-ever-yet evaluation time of much less than one second. Other highlights of the year include advances in, e.g., neuro-modulation research within the PREP2GO, NEUROMAN, CRANIO, and NeuHeart projects. Further, we have three new projects in our recently launched priority

field of research in temporal interference, funded by the ETH Zurich, FreeNovation Funding Program of Novartis Research Foundation, and the Foundation Bertarelli.

We also initiated an extensive search for talent, as my past experiences have taught me that periods of economic turbulence can provide unparalleled opportunities to attract exceptional talent. The roster of new hires listed on page 6 demonstrates that we have been successful in this endeavor.

We are, as ever, immensely grateful for the continued consistent support, encouragement, and insightful counsel of our Foundation Board Members (see page 4). I take this opportunity to announce changes in the Board: at the end of 2020, three longtime members – Dr. Mirjana Moser (Member since 1999), Prof. Heinrich Walt (Member since 2009), and Prof. Peter Niederer (President since 2005) – announced their retirements. The successor to Prof. Niederer, who guided the Foundation through the past 15 turbulent years with dedication and success, is Prof. Stephan Bodis, who is supported by Profs. Peter Achermann and Qiuting Huang as Vice Presidents. Three new members who have joined the Board provide considerable expertise and experience in biomedical research: Prof. Beatrice Beck Schimmer, Vice President Medicine of the University of Zurich, Switzerland; Prof. Alex Dommann, Head of the "Materials Meet Life" Department and member of the Board of Directors of the Swiss Federal Laboratories for Materials Science and Technology (Empa), Switzerland; and Prof. Alvaro Pascual-Leone, Professor of Neurology and Program Director of the Harvard-Thorndike Clinical Research Center, Harvard Medical School, USA.

The IT'IS Foundation's success in 2020 would not have been possible without the unrelenting dedication of our gifted staff, who continue to ever expand the boundaries of knowledge. We are equally grateful for the support of a large number of public agencies and commercial sponsors who fund much of our research (see page 9).

Prof. Niels Kuster

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## **Lifetime Honorary President**

Prof. Dr. Ralf Hütter, Emeritus ETH Zurich, CH

## **Lifetime Honorary Member**

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Prof. Dr. Peter Niederer, Emeritus ETH Zurich, CH

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Prof. Dr. Quirino Balzano, University of Maryland, US

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Prof. Dr. Qiuting Huang, ETH Zurich, CH

Prof. Dr. Niels Kuster, IT'IS Foundation, CH

Dr. Mirjana Moser, CH

Prof. Dr. Lukas Novotny, ETH Zurich, CH

Prof. Dr. Klaas Prüssmann, ETH Zurich, CH

Prof. Dr. Primo Schär, University of Basel, CH

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Prof. Dr. med. Paul Kleihues, Emeritus University Hospital Zurich, CH (2007 – 2008)

Prof. Dr. Albert Kündig, Emeritus ETH Zurich, CH (1999 – 2007)

Michael Milligan, Mobile & Wireless Forum, BE (1999 – 2010)

Prof. Dr. Toshio Nojima, Hokkaido University, JP (2002 – 2015)

Prof. Dr. Masao Taki, Tokyo Metropolitan University, JP (1999 – 2002)

Dr. Christer Törnevik, Ericsson, SE (1999 – 2005)

# BOARD MEMBERS 2021

## **Lifetime Honorary President**

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Prof. Dr. Wolfgang Fichtner, Emeritus ETH Zurich, CH

## **President**

Prof. MD Stephan Bodis, University Hospital Zurich and Cantonal Hospital Aarau, CH

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Prof. Dr. Alex Dommann, Swiss Federal Laboratories for Materials Science and Technology, CH

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Prof. Dr. Lukas Novotny, ETH Zurich, CH

Prof. Dr. Alvaro Pascual-Leone, Harvard Medical School, USA

Prof. Dr. Klaas Prüssmann, ETH Zurich, CH

Prof. Dr. Primo Schär, University of Basel, CH

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Prof. Dr. Albert Kündig, Emeritus, ETH Zurich, CH (1999 – 2007)

Michael Milligan, Mobile & Wireless Forum, BE (1999 – 2010)

Dr. Mirjana Moser, Federal Office of Public Health, CH (1999 – 2020)

Prof. Dr. Toshio Nojima, Hokkaido University, JP (2002 – 2015)

Prof. Dr. Masao Taki, Tokyo Metropolitan University, JP (1999 – 2002)

Dr. Christer Törnevik, Ericsson, SE (1999 – 2005)

Prof. Dr. Heinrich Walt, Emeritus University Hospital Zurich, CH (2009 – 2020)

# OUR TEAM



Niels Kuster, PhD, Prof., Director  
Myles H. Capstick, PhD, Associate Director  
Esra Neufeld, PhD, Associate Director  
Antonino M. Cassarà, PhD, Project Leader (EEO)  
Nicolas Chavannes, PhD, Project Leader (EEO)  
Dahye Choi, PhD, Project Leader (EEO)  
Mark G. Douglas, PhD, Project Leader (EEO)  
Arya Fallahi, PhD, Project Leader (EEO)  
Thomas Fussinger, Project Leader (EEO)  
Tolga Goren, PhD, Project Leader (EEO)  
Sina Hashemi Zadeh, PhD, Project Leader (EEO)  
Sven Kühn, PhD, Project Leader (EEO)  
Ilaria Liorni, PhD, Project Leader (EEO)  
Bryn Lloyd, PhD, Project Leader (EEO)  
Taylor Newton, PhD, Project Leader (EEO)  
Marisa M. Oliveira, PhD, Scientific Coordinator (EEO)  
Jacqueline C. Pieper, Finance & Administration (EEO)  
Jingtian Xi, PhD, Project Leader (EEO)

Alessandro Alaia, PhD, Research Computational Phantoms  
Alexandre Allexandre, DevOps Engineer  
Sylvain Anderegg, Senior Software Developer  
Stefan Benkler, PhD, Senior Software Engineer  
Kathrin Burckhardt, PhD, Project Leader  
Pedro Crespo-Valero, PhD, Senior Software Engineer

Paolo Crosetto, PhD, Senior Software Developer  
Kristian Cujia, PhD, Postdoc  
Manuel Guidon, PhD, Senior Software Engineer  
Cindy Karina, Electrical Engineer/RF Test Engineer  
Odei Maiz, Software Engineer  
Lucas Monnin, Software Engineer  
Andrei Neagu, Senior Software Engineer  
Ignacio Pascual, Software Developer  
Eduardo Valdés Cambero, PhD, Application Engineer  
Sung-Jun Yang, PhD, Postdoc  
Aiping Yao, PhD, MRI Implant Safety  
Katie Zhuang, PhD, Neuroscientist  
Fariba Karimi, PhD Student  
Hazael Montanaro Ochoa, PhD Student  
Redi Poni, PhD Student

