IT'IS FOUNDATION 2023

Cover: Induced electric field distribution of the 30 GHz cavity-fed dipole array at 1 mm from the phantom surface in the skin simulating liquid measured with the novel DASY8 Module APD V1.0β.

2023 – A YEAR OF CHALLENGES AND SUCCESSES

In 2023, we persistently pushed the boundaries of technology across our three primary fields of research: electromagnetics, computational life sciences (CLS), and temporal interference (TI). In spite of the unforeseen challenges we encountered – challenges that tested our resources and delayed the completion of projects – we forged ahead with determination, and our accomplishments were, overall, remarkable.

In electromagnetics, Z43 partner SPEAG was able to release the world's first absorbed power density (APD) assessment system for compliance testing of body worn millimeter wave (mm-wave) devices (see pages 12–13). We were also able to install the SEAWave mm-wave exposure systems for human provocation and animal studies, which are being used in the first systematic studies to evaluate potential risks of 5G mm-wave exposures.

In Spring 2023, we successfully launched S4L^{lite}, the free student version of our Sim4Life computational platform and the first one that runs natively in the cloud. The launch was made possible thanks to the technologies developed within our o^{2}S^{2}PARC open-source, cloud-based platform for the development, execution, and sharing of computational models, simulations, and data analysis pipelines, and the presentation of results. Although the release of the full Sim4Life web version had unfortunately to be postponed until early 2024, we have in the meantime started new activities in the areas of complex neuronal networks and metamodeling. Our robust expansion into the neuro-sciences will hopefully intensify our future scientific impact in the domains of medicine, bioelectronics and neuro-prosthetics, innovative neurostimulation paradigms, and personalized modeling and treatment planning.

Our TI activities – encompassing basic and applied research, as well as hardware and software engineering and the support of research groups via the Early Adopter Program (EAP) of Z43 partner TI Solutions AG – expanded significantly throughout 2023. We initiated the patent process for a novel TI stimulation method based on phase modulation and developed high- and low-pass filters to enable application of TI stimulation simultaneously with electroencephalography (EEG) recording, thereby unlocking new avenues for closed-loop stimulation protocols. The achievement of personalized TI planning became feasible through our success in leveraging artificial intelligence (AI) for automated segmentation of 30 different head tissues. Furthermore, the publication of two papers in Nature Neuroscience (see page 15) marked important milestones, demonstrating the first-ever use of TI stimulation to modulate target deep brain structures in humans to influence memory and motor learning.

All of these successes were possible only because of the passion, dedication, and dynamism of all IT'IS researchers, students, and external advisors (see page 5) and the invaluable guidance of our Board Members (see page 4). We are grateful to Professor Alex Dommann for taking over the presidency during this period of expansion, and to Professor Stephan Bodis, his predecessor, for guiding us through our diversification into the medical sciences. Our gratitude also goes to Professors Qiuting Huang, Mathieu Luisier, Lukas Novotny, and Klaas Prüssman for their support with infrastructure sharing and for their advice to our students and researchers. Additionally, the clinical expertise of Professors Beatrice Beck Schimmer, Stephan Bodis, and Alvaro Pascual-Leone, and the advice and support of Professors Peter Achermann, Quirino Balzano, and Primo Schär have been crucial to our progress.

Our fruitful collaborations with partner institutions (see pages 8–9) draw on a rich, diverse reservoir of scientific expertise that ensures insightful results for sustained innovation and advancement. Equally important is the long-term commitment of our Z43 partners to sponsor basic research, and the support of funding agencies such as Innosuisse, the Swiss National Science Foundation, Horizon EUROPE, the U.S. National Institutes of Health, and numerous sponsors and donors (page 10) is instrumental. This support enables us to pursue our passion and excel in our endeavors to fulfil our mission:

Transforming the Future through Research.

Prof. Niels Kuster

BOARD MEMBERS

Lifetime Honorary President
Prof. em. Dr. Ralf Hütter, ETH Zurich, CH
Prof. em. Dr. Peter Niederer, ETH Zurich, CH

Lifetime Honorary Member
Prof. em. Dr. Wolfgang Fichtner, ETH Zurich, CH

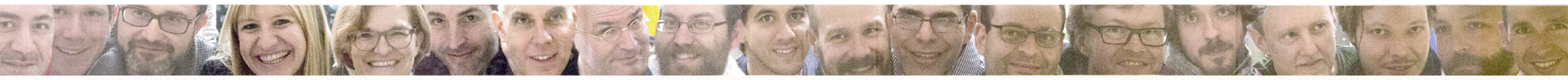
President
Prof. em. Dr. Alex Dommann, University of Bern, CH

Vice Presidents
Prof. em. Dr. Peter Achermann, University of Zurich, CH
Prof. em. Dr. Qiuting Huang, ETH Zurich, CH

Members
Prof. Dr. Quirino Balzano, University of Maryland, US
Prof. Dr. Beatrice Beck Schimmer, University of Zurich, CH
Prof. em. MD Stephan Bodis, University Hospital Zurich and
Cantonal Hospital Aarau, CH (IT'IS President, December 2020 – June 2023)
Prof. em. Dr. Niels Kuster, IT'IS Foundation, CH
Prof. Dr. Mathieu Luisier, ETH Zurich, CH
Prof. Dr. Lukas Novotny, ETH Zurich, CH
Prof. Dr. Alvaro Pascual-Leone, Harvard Medical School, US
Prof. Dr. Klaas Prüssmann, ETH Zurich, CH
Prof. Dr. Primo Schär, University of Basel, CH

Former Board Members
Prof. em. Dr. Alexander Borbély, former Vice President, University of Zurich, CH (1999 – 2005)
Dr. Michael Burkhardt, formerly Sunrise Communications AG, CH (1999 – 2005)
Dr. Christophe Grangeat, Alcatel, FR (1999 – 2002)
Prof. em. Dr. med. Paul Kleihues, University Hospital Zurich, CH (2007 – 2008)
Prof. em. Dr. Albert Kündig, ETH Zurich, CH (1999 – 2007)
Michael Milligan, Mobile & Wireless Forum, BE (1999 – 2010)
Dr. Mirjana Moser, formerly Federal Office of Public Health, CH (1999 – 2020)
Prof. em. Dr. Toshio Nojima, Hokkaido University, JP (2002 – 2015)
Prof. em. Dr. Masao Taki, Tokyo Metropolitan University, JP (1999 – 2002)
Dr. Christer Törnevik, Ericsson, SE (1999 –2005)
Prof. em. Dr. Heinrich Walt, University Hospital Zurich, CH (2009 – 2020)

OUR TEAM



Niels Kuster, PhD, Prof., Director
Myles H. Capstick, PhD, Associate Director
Esra Neufeld, PhD, Associate Director

Isaac Alonso Marin, Project Leader (EEO)
Stefan Beerli, Project Leader (EEO)
Lena Bostnavaron-Kranold, PhD, Project Leader (EEO)
Antonino M. Cassarà, PhD, Project Leader (EEO)
Nicolas Chavannes, PhD, Project Leader (EEO)
Mark G. Douglas, PhD, Project Leader (EEO)
Tolga Goren, PhD, Project Leader (EEO)
Sina Hashemi Zadeh, PhD, Project Leader (EEO)
Ioannis Koufogiannis, PhD, Project Leader (EEO)
Sven Kühn, 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)
Werner Van Geit, Project Leader (EEO)
Jingtian Xi, PhD, Project Leader (EEO)
Maksym Yushchenko, PhD, Project Leader (EEO)

Ercole Matteo Amadei, PhD, Researcher
Alexandre Allexandre, DevOps Engineer
Sylvain Anderegg, Senior Software Developer
Stefan Benkler, PhD, Senior Software Engineer
Mads Rystock Bisgaard, PhD, Senior Software Engineer
Cédric Bujard, PhD, Senior Software Engineer
Pedro Crespo-Valero, PhD, Senior Software Engineer
Paolo Crosetto, PhD, Senior Software Developer
Kristian Cujia, PhD, Postdoctoral Researcher
Matus Drobuliak, Software Engineer
AmirAli Farokhniaee, PhD, Postdoctoral Researcher
Carina Fuss, Application Engineer