Christian Baumgartner, Scientific Assistant  
Silvia Farcito, PhD, Scientific Assistant  
Katharina Honegger, PhD, Scientific Assistant  
Patricia L. Bounds, PhD, Scientific Writer  
Anja Burse, Photography, Art Director & Media Design  
Charlotte Roberts, Personal Assistant to the Director  
Mayuko Sasaki-Kuroiwa, Graphic Design  
Kevin Ceresa, Intern  
Joseph Tharayil, Intern

## External Advisors

Quirino Balzano, PhD, Prof., University of Maryland, US  
Andreas Christ, PhD, BR  
Charlie Götschi and Markus Müller, Untersee Composites, CH  
Tobias Oetiker, Oetiker+Partner, CH

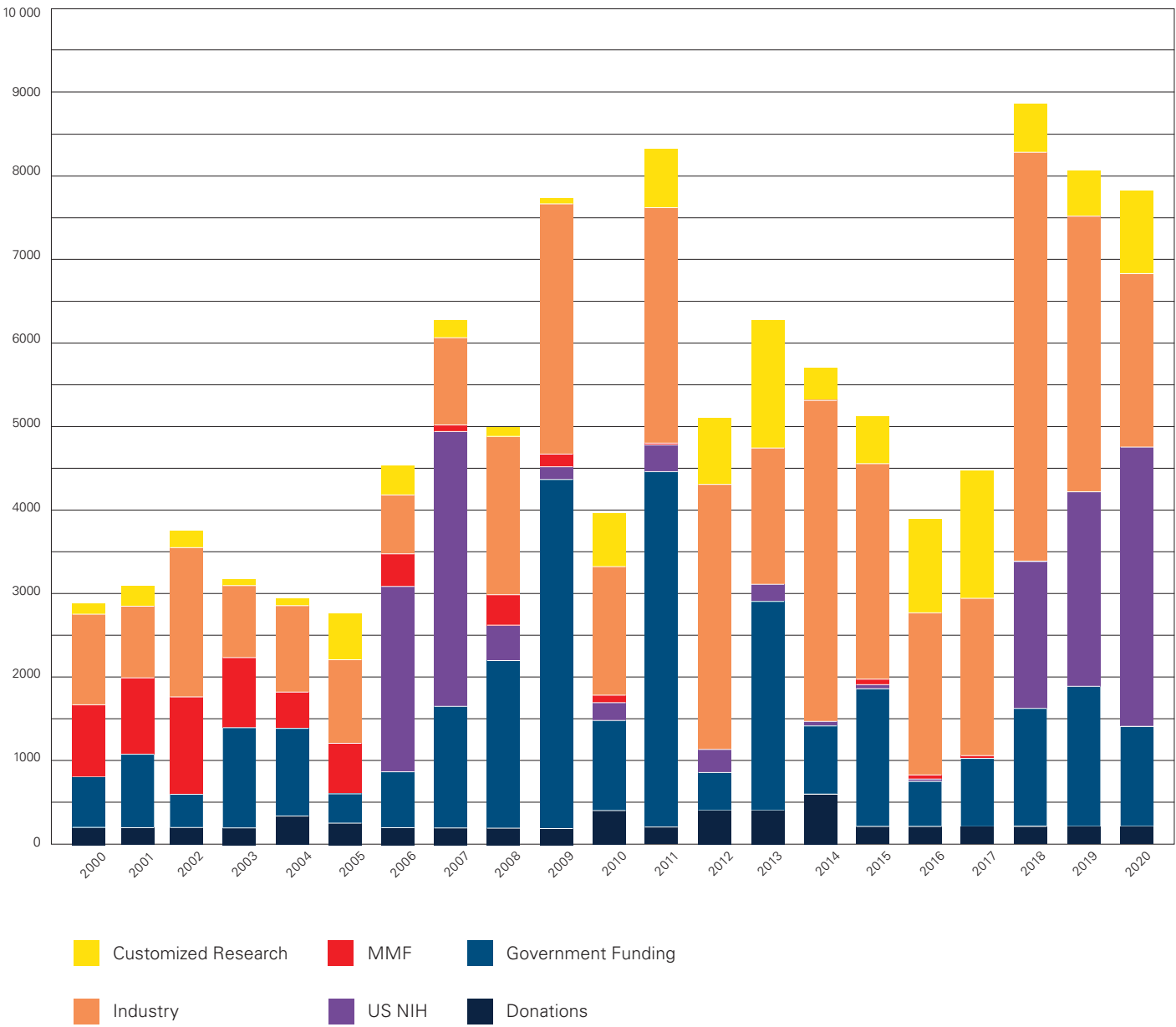
Sabine Regel, PhD, SR Scientific GmbH, CH  
Theodors Samaras, PhD, Prof., Aristotle University of Thessaloniki, GR  
Roger Yew-Siow Tay, PhD, SG

## Former Employees

Ross W. Adey, Michael Ammann, Veronica Berdiñas-Torres, Malika Bouterfas, Clémentine Boutry-Viellard, Michael Burkhardt, Barbara Bühlmann, Eugenia Cabot, Eduardo Carrasco Yopez, Vick Chen, Zhen Chen, Emilio Cherubini, Andreas Christ, Matthias Christen, Maria Christopoulou, Benedict da Silva, Guillermo del Castillo, Martin Dällenbach, Valerio De Santis, Fabienne Di Gennaro, Roxana Djafarzadeh, Valérie Dobler, Benjamin Drayer, Szami Dzsaber, Sven Ebert, Oliver Egger, Nicole Emmenegger, Sang Jin Eom, Francesca Dalia Faraci, José Fayos-Fernández, Mariana de Sá Ricca Manadelo Ferreira, Jane Fotheringham, Jürg Fröhlich, Peter Futter, Maximilian Fütterer, Luigi Ganzerla, Regula Gehrig, Siri Georjon, Livia Gerber, Joachim Goecke, Christian Goiceanu, Marie-Christine Gosselin, Yijian Gong, Elzbieta Gradauskatie, Jean-Claude Gröbli, Jonathan Gubler, Mona Hammad, Philippe Hasgall, Isabel Hilber, Eveline Huber, Ciprian Iacob, Dimce Iliev, Roger Jacot, Eva Jakubcaninova, Maria Jedensjö, Jari Jekkonen, Wolfgang Kainz, Ralph Kästle, Valentin Keller, Sinan Köksoy, Georg Klaus, Anja Klingeböck, Axel Kramer, Amit Kumar, Adamos Kyriakou, Chung-Huan Li, Marco Lichtsteiner, Tomasz Lisewski, Martin Loeser, Urs Lott, Irina Mahlstein, Klaus Meier, Rainer Mertens, Heidi Moser, Peter Müller, Ferenc Murányi, Manuel Murbach, Jagadish Nadakuduti, Neviana Nikoloski, Michael Oberle, Walter Oesch, Joanna Olszewska, Andrea Ott, Davnah Payne, Marcin Pastewski, David Perels, Sergey Perov, Serge Pfeifer, Katja Pokovic, Mavi Polatoglu, Lucas Portelli, Amie Rieseberg, Albert Romann, Salome Ryf, Darko Saik, Theodoros Samaras, Jonnahtan Saltarin, Valerio De Santis, Stefan Schild, Thomas Schmid, Frank Schönborn, Jürgen Schuderer, Eva Schumacher, Thomas Schwitter, Christos Serletis, Deepika Sharma, Denis Spät, Glen Stark, Tomasz Stefanski, Philipp Storchenegger, Mimi Sun, Magnus Sundberg, Iris Szankowski, Dominik Szczerba, Roger Yew-Siow Tay, Frederico Teixeira, David Trudel, Markus Tuor, Saskia Venema, Ioannis Vogiatzis Oikonomidis, Ondrej Voles, Michelle von Issendorff-Stubbs, Daniel Walser, Qiang Wang, Miriam Wanner, Martin Wälti, Andreas Wassmer, Marc Wegmüller, Ellis Whitehead, Aleksandra Winiarski, Philipp Wissmann, Johanna Wolf, Chenghao Yuan, Earl Zastrow, Marcel Zefferer, Oliver Zehnder, Gu Zong