Manuel Guidon, PhD, Senior Software Engineer
Yury Hrytsuk, Software Engineer
Elisabetta Iavarone, PhD, Support and Application Engineer
Dustin Kaiser, PhD, DevOps / Backend Software Engineer
Joel Macht, Software Engineer
Odei Maiz, Software Engineer
Lucas Monnin, Software Engineer
Andrei Neagu, Senior Software Engineer
Ignacio Pascual, Software Developer
Melanie Steiner, Software Engineer, AI / ML Specialist
Riccardo Uslenghi, Software Engineer / Computational Scientist
Shihao Wu, Software Developer

Pablo Benlloch Garcia, PhD Student
Brahim Ben Hamouda, PhD Student
Ninad Chitnis, PhD Student
Alessandro Fasse, PhD Student
Fariba Karimi, PhD Student
Cindy Karina, PhD Student
Lucia Moya Sans, PhD Student

Christian Baumgartner, Scientific Assistant
Paraskevi Chrysopoulidou, Scientific Assistant
Silvia Farcito, PhD, Scientific Assistant
Rael Kalda, Scientific Assistant

Patricia L. Bounds, PhD, Scientific Writer
Anja Burse, Photography, Art Director & Media Design
Anastasia Liaskou, Visual Marketing Specialist
Charlotte Roberts, Personal Assistant to the Director
Mayuko Sasaki-Kuroiwa, Graphic Design

Merle Backmeyer, Intern
Michelle Fang, Visiting Researcher
Robin Wydaeghe, Visiting PhD Student

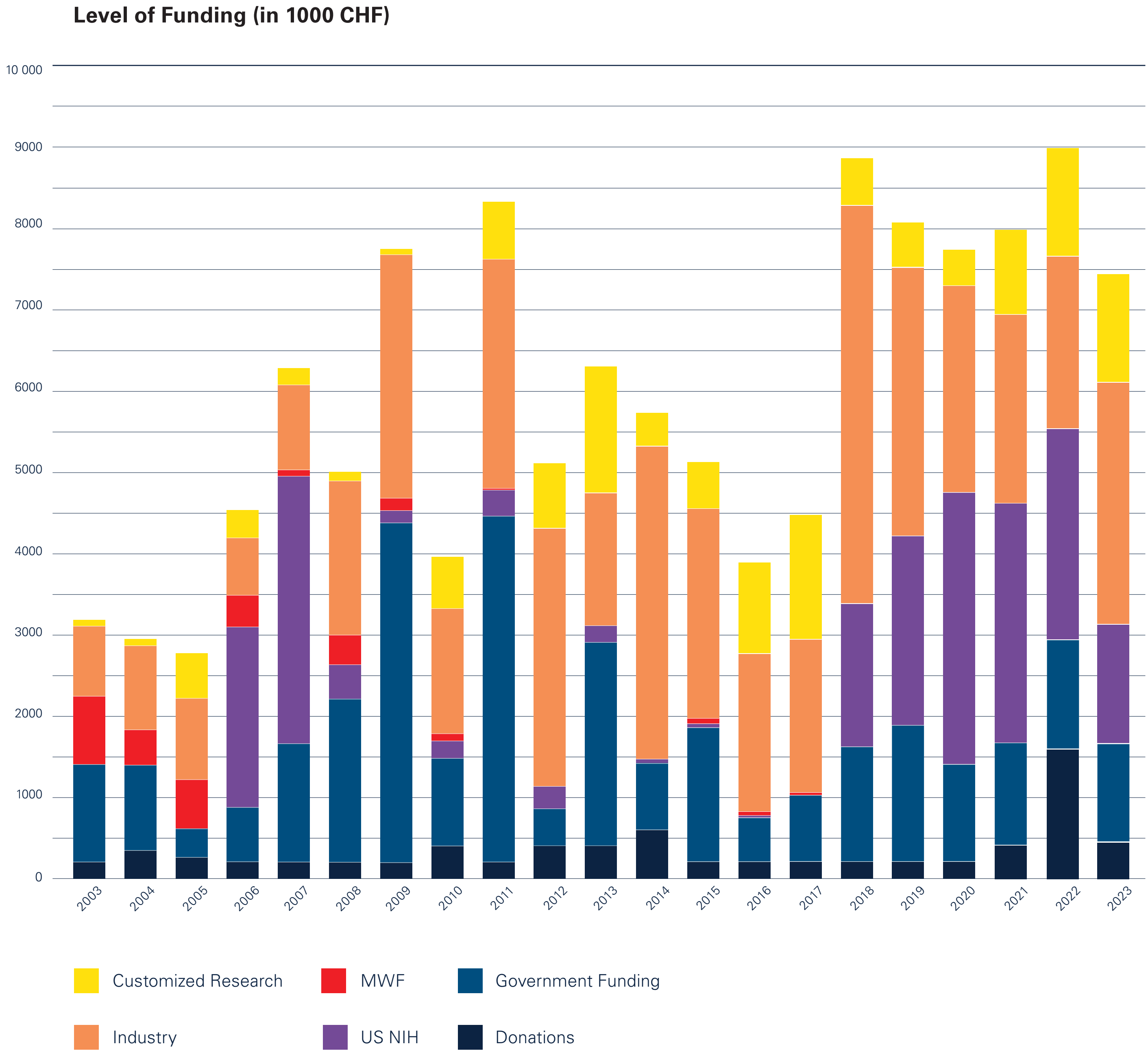
External Advisors

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
Theodoros Samaras, PhD, Prof., Aristotle University of Thessaloniki, GR
Roger Yew-Siow Tay, PhD, SG

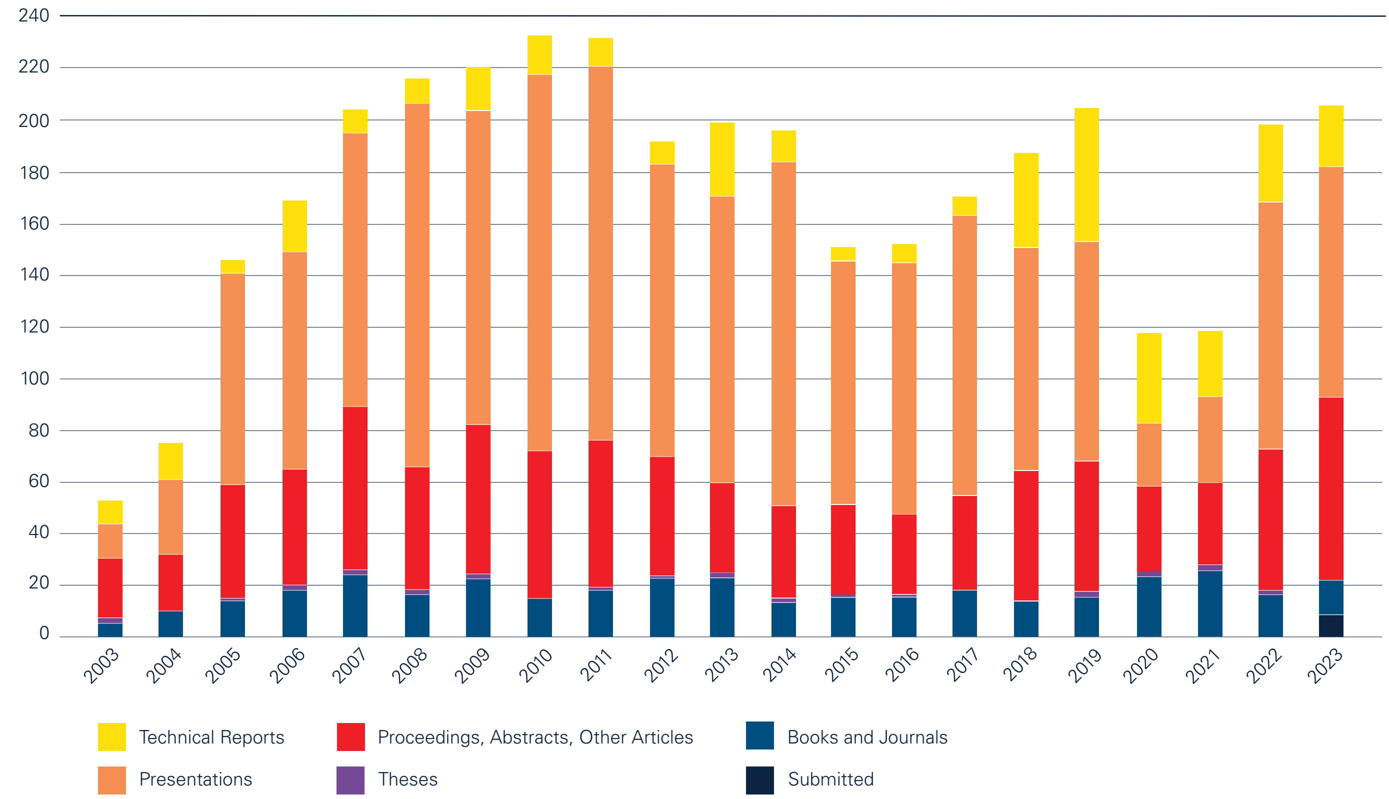
Former Employees and Advisors

Ross W. Adey, Alessandro Alaia, Michael Ammann, Niklas Bachmaier, Veronica Berdiñas-Torres, Malika Bouterfas, Clémentine Boutry-Viellard, Barbara Bühlmann, Kathrin Burckhardt, Michael Burkhardt, Jil Bürki, Eugenia Cabot, Eduardo Carrasco Yepez, Kevin Ceresa, Vick Chen, Zhen Chen, Emilio Cherubini, Dahye Choi, Andreas Christ, Matthias Christen, Maria Christopoulou, Martin Dällenbach, Benedict da Silva, Guillermo del Castillo, Valerio de Santis, Mariana de Sá Ricca Manadelo Ferreira, Fabienne Di Gennaro, Roxana Djafarzadeh, Valérie Dobler, Benjamin Drayer, Szami Dzsaber, Sven Ebert, Oliver Egger, Nicole Emmenegger, Sang Jin Eom, Arya Fallahi, Francesca Dalia Faraci, José Fayos-Fernández, Jane Fotheringham, Jürg Fröhlich, Thomas Fussinger, 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, Katharina Honegger, Eveline Huber, Ciprian Iacob, Dimce Iliev, Roger Jacot, Eva Jakubcaninova, Maria Jedensjö, Jari Jekkonen, Wolfgang Kainz, Ralph Kästle, Thomas Hinano Keller, Valentin Keller, Georg Klaus, Anja Klingenböck, Sinan Köksoy, Axel Kramer, Amit Kumar, Adamos Kyriakou, Chung-Huan Li, Marco Lichtsteiner, Ilaria Liorni, Tomasz Lisewski, Martin Loeser, Urs Lott, Irina Mahlstein, Klaus Meier, Rainer Mertens, Hazael Montanaro Ochoa, Heidi Moser, Peter Müller, Ferenc Murányi, Manuel Murbach, Jagadish Nadakuduti, Neviana Nikoloski, Michael Oberle, Walter Oesch, Joanna Olszewska, Andrea Ott, Marcin Pastewski, Davnah Payne, David Perels, Sergey Perov, Serge Pfeifer, Redi Poni, Katja Poković, Mavi Polatoglu, Lucas Portelli, Amie Rieseberg, Albert Romann, Salome Ryf, Darko Saik, Theodoros Samaras, Jonnahtan Saltarin, Stefan Schild, Thomas Schmid, Frank Schönborn, Jürgen Schuderer, Eva Schumacher, Thomas Schwitter, Christos Serletis, Deepika Sharma, Denis Spät, Glen Stark, Tomasz Stefanski, Philipp Storchenegger, Michelle Stubbs, Mimi Sun, Magnus Sundberg, Iris Szankowski, Dominik Szczerba, Roger Yew-Siow Tay, Frederico Teixeira, Joseph Tharayil, David Trudel, Markus Tuor, Eduardo Vicente Valdés Cambero, Saskia Venema, Ioannis Vogiatzis Oikonomidis, Ondrej Voles, Daniel Walser, Martin Wälti, Qiang Wang, Miriam Wanner, Andreas Wassmer, Marc Wegmüller, Ellis Whitehead, Aleksandra Winiarski, Philipp Wissmann, Johanna Wolf, Sung-Jun Yang, Aiping Yao, Chenghao Yuan, Earl Zastrow, Marcel Zefferer, Oliver Zehnder, Katie Zhie Zhuang, Gu Zong

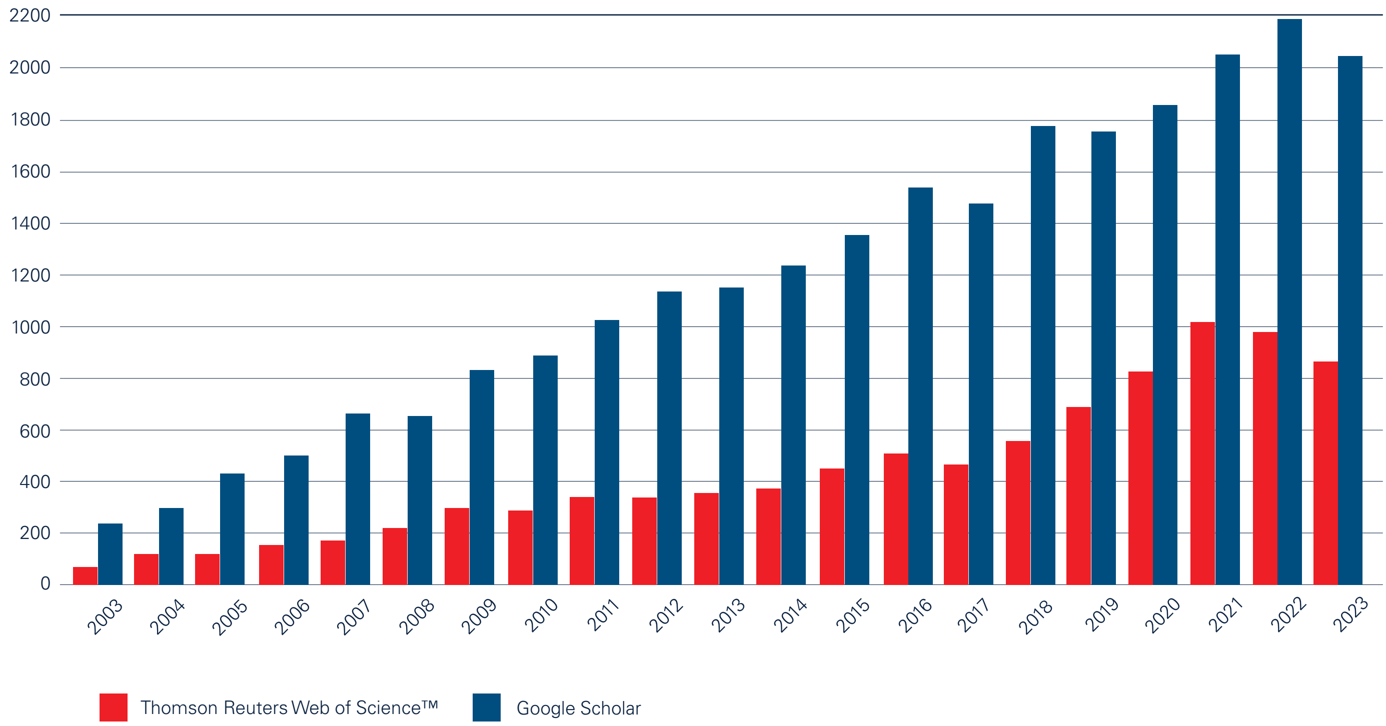
KEY FIGURES


Level of Funding (in 1000 CHF)
10 000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Customized Research
MWF
Government Funding
Industry
US NIH
Donations