# KEY FIGURES

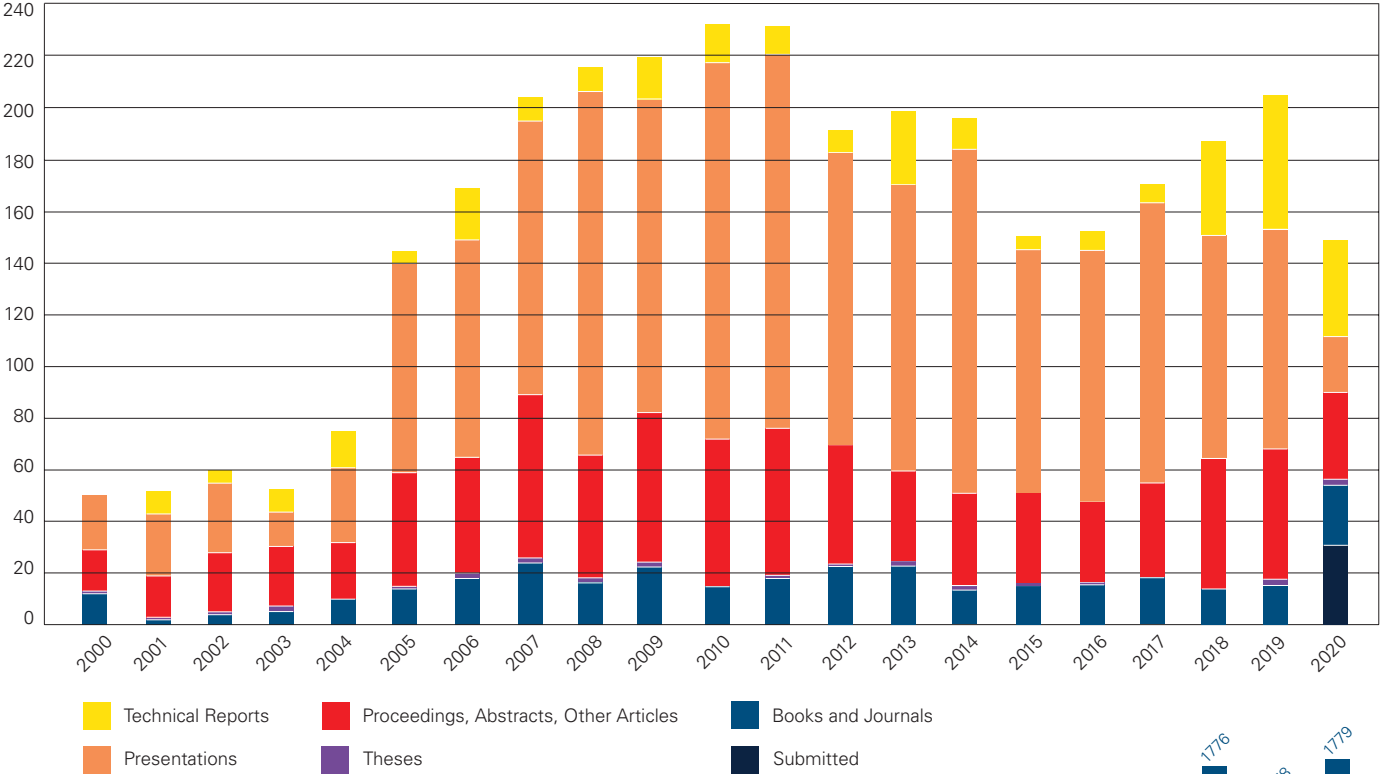
Level of Funding (in 1000 CHF)