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 PARTNERS SINCE 2000

Universities and Other Research Institutions

Competence Center Personalized Medicine UZH / ETH, CH
EMPA – Swiss Federal Laboratories for Materials Science and Technology, CH
EPFL – Swiss Federal Institute of Technology in Lausanne*, CH
ETHZ – Swiss Federal Institute of Technology in Zurich*, CH
European Organization for Nuclear Research, CH
Swiss Tropical and Public Health Institute, CH
Università della Svizzera Italiana*, CH
University of Applied Sciences of Southern Switzerland*, CH
University of Basel*, CH
University of Bern*, CH
University of Geneva*, CH
University of Zurich*, CH
Vetsuisse Faculty of the University of Zurich, CH
Wyss Center for Bio and Neuroengineering, CH
Zurich University of Applied Sciences*, CH
Austrian Institute of Technology*, AT
University of Vienna*, AT
University of Wollongong*, AU
Department of Information Technology – INTEC, University of Ghent, BE
Interdisciplinary Institute for BroadBand Technology, BE
Interuniversity Microelectronic Center, BE
McGill University*, CA
University of Toronto*, CA
Beijing University of Technology*, CN
Third Military Medical University*, CN
Zhejiang University*, CN
Technical University of Berlin*, DE
Fraunhofer Institute for Microtechnology and Microsystems, DE
Fraunhofer Institute for Toxicology and Experimental Medicine, DE
Friedrich Schiller University of Jena, DE
German Cancer Research Center, DE
Institute for Mobile and Satellite Technology, University of Duisburg-Essen, DE
Institute of Biophysics, Leibniz University Hannover, DE
International University of Applied Sciences*, DE
Ludwig Maximilian University of Munich*, DE
Max Planck Institute for Human Cognitive and Brain Sciences, DE
Max Planck Institute for Neurological Research, DE
National Research Center for Environment and Health – GSF, DE
University of Ulm*, DE
Aalborg University*, DK
University of Aarhus*, DK
Centre for Research in Environmental Epidemiology, ES
Instituto de Salud Global Barcelona – ISGlobal, ES
University of Salamanca*, ES
Aalto University*, FI
Helsinki University of Technology*, FI
University of Eastern Finland*, FI
University of Helsinki*, FI
Finnish Institute of Occupational Health, FI
Paris Electrical and Electronic Engineering Laboratory – GeePS, FR
Ecole Supérieur d'Electricité*, FR
Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment, FR
Institute Mines-Télécom, FR
French National Institute for Industrial Environment and Risks, 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
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
Scuola Superiore Sant'Anna*, IT
University of Bologna*, IT
University of Cassino and Southern Lazio*, IT
University of Turin*, IT
University of Salerno*, IT
Gifu University*, JP
Hokkaido University*, JP
Tokyo Metropolitan University*, JP
University of Tokyo*, JP
Dongguk University*, KR
School of Computer and Communication Engineering, in Bahasa, Universiti Malaysia Perlis, MY
Delft University of Technology*, NL
Eindhoven University of Technology, NL
Utrecht University*, NL
TNO Physics & Electronics Laboratory, NL
Wageningen University*, NL
University of Bergen*, NO
King Saud University*, SA
Chalmers University of Technology*, SE
Karolinska Institute, SE
Research Institutes of Sweden, SE
SP Technical Research Institute of Sweden, SE
University of Stockholm*, SE
University of Uppsala*, SE
Institute of Nonionizing Radiation, SI
Beatson Institute for Cancer Research, 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
University of Minnesota*, US
Focused Ultrasound Foundation, US
Illinois Institute of Technology Research Institute, US
Iowa State University*, US
Massachusetts Institute of Technology*, US
Temple University*, US
University of Alabama at Birmingham*, US
University of Buffalo*, US
University of California Davis*, US
University of California Riverside*, US
University of Colorado Boulder*, US
University of Houston*, US
University of Maryland*, US
University of Miami*, US
University of Minnesota*, 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

Hospitals and Clinics

Animal Hospital, UZH, CH
Basel University Hospital*, CH
Cantonal Hospital Aarau*, CH
Centre Hospitalier Universitaire Vaudois, Lausanne University Hospital, CH
Children's Hospital Geneva*, CH
Hirslanden Clinic Zurich*, CH
Hospital Neuchâtelois – La Chaux-de-Fonds, 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
Medical University of Vienna*, AT
Charité – University Hospital Berlin*, DE
Medical Center, University of Freiburg, DE
University Hospital Benjamin Franklin, Free University Berlin, DE
University Hospital Erlangen, Friedrich-Alexander-University, DE
Schneider Children's Medical Center of Israel, IL

Rizzoli Orthopedic Institute, IT
Hospital District of Helsinki and Uusimaa, FI
Hospital District of Southwest Finland, FI
Fukushima Medical University Hospital*, JP
Ajou University School of Medicine*, KR
Erasmus University Medical Center Rotterdam, NL
University Medical Center Utrecht, NL
Haukeland University Hospital*, NO
Hammersmith Hospital*, UK
Arkansas Children Hospital*, US
Johns Hopkins Bayview Medical Center, US
Roswell Park Comprehensive Cancer Center, US
Stanford University School of Medicine, US

Public Offices and Agencies
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
French Alternative Energies and Atomic Energy Commission, FR
International Agency for Research on Cancer, FR
Laboratoire National de Métrologie et d'Essais, FR
National Frequency Agency, FR
Greek Atomic Energy Commission, GR
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

Private Industry
41Medical AG, CH
Antia Therapeutics AG, CH
BoneBridge AG, CH
Disney Research, CH
Fachkommission für Hochspannungsfragen, CH
Geosatis, CH
Huber + Suhner AG, CH
IBM Switzerland AG, CH
dormakaba Holding AG (Kaba Gruppe), CH
Logitech, CH
maxwave AG, CH
Medartis AG, CH
ON Semiconductor Switzerland SA, CH
Research and Consulting Co. Ltd., CH
Roche Diagnostics, CH
Schmid & Partner Engineering AG, CH
SensArs Neuroprosthetics Sàrl, CH
Sonova Communications AG, CH
Swiss Federal Railways, CH
Swisscom, CH
TI Solutions AG, CH
ZMT Zurich MedTech AG, CH
FRONIUS International GmbH, AT
MED-EL, AT
Cochlear, AU
Epiminder, AU
Cardiatis S.A., BE
iMinds, BE
Mobile & Wireless Forum, BE
Synergia Medical AG, BE
MicroPort Scientific Corporation CRM, CN
Altavo GmbH, DE
Biotronik, DE
Dialogik GmbH, DE
Dr. Sennewald Medizintechnik GmbH, DE
Dräger, DE
Kathrein-Werke KG, DE
Neuroloop, DE
Pfisterer International AG, DE
Precisis, DE
Siemens AG, DE
T-Mobile International AG, DE
TÜV SÜD, DE
Nokia Research Center, FI
Healtis SAS, FR
Image Guided Therapy, FR
Orange S.A., FR
Oticon Medical, FR
Sorin CRM/MicroPort, FR
Valeo, FR
THESS, 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 Inc., JP
SB-Kawasumi, JP
Toshiba, JP
Dymstec, KR
HCTM, KR
ONWARD Medical B.V., NL
Philips Medical Systems, NL
Salvia BioElectronics B.V., NL
Sensius B.V., NL
Vratis, PL
Ericsson Radio Systems AB, SE
Volvo Car Corporation, SE
Galvani Bioelectronics, UK
IndexSAR, UK
Vodafone Group Plc., UK
York EMC Services, UK
Abbott (former St. Jude Medical Inc), US
AGC Automotive, US
BrainsGate, US
Boston Scientific Corporation, US
Cambridge Consultants, US
CranioVation, US
CTIA, US
Exponent Inc., US
GE Healthcare, US
Imricor Medical Systems, US
Intel Corporation, US
LivaNova, US
Mainstay Medical, US
Medtronic, US
Micro Systems Engineering Inc., US
Microsoft, US
Motorola, US
MRI Interventions Inc., US
National Instruments, US
Nevro Corporation, US
NuCurrent, US
Qualcomm Inc., US
SeboTek Hearing Systems, US
SetPoint Medical, US
Synchron, US
WiTricity, US

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

SELECTED SPONSORS SINCE 2000

Government Agencies
5th–9th Framework Programmes of the European Union, BE
Centre for Technology Assessment, CH
EURAMET, DE
EUREKA, BE
EUROSTARS, BE
Innosuisse – Swiss Innovation Agency, CH
Federal Office for the Environment, CH
Federal Office of Communications, 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 Federal Office of Energy, CH
Swiss Federal Railways, CH
Swiss National Science Foundation, CH
The Netherlands Organisation for Health Research and Development, NL
U.S. Food and Drug Administration, US

Academic Institutions and Non-Profit Organizations
Bertarelli Foundation, CH
Swiss Federal Institute of Technology in 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
Swiss Research Foundation for Electricity and Mobile Communication, CH
Swiss Academy of Medical Sciences, CH
Swiss Federal Institute of Technology in Zurich, CH
University of Zurich, CH
Wyss Center for Bio and Neuroengineering, CH

Multinational Corporations
Abbott (formerly St. Jude Medical Inc.), US
Association of Radio Industries and Businesses, JP
Auden Techno Corp., TW
Biotronik, DE
Boston Scientific Corporation, US
Cisco Systems, US
Clarins Laboratories, FR
Cochlear, AU
CTIA, US
Disney Research, CH
dormakaba Holding AG (Kaba Gruppe), CH
Ericsson Radio Systems AB, SE
GE HealthCare, US
GSM Association, CH
Intel Corporation, US
International Business Machines Corporation, US
LG Electronics, KR
LivaNova, US
MED-EL, AT
Medartis AG, CH
Micro Systems Engineering Inc., US
Mobile & Wireless Forum, BE
Motorola, US
Nevro Corporation, US
Nokia Research Center, FI
NTT DoCoMo Inc., JP
Oticon Medical, FR
Panasonic Corporation, JP
Philips Medical Systems, NL
Qualcomm Inc., US
Samsung Electronics Co., Ltd., KR
SB-Kawasumi, JP
Semtech Neuchâtel Sàrl, CH
Sensirion AG, CH
Siemens AG, DE
Sonova Communications AG, CH
Sony Corporation, JP
TÜV SÜD, DE
Vodafone Group Plc., UK

Small and Medium Enterprises
41Medical AG, CH
Autem Medical, US
BoneBridge AG, CH
Cardiatis S.A., BE
Clearity, US
Felsenmeer AG, CH
Healtis SAS, FR
Mainstay Medical, US
maxwave AG, CH
Medico S.p.A., IT
Pharma Digital, CH
Schmid & Partner Engineering AG, CH
Sensimed AG, CH
SetPoint Medical, US
UNEEG medical A/S, DK
ZMT Zurich MedTech AG, CH

PROJECTS

EM Technology

5&6GEARS	Development of an ultra-miniature wideband 5G and 6G electromagnetic radiation sensor for future mobile communication systems
Dielectric Spectroscopy	Development of novel methodologies for characterization of materials from DC to >100 GHz
expo6G	Multi-modal optimization of 5G and 6G hybrid wireless and internet of things communication networks in Switzerland
MEWS	Metrology for emerging wireless standards
Module APD	Module for exposure assessment of the absorbed power density of millimeter wave wireless devices
MRIcompLEAD	Magnetic resonance imaging-compatible leads
Science for Standards	Provision of science in support of electromagnetic product standards and support of standard committees and governments
STASIS	Standardization for safe implant scanning in magnetic resonance imaging
TD SENSOR	Development of time-domain near-field sensor technology
TyProxi	Development of a regulatory-grade test system for compliance of wireless devices with proximity sensors
WPT	Development of test equipment and software to show compliance with electromagnetic safety guidelines of wireless power transfer systems

IT'IS for Health

CLS – CRANIO	Modeling of craniospinal compliance in humans to advance the understanding of dynamic compliance and its pathophysiologic basis
CLS – NeuHeart	Development of a neuroprosthesis to restore the vagal-cardiac closed-loop connection after heart transplantation
CLS – o²S²PARC	Establishment of an interactive, freely accessible online computational platform for simulating peripheral nervous system neuromodulation / stimulation
CLS – OptiStim	Optimal neurostimulation for the treatment of chronic headaches
CLS – PersonalizedSTIMO	Personalized epidural electrical stimulation of the lumbar spinal cord for clinically applicable therapy to restore mobility after paralyzing spinal cord injury
CLS – SENS-THERM	Development of hardware and software for electromagnetic sensing, video control and metamodeling in thermotherapy of advanced head and neck (H&N) cancer
CLS – TARA	Development of a platform to provide an open-access repository and database for acupoint research – Topological Atlas and Repository for Acupoint research
CLS – UNMOD	Experimentally validated computational pipeline of ultrasound propagation and neuron-coupling for non-invasive peripheral nervous system stimulation
CLS – V&V40	Development of novel concepts for verification and validation of computational life science software platforms and their applications
MRI – Implant Safety	Improved procedures and instrumentation for magnetic resonance imaging safety evaluation of medical implants
REPLICATIONS	Co-funding of confirmation studies of bioelectromagnetic experiments
TI	Temporal interference stimulation device and planning tool: Basic research, and hardware and software development
ViP 4.x	Development of the next generation of high-resolution computational anatomical models
ViP-P/VM/M	Development of novel posers, methodology for enhanced volume meshes of anatomical structures, and a physically-based morphing tool

EM Exposure and Risk Assessment

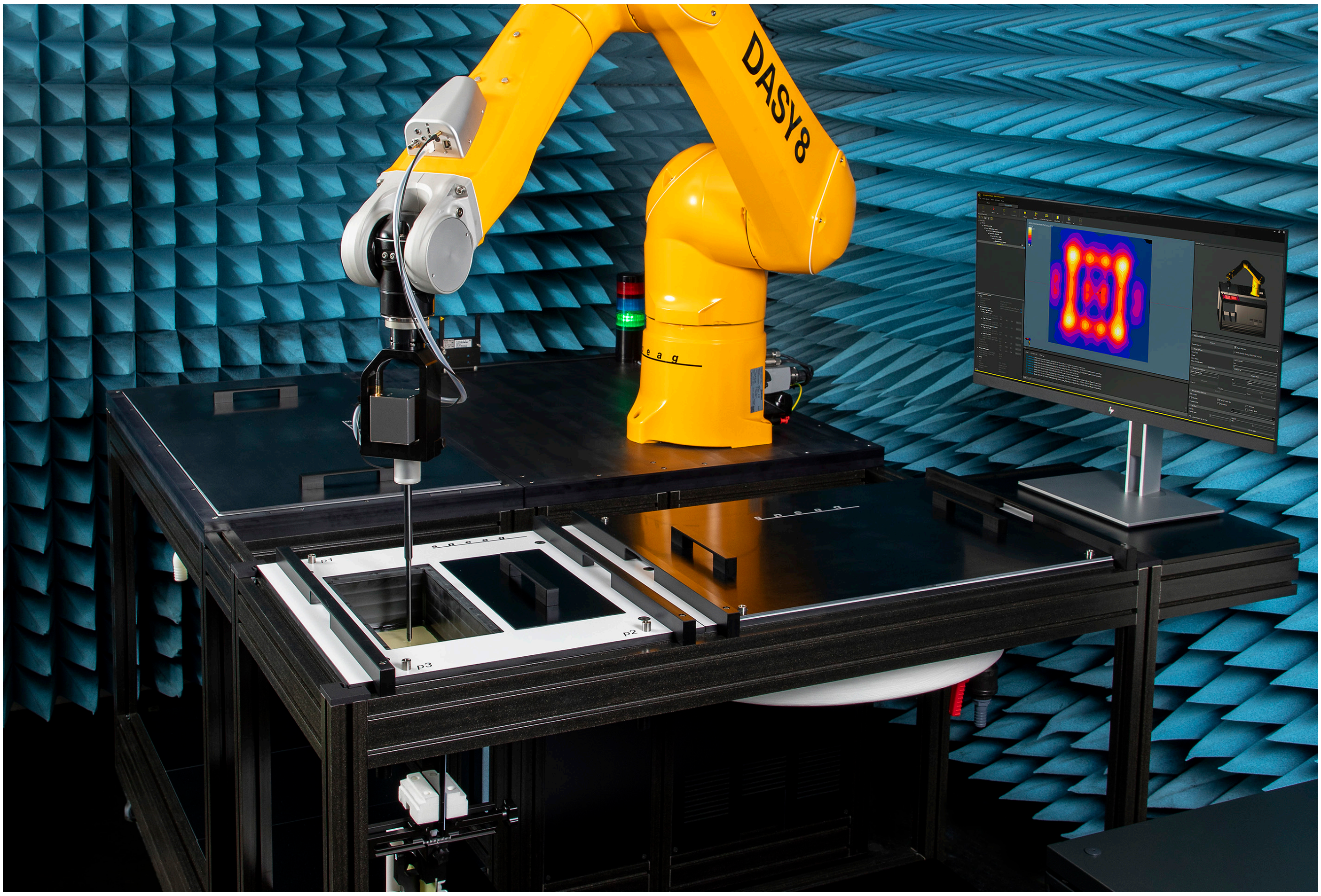
Brain in a dish	Effects of radiofrequency electromagnetic fields (5G) on brain development and neurodegeneration
Sleep Studies	A causal role for a voltage-gated $Ca_v1.2$ calcium channel in mediating non-ionizing radiation 5G frequency range 1 effects on sleep associated brain health in humans?
SEAWave	Scientific-based exposure and risk assessment of radiofrequency and millimeter wave systems from children to elderly (5G and beyond)
RADIODEP	Effects of radiofrequency (5G) in healthy and depressive subjects: Behavioral and neurobiological approaches of electromagnetic 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 *in vivo* follow-up studies