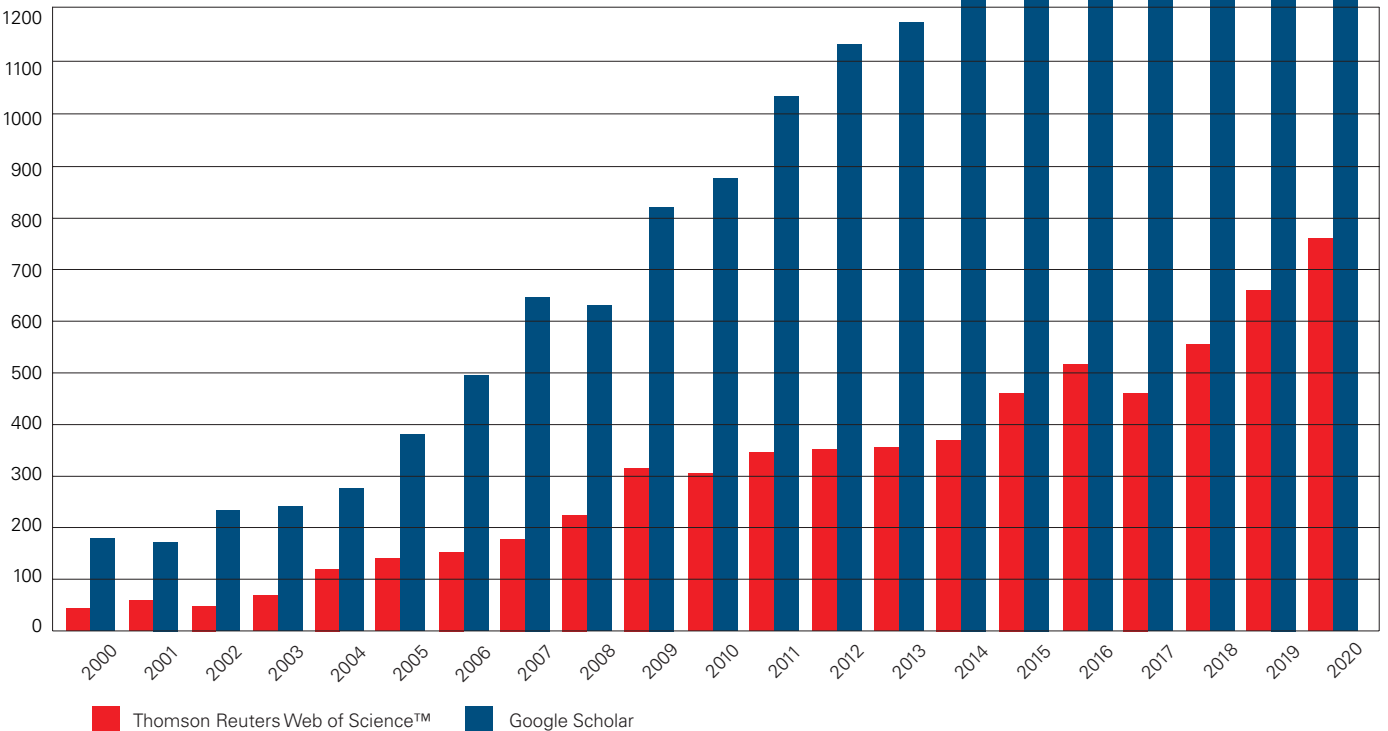


# KEY FIGURES

Number of Publications



Group Citation Index



The Citation Index is given by the number of citations per year. The compiled index represented in red is based on data available from the Thomson Reuters Web of Science™ database; the number of citations reported are from peer-reviewed publications and excludes self-citations. The index represented in blue is based on data available from Google Scholar.



# SELECTED SPONSORS SINCE 2000

## **Government Agencies**

5th–8th Framework Programmes of the European Union, BE  
Centre for Technology Assessment, CH  
EUREKA, BE  
EUROSTARS, BE  
Federal Office for the Environment, CH  
Federal Office of Communications, CH  
Federal Office of Energy, CH  
Federal Office of Public Health, CH  
Federal Institute for Occupational Safety and Health, DE  
Federal Office for Radiation Protection, DE  
French Agency for Food, Environmental and Occupational Health & Safety, FR  
French National Institute for Industrial Environment and Risks, FR  
National Institute of Environmental Health Sciences, US  
National Institutes of Health, US  
National Institute of Standards and Technology, US  
State Secretariat for Education, Research and Innovation, CH  
Swiss Innovation Promotion Agency (Innosuisse), CH  
Swiss National Science Foundation, CH  
The Netherlands Organisation for Health Research and Development, NL  
U.S. Food and Drug Administration, US

## **Non-Profit Organizations**

Bertarelli Foundation, CH  
Contact Group for Research Matters, CH  
École polytechnique fédérale de Lausanne, CH  
European Cooperation in Science and Technology, BE  
Foundation for Behaviour and Environment, DE  
FreeNovation Funding Program, Novartis Research Foundation, CH  
Health Canada, CA  
Imperial College London, UK  
Research Association for Radio Applications, DE  
Research Foundation for Electricity and Mobile Communication, CH  
Swiss Academy of Medical Sciences, CH  
Swiss Federal Institute of Technology Zurich, CH  
University of Zurich, CH

## **Multinational Corporations (MNC)**

Abbott (formerly St. Jude Medical Inc.), US  
AMI Semiconductor, CA  
Association of Radio Industries and Businesses, JP  
Arizona Chemical, US  
Biotronik, DE  
Boston Scientific Corporation, US  
Cisco Systems, US  
Clarins Laboratories, FR  
CTIA, US

Disney Research, US  
Dow Corning, BE  
Ericsson, SE  
GE Medical Systems, US  
GSM Association, CH  
Intel Corporation, US  
International Business Machines Corporation, US  
Dormakaba Schweiz AG, CH  
LG Electronics, KR  
LivaNova, US  
Micro Systems Engineering, Inc., US  
Mitsubishi Electric Corporation, JP  
Mobile & Wireless Forum, BE  
Motorola, US  
Nokia, FI  
Nokia Solutions and Networks, FI  
NTT DoCoMo, JP  
Panasonic Corporation, JP  
Philips, NL  
Phonak Communications AG, CH  
Qualcomm Inc., US  
RUAG, CH  
Sagem S.A., FR  
Samsung Electronics Co., Ltd., KR  
Sensirion AG, CH  
Siemens AG, DE  
Sony Ericsson, JP  
Sorin Group, FR  
Toshiba Medical Research Institute, US  
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Vodafone Group Plc., UK

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Cardiatis S.A., BE  
Clarity, US  
Felsenmeer AG, CH  
Healtis, FR  
Mainstay Medical, IE  
maxwave AG, CH  
MED-EL, AT  
Medartis, CH  
Medico S.p.A., IT  
Nevro Corporation, US  
Oticon Medical, FR  
Pharma Digital, CH  
Schmid & Partner Engineering AG, CH  
Sensimed AG, CH  
TI Solutions AG, CH  
VAT Group AG, CH  
ZMT Zurich MedTech AG, CH

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ETHZ – Swiss Federal Institute of Technology in Zurich\*, CH  
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University of Bern\*, CH  
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USI – Università della Svizzera Italiana\*, CH  
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Wyss Center for Bio and Neuroengineering, CH  
Zurich University of Applied Sciences\*, CH  
Austrian Institute of Technology, AT  
Medical University of Vienna, AT  
Tissue Dynamics Laboratory, Paracelsus Private Medical University, AT  
University of Vienna, AT  
University of Wollongong, AU  
INTEC, University of Ghent, BE  
Interdisciplinary Institute for BroadBand Technology, BE  
McGill University, CA  
University of Toronto, CA  
Beijing University of Technology, CN  
Third Military Medical University, CN  
Zhejiang University, CN  
Center of Radiation Medicine, Technical University of Berlin, DE  
Charité – University Hospital Berlin, DE  
Fraunhofer Institute for Microtechnology and Microsystems, DE  
Fraunhofer Institute of Toxicology and Experimental Medicine, DE  
Friedrich Schiller University of Jena, DE  
German Cancer Research Center, DE  
GSF – National Research Center for Environment and Health, DE  
IMTEK – Department of Microsystems Engineering, University of Freiburg, DE  
Institute for Mobile and Satellite Technology, University of Duisburg-Essen, DE  
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IPK – Leibniz Institute of Plant Genetics and Crop Plant Research, DE  
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Max Planck Institute for Neurological Research, DE  
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University of Freiburg, DE  
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Technical University of Denmark, DK  
University of Aarhus, DK  
Autonomous University of Madrid, ES  
Centre for Research in Environmental Epidemiology, ES  
Institute of Applied Physics, ES  
Institute of Cancer Molecular and Cellular Biology, University of Salamanca, ES  
Research Centre for Energy Resources and Consumption, ES  
Aalto University, FI  
Helsinki University of Technology, FI  
Hospital District of Helsinki and Uusimaa, FI  
Hospital District of Southwest Finland, FI  
University of Eastern Finland, FI  
University of Helsinki, FI  
Finnish Institute of Occupational Health, FI  
GeePS – Paris Electrical and Electronic Engineering Laboratory, FR  
Ecole Supérieure d'Electricité, FR  
Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment, FR  
National Competence Center for Industrial Safety and Environmental Protection, FR  
Registre National des Tumeurs Solides de l'Enfant, FR  
University of Bordeaux, FR  
University of Strasbourg, FR  
Aristotle University of Thessaloniki, GR  
National Technical University of Athens, GR  
Budapest University of Technology and Economics, HU  
National University of Ireland Galway, IE

Schneider Children's Medical Center of Israel, IL  
The Gertner Institute for Epidemiology and Health Policy Research, IL  
Weizmann Institute of Science, IL  
Indian Institute of Technology Kanpur, IN  
Center for Information Technology IRST, IT  
Institute of Biomedical Engineering, Polytechnic University of Milan, IT  
Polytechnic University of Turin, IT  
Rizzoli Orthopedic Institute, IT  
Scuola Superiore Sant'Anna, IT  
University of Bologna, IT  
University of Cassino and Southern Lazio, IT  
University of Salerno, IT  
University of Turin, IT  
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Gifu University, JP  
Hokkaido University, JP  
Tokyo Metropolitan University, JP  
University of Tokyo, JP  
Ajou University School of Medicine, KR  
Dongguk University, KR  
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Delft University of Technology, NL  
Erasmus MC – Daniel den Hoed Cancer Center, NL  
Erasmus University Rotterdam, NL  
Institute for Risk Assessment Sciences, Utrecht University, NL  
Physics and Electronics Laboratory, TNO, NL  
University Medical Center Utrecht, NL  
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Haukeland University Hospital, NO  
University of Bergen, NO  
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Karolinska Institute, SE  
Research Institutes of Sweden, SE  
SP Technical Research Institute of Sweden, SE  
Stress Research Institute, University of Stockholm, SE  
University of Uppsala, SE  
Institute of Nonionizing Radiation, SI  
Beatson Institute for Cancer Research, UK  
Hammersmith Hospital, UK  
Imperial College London, UK  
Keele University, UK  
King's College London, UK  
Oxford University, UK  
University College London, UK  
University of Cambridge, UK  
University of Leicester, UK  
University of York, UK  
Arkansas Children Hospital, US  
Center for Magnetic Resonance Research, University of Minnesota, US  
Focused Ultrasound Foundation, US  
Illinois Institute of Technology Research Institute, US  
Iowa State University, US  
Massachusetts Institute of Technology, US  
Roswell Park Cancer Institute, US  
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University of Colorado Boulder, US  
University of Houston, US  
University of Miami, US  
University of Pennsylvania, US  
University of Wisconsin–Madison, US  
Wake Forest University, US  
Washington University in St. Louis, US  
Wireless Research Center of North Carolina, US  
University of Maryland, US  
University of Minnesota, US

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Basel University Hospital, CH  
Cantonal Hospital Aarau, CH  
Children's Hospital Geneva, CH

Hirslanden Clinic Zurich, CH  
 Hospital Neuchâtelois – La Chaux-de-Fonds, CH  
 Lausanne University Hospital, CH  
 University Children's Hospital Basel, CH  
 University Children's Hospital Zurich, CH  
 University Hospital Bern, CH  
 University Hospital Geneva, CH  
 University Hospital Zurich, CH  
 Johns Hopkins Bayview Medical Center, US

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Federal Office for the Environment, CH  
 Federal Office of Communications, CH  
 Federal Office of Public Health, CH  
 State Secretariat for Economic Affairs, CH  
 Swiss Federal Office of Energy, CH  
 World Health Organization, CH  
 Communications Research Center, Industry Canada, CA  
 SITT, Industry Canada, CA  
 China Academy of Telecommunication Research, CN  
 State Radio Monitoring Center, Ministry of Information Industry, CN  
 Telecommunication Metrology Center, CN  
 Federal Office for Radiation Protection, DE  
 National Metrology Institute of Germany, DE  
 Danish Council for Strategic Research, DK  
 Spanish National Research Council, ES  
 Radiation and Nuclear Safety Authority, FI  
 International Agency for Research on Cancer, FR  
 Laboratoire National de Métrologie et d'Essais, FR  
 Italian National Agency for New Technologies, Energy and Sustainable  
 Economic Development, IT  
 National Institute of Metrological Research, IT  
 National Research Council, IT  
 Institute of Electronic, Information and Communication Engineers, JP  
 National Institute of Information and Communications Technologies, JP  
 Radio Research Agency, KR  
 Electronics and Telecommunication Research Institute, KR  
 Health Council of the Netherlands, NL  
 Dutch National Metrology Institute, NL  
 Norwegian Institute of Public Health, NO  
 Russian Academy of Medical Science, RU  
 Public Health England, UK  
 National Physical Laboratory, UK  
 Federal Communications Commission, US  
 National Institute of Environmental Health Sciences, US  
 National Institutes of Health, US  
 National Institute of Standards and Technology, US  
 U.S. Food and Drug Administration, US  
 South African Bureau of Standards, ZA