FROM RESEARCH TO TECHNOLOGY: THE FIRST SOLUTION FOR ASSESSMENT OF ABSORBED POWER DENSITY

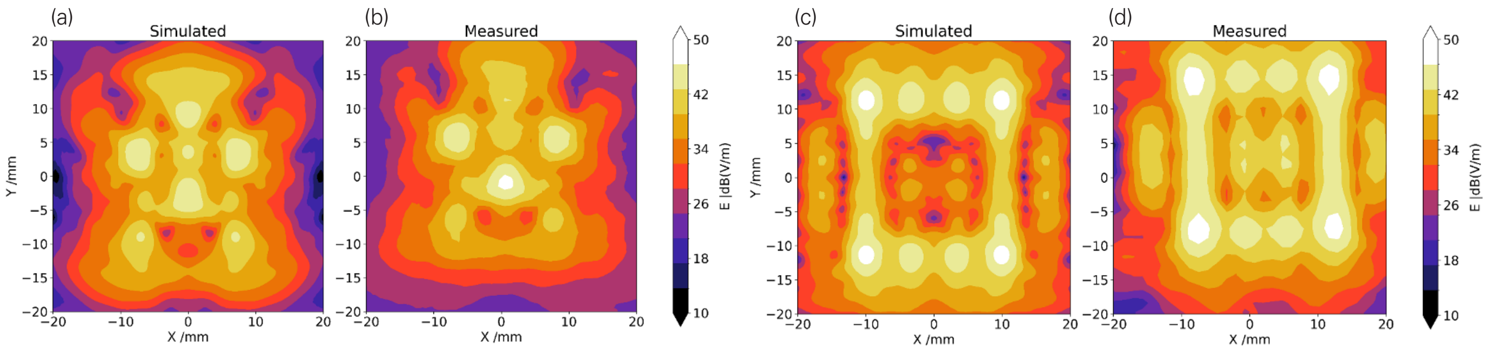
The 5th Generation (5G) of mobile communications systems has been designed to offer massive connectivity, lower latency, and higher data rates to enable new applications such as the Internet of Things, autonomous driving, and more. In addition to the sub-6 GHz bands (the so-called frequency range 1 (FR1)), millimeter bands (FR2) have been defined with Release 15 of the 3rd Generation Partnership Project (3GPP) in 2018. To protect against localized sources operating at FR2 frequencies close to the body, the guidelines on "Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz)"[1] have been revised to define a new basic restriction, the absorbed power density (APD), for frequencies >6 GHz. Well-defined exposure limits are beneficial for all stakeholders – the public, regulators, and mobile manufacturers.

Importantly, the APD metric reduces assessment uncertainties and the compliance burden for makers of wireless devices that operate close to the human body. APD has, therefore, been rapidly adopted by regulators worldwide for frequencies ≤10 GHz; for frequencies >10 GHz, however, adoption has so far been hampered by the lack of suitable solutions for APD measurement.

Hence, in 2020, IT'IS joined forces with the Integrated Systems Laboratory of the ETH Zurich and Z43 partner SPEAG to develop the world's first measurement system for accurate and comprehensive assessment of APD for the 24–30 GHz frequency band. The system developed consists of a new APD phantom, a new APD probe, a traceable probe calibration system, and characterized verification and validation (V&V) sources.



DASY8 Module APD measurement system for compliance testing of millimeter wave mobile devices with dosimetric safety limits, including the APD probe, APD phantom filled with skin-simulating liquid and a precisely positioned mobile device.



Validation results of the newly developed DASY8 Module APD assessement system. APD simulation (a) and measurement (b) of a cavity-backed dipole array. APD simulation (c) and measurement (d) of a slotted horn antenna.

APD phantom: The main challenge to the realization of experimental dosimetric systems is that the penetration depth in the skin is very short; in addition, the water content of the stratum corneum is very low, and it, therefore, acts like a matching layer that reduces reflection and increases the APD values compared to a homogeneous phantom[2]. To enable measurement in the interior of the phantom, we developed a new phantom that simulates the reflection and absorption of the skin for any incident field configuration while increasing the penetration depth by more than a factor of 5. The new phantom has a mechanically stable shell with high permittivity containing a skin-simulating liquid (SSL) that allows assessment of the APD of devices positioned as close as 2 mm to the skin. The performance of the phantom has been thoroughly validated.

APD probe: The new APD probe, which has a sensing volume of ≤0.5 mm^3, is composed of two orthogonal electrically small resistive dipole sensors with diode detectors. By rotating the probe around its axis by 120° and 240°, the local polarization ellipse based on the pseudo-vector principle can be assessed[4]. In addition, the probe was dielectrically matched to the SSL, which minimizes measurement distortion due to scattering. The probe covers a frequency range from 6–45 GHz with an axial isotropy error of <0.3 dB and a linearity error of <0.2 dB over a dynamic range of 0.3 to >1000 W/m^2.

Calibration system: Application for product certification of the new APD probe requires traceable calibration of the APD probe's electric (E-)field sensitivity. A semi-analytical solution for an open-ended rectangular waveguide radiating into an infinite half-space of SSL was derived that warrants traceability via input power and frequency.

Field reconstruction: The experimental APD assessment involved the use of an automated scanning system to determine the orthogonal component of the Poynting vector at the phantom surface from the scanned E-field in the SSL volume over a predefined grid. Two evaluation approaches were implemented to determine the APD at the phantom surface: (i) scalar, based on the measured decay in the phantom, and (ii) vectorial, based on a total field reconstruction algorithm and back-propagation to the surface of the phantom. A comprehensive uncertainty analysis addresses all components integral to the measurement system and post-processing. The expanded uncertainty for the APD measurement system is 1.49 dB.

V&V sources: System validation was performed as the final APD assessment system development step. The validation involved measuring the APD and reflection from the phantom surface with the previously developed numerical validation sources. The peak spatial-averaged APD from measurements was compared with their numerical targets and the numerical and measured reflection coefficients. The APD validation was successful, with a normalized error as small as 0.1 ($k = 2$).

The APD system is based conceptually on specific absorption rate assessment systems and can be integrated into SPEAG's existing robot-based high-precision electromagnetic near-field scanning platform DASY8.

Our research efforts led to the release of DASY8 Module APD V1.0 in December 2023 to help ensure that the exposure of users of 5G technologies does not exceed the limits defined by national health agencies.

1 International Commission on Non-Ionizing Radiation Protection. *Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz).* Health physics 118(5):483–524, May 1, 2020. DOI: 10.1097/HP.0000000000001210

2 A. Christ, T. Samaras, E. Neufeld, and N. Kuster. *RF-induced temperature increase in a stratified model of the skin for plane-wave exposure at 6–100 GHz.* Radiation Protection Dosimetry 188(3):350–360, June 2020. DOI: 10.1093/rpd/ncz293

3 A. Christ, A. Aeschbacher, F. Rouholahnejad, T. Samaras, B. Tarigan, and N. Kuster. *Reflection properties of the human skin from 40 to 110 GHz: A confirmation study.* Bioelectromagnetics 42(7):562–574, October 2021. DOI: 10.1002/bem.22362

4 K. Pokovic, T. Schmid, J. Frohlich, and N. Kuster. *Novel probes and evaluation procedures to assess field magnitude and polarization.* IEEE Transactions on Electromagnetic Compatibility 42(2):240–244, May 2000. DOI: 10.1109/15.852419

INFRASTRUCTURE

Dosimetric, Near-Field, and EMC/EMI Facilities

Semi-Anechoic Chamber

This shielded, rectangular chamber has the dimensions 7 × 5 × 2.9 m (L × W × H). It is equipped with a reflecting ground plane floor, and half of its walls are covered with electromagnetic wave absorption panels. The chamber, which contains an integrated DASY52NEO system, can be used 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, micro-base and pico-base station antennas, exposure setups, calibration procedures, electromagnetic interference tests, magnetic resonance imaging safety tests, compliance testing of implants, etc.