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 Disney Research, CH  
 Fachkommission für Hochspannungsfragen, CH  
 Geosatis, CH  
 Huber + Suhner AG, CH  
 IBM, CH  
 Kaba AG, CH  
 Logitech, CH  
 maxwave AG, CH  
 Medartis AG, CH  
 On Semiconductor, CH  
 Phonak Communications AG, CH  
 Research and Consulting Co. Ltd., CH  
 RUAG, CH  
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 FRONIUS International GmbH, AT  
 MED-EL, AT  
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 Dow Silicones Belgium SPRL, BE  
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 Draeger, DE  
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 Kathrein-Werke KG, DE  
 Pfisterer International AG, DE  
 Roche Diagnostics, DE  
 Siemens AG, DE  
 T-Mobile International AG, DE  
 TÜV SÜD Auto Service GmbH, DE  
 Nokia Research Center, FI  
 SYNOSTE, FI  
 Healtis, FR  
 Image Guided Therapy, FR  
 Orange S.A., FR  
 Oticon Medical, FR  
 Sorin CRM/LivaNova, FR  
 TESS, GR  
 Istituto Di Ricerche Biomediche "Antoine Marxer" S.p.A., IT  
 Milexia Group, IT  
 MEDICO S.p.A., IT  
 TILAB S.p.A., IT  
 Alnair Labs, JP  
 Association of Radio Industries and Businesses, JP  
 Mitsubishi, JP  
 NTT Communications, JP  
 NTT DoCoMo, JP  
 Takeda Pharmaceutical Company, JP  
 Toshiba, JP  
 Dymtec, KR  
 HCTM, KR  
 ONWARD Medical B.V., NL  
 Philips Medical Systems, NL  
 Salvia BioElectronics B.V., NL  
 Vratiss, PL  
 Ericsson Radio Systems AB, SE  
 Torptronics Engineering AG, SE  
 Volvo Car Corporation, SE  
 EMFields Solutions Ltd., UK  
 Galvani Bioelectronics, UK  
 IndexSAR, UK  
 MCL Technology Ltd., UK  
 Vodafone, UK  
 York EMC Services, UK  
 Abbott/St. Jude Medical Inc, US  
 AGC Automotive, US  
 AT&T, US  
 BrainsGate, US  
 Boston Scientific, US  
 CranioVation, US  
 CTIA, US  
 Exponent Inc., US  
 Flex, US/SG  
 GE Healthcare, US  
 Imricor Medical Systems, US  
 Intel Corp., US  
 Mainstay Medical, US  
 Micro Systems Engineering Inc., US  
 Microsoft, US  
 Motorola, US  
 MRI Interventions Inc., US  
 National Instruments, US  
 Nevro Corporation, US  
 Qualcomm, US  
 SeboTek Hearing Systems, US  
 Synopsis Inc., US

\* For more information about individual departments, please consult  
<https://www.itis.swiss/who-we-are/partners/>

# CURRENT PROJECTS

## EM Technology

Dielectric Spectroscopy	Development of novel methodologies for characterization of materials from DC to >100 GHz
Module APD	Module for exposure assessment of the absorbed power density of millimeter wave wireless devices
TD SENSOR	Development of time-domain near-field field sensor technology
SNF SPARK	Relativistic particle trapping for compact coherent X-ray sources
WPT	Development of test equipment and software to show compliance with electromagnetic (EM) safety guidelines of wireless power transfer (WPT) systems
WPT4FOIL	Preventing chronic migraine with a novel wirelessly powered implantable bioelectronic foil

## EM Exposure and Risk Assessment

MICEV	Development of metrology techniques to advance inductive power transfer for charging electric vehicles
MIMAS	Development of anatomical models, computational tools, and methodology to facilitate the safety assessment of metallic implants during magnetic resonance imaging (MRI) scanning
RADIODEP	Effects of radiofrequency (5G) in healthy and depressive subjects: behavioral and neurobiological approaches of EM hypersensitivity in the rat
sXc, sXv, sXh	Development of optimized exposure systems for bio-experiments from static to >100 GHz including the systems for NIEHS <i>in vivo</i> follow-up studies

## IT'IS for Health

CLS – ART-REWARD	Artificial regulation of reward processing via non-invasive deep brain stimulation
CLS – CRANIO	Modelling of craniospinal compliance in humans to advance the understanding of dynamic compliance and its pathophysiological basis
CLS – DEEP-MCI-T	Development of a novel approach, based on temporal interference stimulation, aimed at deep non-invasive brain stimulation to enhance cognitive function in mild cognitive impairment and traumatic brain injury
CLS – FUS	Advances in transcranial focused ultrasound (FUS), including SonoKnife and investigation of liver motion during FUS interventions
CLS – NeuHeart	Development of a neuroprosthesis to restore the vagal-cardiac closed-loop connection after heart transplantation
CLS – o <sup>2</sup> S <sup>2</sup> PARC	Establishment of an interactive, freely accessible online platform for simulating peripheral nervous system neuromodulation/stimulation
CLS – PREP2GO	Development of a pre-operative planning system for neuromodulation surgery for spinal cord injury rehabilitation
CLS – RISE	Implementation of a protocol for reaching deep structures by non-invasive brain stimulation to modulate striatum-based learning
CLS – V&V40	Development of novel concepts for verification and validation of computational life science software platforms and their applications
HT-KSA/UHZ/ETHZ	Development of novel hyperthermia hardware and treatment planning software for human applications
MRI – Implant Safety	Improved procedures and instrumentation for MRI safety evaluation of medical implants
REPLICATIONS	Co-funding of confirmation studies of bioelectromagnetic experiments
STANDARDIZATION	Participation in regulatory activities (standards committees and governments)
ViP 4.x	Development of the next generation of high-resolution anatomical models
ViP – NEUROMAN	Functionalized anatomical models for studying EM-neuronal dynamic interactions
ViP-P/VM/M	Development of novel posers, of methodology for enhanced volume meshes of anatomical structures, and of a physically-based morphing tool

# EMERGENCE OF A NEW COMPUTATIONAL SIMULATION PLATFORM

Over the years, we have successfully demonstrated that physical and physiological processes within complex anatomies can be simulated with high levels of detail, realism, and reliability. Our research in numerical mathematics, image-based modeling, anatomical phantom creation and functionalization with dynamic tissue models, high-performance computing (HPC) solvers, uncertainty assessment, and quality assurance formed the basis for the development of two platforms: Sim4Life for computational life sciences and SEMCAD X for computational electromagnetics.

Now, we are pushing the boundaries towards a fundamental change in computational modeling by developing the open, extensible, online-accessible, cloud-based collaborative simulation platform  $\alpha^2S^2$ PARC to replace desktop-computer-based solutions.  $\alpha^2S^2$ PARC has been initiated as part of the NIH SPARC Program<sup>1</sup> to host and integrate all computational modeling/analysis program results in a reproducible and sustainable manner.

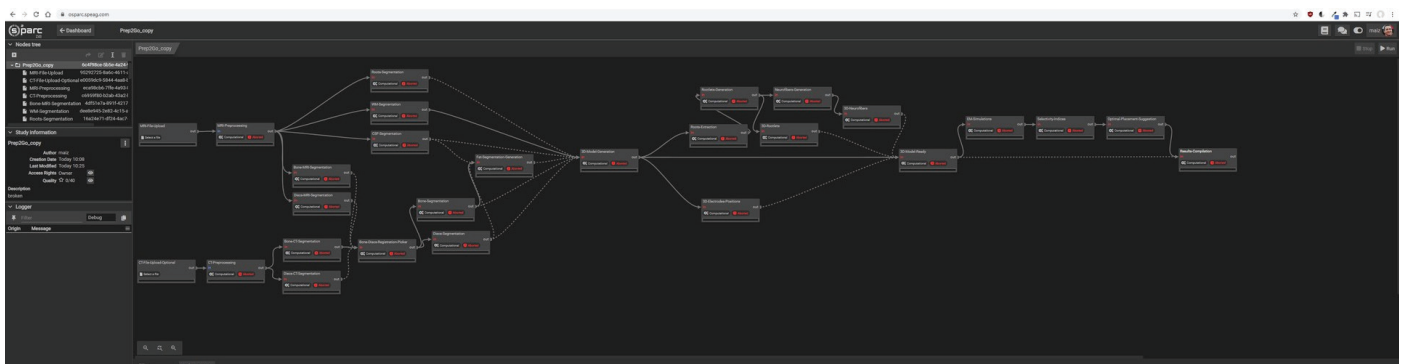
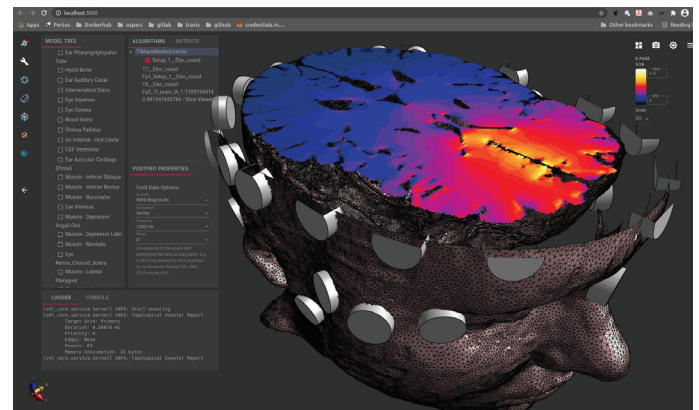
The platform offers already today (i) an infrastructure that allows users to integrate and share their own tools and workflows as modules with a common user-friendly interface and to pipeline/couple them with other modules, (ii) fundamental functionalities – such as anatomical models physiologically functionalized according to a multi-scale scaffold concept that integrates measurement and imaging data with computational models from the micro- to the whole-body level – and robust HPC-enabled physics and physiology solvers as well as (iii) a wide variety of specific models ranging from machine learning to cardio-physiological control and the patient-specific assessment of spinal-cord stimulation for the restoration of locomotion and bladder control in paraplegics. Currently, the platform

is being extended with the *Guided Mode* feature for easy implementation of treatment planning tools, i.e., the transformation of expert workflows into wizard-like, step-by-step, and stand-alone applications with minimal interaction requirements for a broad audience.

Most importantly, complex simulations computed on scalable cloud resources can be created, modified and executed through a browser-based graphical user interface with the same responsiveness and ease-of-use as a native desktop application, but without the need to locally establish custom infrastructures.

Our vision is to transform the platform beyond computational neuroscience and to extend it in collaboration with the modeling community to find solutions for the many new challenges to come.

<sup>1</sup> The SPARC Program funds groundbreaking research to understand and exploit the role of the autonomic nervous system in regulating organ function to treat a wide range of diseases and malfunctions through neuro-modulation (electroceuticals).





# INFRASTRUCTURE

## Dosimetric, Near-Field, and EMC/EMI Facilities

### *Semi-Anechoic Chamber*

This shielded, rectangular chamber has the dimensions  $7 \times 5 \times 2.9$  m (L  $\times$  W  $\times$  H). It is equipped with a reflecting ground plane floor, and half of its walls are covered with EM absorbers. The chamber contains an integrated DASY52NEO system and can be utilized for all research activities involving dosimetric, near-field and far-field evaluations, the optimization and synthesis of handheld devices, body-mounted transmitters, implants, desktop applications, microcell and picocell base station antennas, exposure setups, calibration procedures, EMI tests, MRI safety tests, compliance testing of implants, etc.

### *Two Reverberation Chambers*

The Blue and NIEHS reverberation chambers have the dimensions  $4 \times 3 \times 2.9$  m and  $3.7 \times 2.2 \times 2.7$  m (L  $\times$  W  $\times$  H), respectively. Both chambers are equipped with two mechanical stirrers and provide controlled and consistent environments for EM emissions and immunity testing, as well as shielding effectiveness and susceptibility testing of EM equipment.

### *Facility for Dosimetric Compliance Testing*

IT<sup>2</sup>IS shares with Schmid & Partner Engineering AG a facility that meets the requirements for dosimetric evaluations. The documentation of Class C accreditation has been completed.

## Technical Equipment and Instrumentation

### *Spectrum and Network Analyzers*

- 1 HP 8753E Network Analyzer, 30 kHz–6 GHz
- 1 HP APC 85033B Calibration Kit
- 1 Rohde & Schwarz FSP Spectrum Analyzer, 9 kHz–30 GHz
- 1 Rohde & Schwarz ZVA24 Vector Network Analyzer, 10 MHz–24 GHz
- 1 Rohde & Schwarz ZVA50 Vector Network Analyzer, 10 MHz–50 GHz
- 1 Rohde & Schwarz ZV-Z52 Calibration Kit
- 1 Copper Mountain R60 Vector Reflectometer
- 1 Keysight E5061B Vector Network Analyzer, 5 Hz–1.5 GHz

### *Signal Generators and Testers*

- 3 Agilent 33120A, Waveform Generators
- 1 Agilent 33250A, Waveform Generator
- 1 Agilent E8251A Signal Generator, 250 KHz–20 GHz
- 3 Anritsu 3700A
- 2 Anritsu MG3700A
- 1 HP 8647A, Signal Generator 250 KHz–1000 MHz
- 1 Rohde & Schwarz CMU200
- 1 Rohde & Schwarz CMW500
- 1 Rohde & Schwarz CTS55, Digital Radio Tester
- 1 Rohde & Schwarz SMIQ02B, Signal Generator
- 2 Rohde & Schwarz SML02, Signal Generators
- 1 Rohde & Schwarz SML03, Signal Generator
- 1 Rohde & Schwarz SMT06, Signal Generator
- 1 Rohde & Schwarz SMU200A, Signal Generator
- 1 Rohde & Schwarz SMY02, Signal Generator