Facility for RF Compliance Testing

IT'IS shares with Schmid & Partner Engineering AG a facility equipped with the latest DASY8 systems for testing compliance with any national and international guidelines, standards, and regulations as well as for a wide range of research and development measurement tasks related to exposure to electromagnetic waves at frequencies from 3 kHz – 110 GHz. The documentation of Class C accreditation has been completed.

Technical Equipment and Instrumentation

Spectrum and Network Analyzers

1 Copper Mountain R60 Vector Reflectometer
1 HP 8753E Network Analyzer, 30 kHz–6 GHz
1 HP APC 85033B Calibration Kit
1 Keysight E5061B Vector Network Analyzer, 5 Hz–1.5 GHz
1 Rohde & Schwarz FSP Spectrum Analyzer, 9 kHz–30 GHz
1 Rohde & Schwarz FPL1003 Spectrum Analyzer, 5 kHz–26 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 ZVA67 Vector Network Analyzer, 10 MHz – 67 GHz
1 Rohde & Schwarz ZV-Z52 Calibration Kit
1 NI PXIe-5668R Vector Signal Analyzer, 100 kHz–26.5 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 Vector Signal Generators
2 Anritsu MG3700A Vector Signal Generators
1 HP 8647A Signal Generator, 250 – 1000 MHz
1 Rohde & Schwarz CMU200
1 Rohde & Schwarz CMW500 Wideband Radio Communication Tester
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
1 Rohde & Schwarz SMW200 Vector Signal Generator
1 Spectrum DN2.816-02 16-Bits Hybrid Netbox

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
5 SPEAG cSAR3D (2 Flat, 1 Left Head, 1 Right Head, and 1 Quad)
2 SPEAG DAE4, Data Acquisition Electronics
1 SPEAG DAE4A, Data Acquisition Electronics
2 SPEAG DAE4ip, Data Acquisition Electronics
4 SPEAG DAEasy4MRI, Data Acquisition Electronics
2 SPEAG DASY52NEOs
1 SPEAG EASY4MRI
2 SPEAG EASY6
4 SPEAG EASY6 DAE, Data Acquisition Electronics
2 SPEAG ELI4 Phantoms
1 SPEAG HAC Radiofrequency Extension
1 SPEAG HAC T-Coil Extension
1 SPEAG ICEy-EMC and -mmW
1 SPEAG SAM V6.0 Phantom
3 SPEAG SHO V2 RB, RC, and RP OTA Hand Phantoms
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
1 ZMT MITS-TT

Probes

1 Greisinger GMH 5430 Conductivity Meter
1 METROLAB THM 1176 Magnetic Field Sensor
1 SPEAG 1RU1PXI TDS Remote Unit
1 SPEAG AMIDV2 Audio Magnetic Field Probe
1 SPEAG AMIDV3 Audio Magnetic Field Probe
1 SPEAG DAK Kit 12/3.5/1.2E
1 SPEAG DAKS-12 Probe
2 SPEAG E1TDSz Electric Field Time Domain Sensor and Remote Units
1 SPEAG E1TDSx-ICEy Electric Field Time Domain Sensor
1 SPEAG E1TDSz-ICEy Electric Field Time Domain Sensor
1 SPEAG EE3DV1 Electric Field Probes
1 SPEAG EF3DV3 Electric Field Probe
1 SPEAG EL3DV2 Electric Field Probe for Wireless Power Transfer
2 SPEAG ER3DV6 Electric Field Probes
1 SPEAG ES3DV2 Electric Field Probe
1 SPEAG ET1DV4 Dosimetric Probe
2 SPEAG ET3DV6 Dosimetric Probes
1 SPEAG EU2DV2 Dosimetric Probe
1 SPEAG EUmmW Electric Field Probe
1 SPEAG EX3DV3 Dosimetric Probe
4 SPEAG EX3DV4 Dosimetric Probes
3 SPEAG H1TDSx Magnetic (H-) Field Time Domain Sensor and Remote Units
1 SPEAG H1TDSx-ICEy Magnetic (H-) Field Time Domain Sensor
1 SPEAG H1TDSz-ICEy Magnetic (H-) Field Time Domain Sensor
4 SPEAG H3DV6 Magnetic (H-) Field Probes
3 SPEAG H3DV7 Magnetic (H-) Field Probes
1 SPEAG HL3DV2 Magnetic (H-) Field Probe for Wireless Power Transfer
1 SPEAG HU2DV1 Magnetic (H-) Field Probe
2 SPEAG T1V3 Temperature Probes
3 SPEAG T1V3LAB Temperature Probes
3 SPEAG T1V4LAB Temperature Probes
6 SPEAG RFoF1P4MED Probes and 1 Remote Unit

Meters

3 Agilent 34970A Data Acquisition Units
2 Agilent E4419B and 4 HP 8482A Power Meters
3 Agilent HP 436A and 3 HP 8481A Power Meters
1 Handyscope HS3 Data Acquisition Unit
1 Handyscope HS4 Data Acquisition Unit
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
8 Mini-Circuit ZHL42 Amplifiers, 700 – 4200 MHz
2 Mini-Circuit ZVE-8G Amplifiers, 2 – 8 GHz
1 Nucletudes ALP336 Amplifier, 1.5 – 2.5 GHz
2 Ophir 5141 Amplifiers, 700 MHz – 3 GHz

Other Equipment

1 Narda EHP-50 Electromagnetic Field Probe Analyzer, 5 Hz–100 KHz
1 Narda ELT-400 Magnetic Field Probe, 1 Hz–400 KHz
1 CEPH Storage Cluster for o^{2}S^{2}PARC:
- *(3 nodes) each 64 core AMD 2.25 GHz, 256 GB RAM, 500 TB storage (total)*

1 Extension of o^{2}S^{2}PARC In-House Cluster:
- *2x 16 core AMD 4.3 GHz, 256 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks*
- *2x 16 core AMD 3.4 GHz, 128 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks*

1 TIP.ITIS.SWISS Mini Cluster:
- *(4 nodes) each 16 core AMD 3.4 GHz, 128 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks*

Computers

75 Laptops, from Acer, Apple, Asus, Dell, HP, IBM, Lenovo
83 Desktop Workstations (from HP, Dell, Acceleware, Dalco, custom built)
13 High Performance Computing Workstations/Servers (from Dalco, Acceleware, custom built)
7 QNAP Network Data Storage Servers
10 Dalco Servers
9 Miscellaneous Peripherals (e.g., network devices, printers, scanners, etc.)

SELECTED PUBLICATIONS

A. Spiegelberg, A. Boraschi, F. Karimi, M. Capstick, A. Fallahi, E. Neufeld, N. Kuster, and V. Kurtcuoglu. *Noninvasive monitoring of intracranial pulse waves,* IEEE Transactions on Biomedical Engineering: 70(1): 144–153, January 2023. DOI: 10.1109/TBME.2022.3186748

J. Xi, A. Christ, and N. Kuster. *Coverage factors for efficient demonstration of compliance of low-frequency magnetic near-field exposures with basic restrictions,* Physics in Medicine & Biology: 68(3): 035007, January 2023. DOI: 10.1088/1361-6560/aca875

F. Karimi, E. Neufeld, A. Fallahi, A. Boraschi, J. J. M. Zwanenburg, A. Spiegelberg, V. Kurtcuoglu, and N. Kuster. *Theory for a non-invasive diagnostic biomarker for craniospinal diseases,* NeuroImage: Clinical, 37:103280, February 2023. DOI: 10.1016/j.nicl.2022.103280