### *DASY, cSAR3D, DAE, EASY4MRI, MITS, PiX, Phantoms, Resonators*

- 1 INDY (3 year old child head) Phantom
- 1 ISABELLA (6 year old child head) Phantom
- 1 SPEAG ASTM Phantom
- 2 SPEAG DAE4, Data Acquisition Electronics
- 1 SPEAG DAE4A, Data Acquisition Electronics
- 2 SPEAG DAE4ip, Data Acquisition Electronics
- 4 SPEAG EASY6 DAE, Data Acquisition Electronics
- 4 SPEAG DAEasy4MRI, Data Acquisition Electronics
- 2 SPEAG DASY52 NEOs
- 1 SPEAG EASY4MRI
- 1 SPEAG EASY6
- 2 SPEAG ELI4 Phantoms
- 1 SPEAG HAC RF Extension
- 1 SPEAG HAC T-Coil Extension
- 5 SPEAG cSAR3D (2 Flat, 1 Left Head, 1 Right Head, and 1 Quad)
- 1 SPEAG SAM V6.0 Phantom
- 1 ZMT MITS 1.5 with ELIT Phantoms
- 1 ZMT MITS 3.0 with ELIT Phantoms
- 2 ZMT Dual Cylinder Phantoms
- 1 ZMT MITS Gradient v1
- 1 ZMT MITS Gradient v2
- 1 ZMT PiXE64
- 1 ZMT MITS-HFR1.5
- 1 ZMT MITS-HFR3.0
- 3 SPEAG SHO V2 RB, RC, and RP OTA Hand Phantoms
- 1 SPEAG ICEy-EMC and -mmW

### *Probes*

- 1 METROLAB THM 1176, Magnetic Field Sensor
- 1 SPEAG AMIDV2, Audio Magnetic Field Probe
- 1 SPEAG AMIDV3, Audio Magnetic Field Probe
- 5 SPEAG T1V3LAB, Temperature Probes
- 1 SPEAG T1V4LAB, Temperature Probes
- 2 SPEAG T1V3, Temperature Probes
- 1 SPEAG EE3DV1, E-Field Probes
- 1 SPEAG EF3DV3, E-Field Probe
- 1 SPEAG EL3DV2, E-Field Probe for WPT
- 2 SPEAG ER3DV6, E-Field Probes
- 1 SPEAG ES3DV2, E-Field Probe
- 1 SPEAG ET1DV4, Dosimetric Probe
- 2 SPEAG ET3DV6, Dosimetric Probes
- 1 SPEAG EU2DV2, Dosimetric Probe
- 1 SPEAG EUmmW E-Field Probe
- 1 SPEAG EX3DV3, Dosimetric Probe
- 4 SPEAG EX3DV4, Dosimetric Probes
- 3 SPEAG H1TDSx, H-Field Time Domain Sensor and Remote Units
- 2 SPEAG E1TDSz, E-Field Time Domain Sensor and Remote Unit
- 1 SPEAG 1RU1PXI TDS Remote Unit
- 1 SPEAG H1TDSx-ICEy H-field Time Domain Sensor
- 1 SPEAG H1TDSz-ICEy H-field Time Domain Sensor
- 1 SPEAG E1TDSx-ICEy E-field Time Domain Sensor
- 1 SPEAG E1TDSz-ICEy E-field Time Domain Sensor
- 4 SPEAG H3DV6, H-Field Probes
- 3 SPEAG H3DV7, H-Field Probes
- 1 SPEAG HL3DV2, H-Field Probe for WPT
- 1 SPEAG HU2DV1, H-Field Probe
- 1 SPEAG DAK Kit 12/3.5/1.2E
- 1 SPEAG DAKS-12 Probe
- 8 SPEAG RfOF1P4MED Probes and 1 Remote Unit
- 1 Greisinger GMH 5430 Conductivity Meter

### *Antennas*

- 1 SPEAG D835, Validation Dipole
- 1 SPEAG D900, Validation Dipole
- 1 SPEAG D1640, Validation Dipole
- 1 SPEAG D1800, Validation Dipole
- 1 SPEAG D1900, Validation Dipole
- 1 SPEAG D3500, Validation Dipole
- 1 SPEAG D5GHz, Validation Dipole
- 1 SPEAG CD835V3, Validation Dipole
- 1 SPEAG CD1880V3, Validation Dipole
- 1 SPEAG CD2450V3, Validation Dipole
- 2 SPEAG PiXitor 64 MHz
- 1 Log-Periodic Antenna (650–4000 MHz)
- 2 Generic Phones (835/1900 MHz)
- 3 SPEAG HAC Dipoles

### *Meters*

- 3 Agilent 34970A Data Acquisition Units
- 2 Agilent E4419B, 4 HP 8482A, Power Meters
- 1 Handyscope HS3 Data Acquisition Unit
- 1 Handyscope HS4 Data Acquisition Unit
- 3 HP 436A, 3 HP 8481A, Power Meters
- 1 Magnet Physik FH49–7030, Gauss/Teslameter
- 2 Rohde & Schwarz NRP2 Power Meters

### *Amplifiers*

- 1 Amplifier Research 10S1G4A, Amplifier, 800 MHz–4.2 GHz
- 1 Kalmus 717FC RF Power Controller, 200–1000 MHz
- 6 LS Elektronik 24xx Amplifiers
- 8 Mini-Circuits Amplifiers, ZHL42, 700–4200 MHz
- 2 Mini Circuits Amplifiers, ZVE-8G, 2–8 GHz
- 1 Nucletrudes ALP336 Amplifier, 1.5–2.5 GHz
- 2 Ophir 5141, 700 MHz–3 GHz

### *Other Equipment*

- 8 Maury 1878B, 3-Step Tuners
- 1 Narda EHP-50 EM Field Probe Analyzer, 5 Hz–100 KHz
- 1 Narda ELT-400 Magnetic Field Probe, 1 Hz–400 KHz
- 1 Siemens Universale Messleitung, (0.5) 1–13 GHz
- 2 SPEAG Dipoles SCC34 Benchmark
- 1 Thermoconcept THW L2 Thermal Conductivity Meter
- 1 RfOF4MED-CU Calibration Unit
- 2 OPUS 20 THI Humidity and Temperature Monitors

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## *History*

The IT<sup>IS</sup> Foundation was established in 1999 through the initiative and support of the Swiss Federal Institute of Technology (ETH) Zurich, the global wireless communications industry, and several government agencies. IT<sup>IS</sup> stands for "Information Technologies in Society".

## *Legal status*

The IT<sup>IS</sup> Foundation is a non-profit tax-exempt research foundation.

## *Mission*

The IT<sup>IS</sup> Foundation is dedicated to expanding the scientific basis of the safe and beneficial application of electromagnetic energy in health and information technologies.

The IT<sup>IS</sup> Foundation is committed to improving and advancing precision medicine and the quality of life of people with disabilities, in particular, through innovative research.

The IT<sup>IS</sup> Foundation is an independent research institute.

The IT<sup>IS</sup> Foundation provides a proactive, creative, and innovative research environment for the cultivation of sound science and research, and education.

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