E. Iavarone, J. Simko, Y. Shi, M. Bertschy, M. García-Amado, P. Litvak, A.-K. Kaufmann, C. O'Reilly, O. Amsalem, M. Abdellah, G. Chevtchenko, B. Coste, J.-D. Courcol, A. Ecker, C. Favreau, A. C. Fleury, W. Van Geit, M. Gevaert, N. R. Guerrero, J. Herttuainen, G. Ivaska, S. Kerrien, J. G. King, P. Kumbhar, P. Lurie, I. Magkanaris, V. Ravindernath Muddapu, J. Nair, F. L. Pereira, R. Perin, F. Petitjean, R. Ranjan, M. Reimann, L. Soltuzu, M. F. Sy, M. A. Tuncel, A. Ulbrich, M. Wolf, F. Clascá, H. Markram, and S. L. Hill. *Thalamic control of sensory processing and spindles in a biophysical somatosensory thalamoreticular circuit model of wakefulness and sleep,* Cell Reports: 42(3):11220028, March 2023. DOI: 10.1016/j.celrep.2023.112200

A. Boraschi, A. Spiegelberg, F. Karimi, K. Graf, A. Fallahi, E. Neufeld, N. Kuster, and V. Kurtcuoglu. *The effect of body position change on noninvasively acquired intracranial pulse waves,* Physiological Measurement: 44(3): 035014, April 2023. DOI: 10.1088/1361-6579/acc3d6

J. Rintoul, E. Neufeld, C. R. Butler, R. O. Cleveland, and N. Grossman. *Remote focused encoding and decoding of electric fields through acoustoelectric heterodyning,* Communications Physics: 6:79, April 2023. DOI: 10.1038/s42005-023-01198-w

W. Potok, A. Post, V. Beliaeva, M. Bächinger, A. M. Cassarà, E. Neufeld, R. Polania, D. Kiper, and N. Wenderoth. *Modulation of visual contrast sensitivity with tRNS across the visual system, Evidence from stimulation and simulation,* eNeuro: 10(6), June 2023. DOI: 10.1523/ENEURO.0177-22.2023

A. Fallahi, N. Kuster, and L. Novotny. *Soft-x-ray confined-electron laser,* Physical Review A: 107:L061504, June 2023. DOI: 10.1103/PhysRevA.107.L061504

F. Missey, M. Silverå Ejneby, I. Ngom, M.J. Donahue, J. Trajlinek, E. Acerbo, B. Botzanowski, A. M. Cassarà, E. Neufeld, E. D. Glowacki, L. Shangold, W. M. Hanes, and A. Williamson. *Obstructive sleep apnea improves with non-invasive hypoglossal nerve stimulation using temporal interference,* Bioelectronic Medicine: 9:18, August 2023. DOI: 10.1186/s42234-023-00120-7

T. Goren, S. Reboux, S. Farcito, B. Lloyd, and N. Kuster. *Influence of patient head definition on induced E-fields during MR examination,* Magnetic Resonance in Medicine: 91(2):735–740, October 2023 DOI: 10.1002/mrm.29894

I. Violante, K. Alania, A. Cassarà, E. Neufeld, E. Acerbo, A. Williamson, D. Kurtin, E. Rhodes, A. Hampshire, N. Kuster, E. Boyden, A. Pascual-Leone, and N. Grossman. *Non-invasive temporal interference electrical stimulation of the human hippocampus,* Nature Neuroscience: 26:1994–2004, October 2023. DOI: 10.1038/s41593-023-01517-y

M. J. Wessel, E. Beanato, T. Popa, F. Windel, P. Vassiliadis, P. Menoud, V. Beliaeva, I. R. Violante, H. Abderrahmane, P. Dzialecka, C.-H. Park, P. Maceira-Elvira, T. Morishita, A. Cassara, M. Steiner, N. Grossman, E. Neufeld, and F. C. Hummel. *Noninvasive theta-burst stimulation of the human striatum enhances striatal activity and motor skill learning,* Nature Neuroscience: 26: 2005–2016, October 2023. DOI: 10.1038/s41593-023-01457-7

U. Zanovello, C. Fuss, A. Arduino, and O. Bottauscio. *Efficient prediction of MRI gradient-induced heating for guiding safety testing of conductive implants,* Magnetic Resonance in Medicine: 90(5):2011–2018, November 2023. DOI: 10.1002/mrm.29787

P. Vassiliadis, E. Beanato, T. Popa, F. Windel, T. Morishita, E. Neufeld, J. Duque, G. Derosiere, M. J. Wessel, and F. C. Hummel. *Non-invasive stimulation of the human striatum disrupts reinforcement learning of motor skills,* bioRxiv: 2022.11.07.515477, April 2023. DOI: 10.1101/2022.11.07.515477

B. Botzanowski, E. Acerbo, S. Lehmann, S. L. Kearsley, M. Steiner, E. Neufeld, F. Missey, L. Muller, V. Jirsa, B. D. Corneil, and A. Williamson. *Controlling focality and intensity of non-invasive deep brain stimulation using multipolar temporal interference in non-human primates and rodents,* bioRxiv: 2023.09.05.556444, September 2023. DOI: 10.1101/2023.09.05.556444

A. M. Cassarà, T. H. Newton, K. Zhuang, S. J. Regel, P. Achermann, A. Pascual-Leone, N. Kuster, and E. Neufeld. *Recommendations for the safe application of temporal interference stimulation in the human brain,* submitted

J. B. A. Brus, J. A. Heng, V. Beliaeva, F. Gonzalez, A. M. Cassarà, E. Neufeld, M. Grueschow, and R. Polania. *Causal phase-dependent control of feature-based attention in human prefrontal cortex,* submitted.

M. Douglas, N. Jain, B. Kochali, and N. Kuster. *Electromagnetic exposure from wireless devices as function of distance,* in proceedings of URSI-GASS 2023, Sapporo, JP, August 19–26, 2023. DOI: 10.23919URSIGASS57860.2023.10265439

J. García Ordóñez, T. H.Newton, M. Burkhardt, A. Cassarà, N. Kuster, and E. Neufeld. F*ast and accurate optimization of targeted neurostimulation using a generalized activating function,* in proceedings of URSI-GASS 2023, Sapporo,JP, August 19–26, 2023. DOI: 10.46620/URSIGASS.2023.3168.TPYC1932

IT'IS FOUNDATION

History
The IT'IS 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'IS stands for "Information Technologies in Society".

Legal status
The IT'IS Foundation is a non-profit tax-exempt research foundation.

Mission
The IT'IS Foundation is dedicated to expanding the scientific basis of the safe and beneficial application of electromagnetic energy in health and information technologies.

The IT'IS 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'IS Foundation is an independent research institute.

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

Funding
National and international public funding, research projects sponsored by agencies and industry, and customized research.

President
Prof. em. Alex Dommann
+41 44 245 9696
foundationboard@itis.swiss

Director
Prof. Niels Kuster
+41 44 245 9690
nk@itis.swiss

Associate Director
Hardware Development
Antenna-, Hyperthermia-
and Exposure Systems
Dr. Myles H. Capstick
+41 44 245 9743
capstick@itis.swiss

Associate Director
Computational Life Sciences
Dr. Esra Neufeld
+41 44 245 9698
neufeld@itis.swiss

Office
IT'IS Foundation
Zeughausstrasse 43
CH–8004 Zurich
Switzerland
+41 44 245 9696
info@itis.swiss

Certification Research
Dr. Mark G. Douglas
+41 44 245 9861
douglas@itis.swiss

Computational Brain Stimulation
Dr. Taylor Newton
+41 44 245 9826
newton@itis.swiss

Customized Research
Dr. Tolga Goren
+41 44 245 9680
goren@itis.swiss

Dielectric Spectroscopy
Dr. Sina Hashemi Zadeh
+41 44 245 9760
sina@itis.swiss

EM Phantoms
Dr. Ioannis Koufogiannis
+41 44 245 9711
koufogiannis@itis.swiss

High-Performance Neuroscience
Werner Van Geit
+41 44 245 9844
vangeit@itis.swiss

Neurostimulation
Dr. Antonino M. Cassarà
+41 44 245 9813
cassara@itis.swiss

Sensors, EMC, EMI, Dosimetry
Dr. Sven Kühn
+41 44 245 9694
kuehn@itis.swiss

Virtual Population and
Tissue Properties Database
Dr. Bryn Lloyd
+41 44 245 9831
lloyd@itis.swiss

www.itis.swiss

IT'IS Foundation
is a member of z43