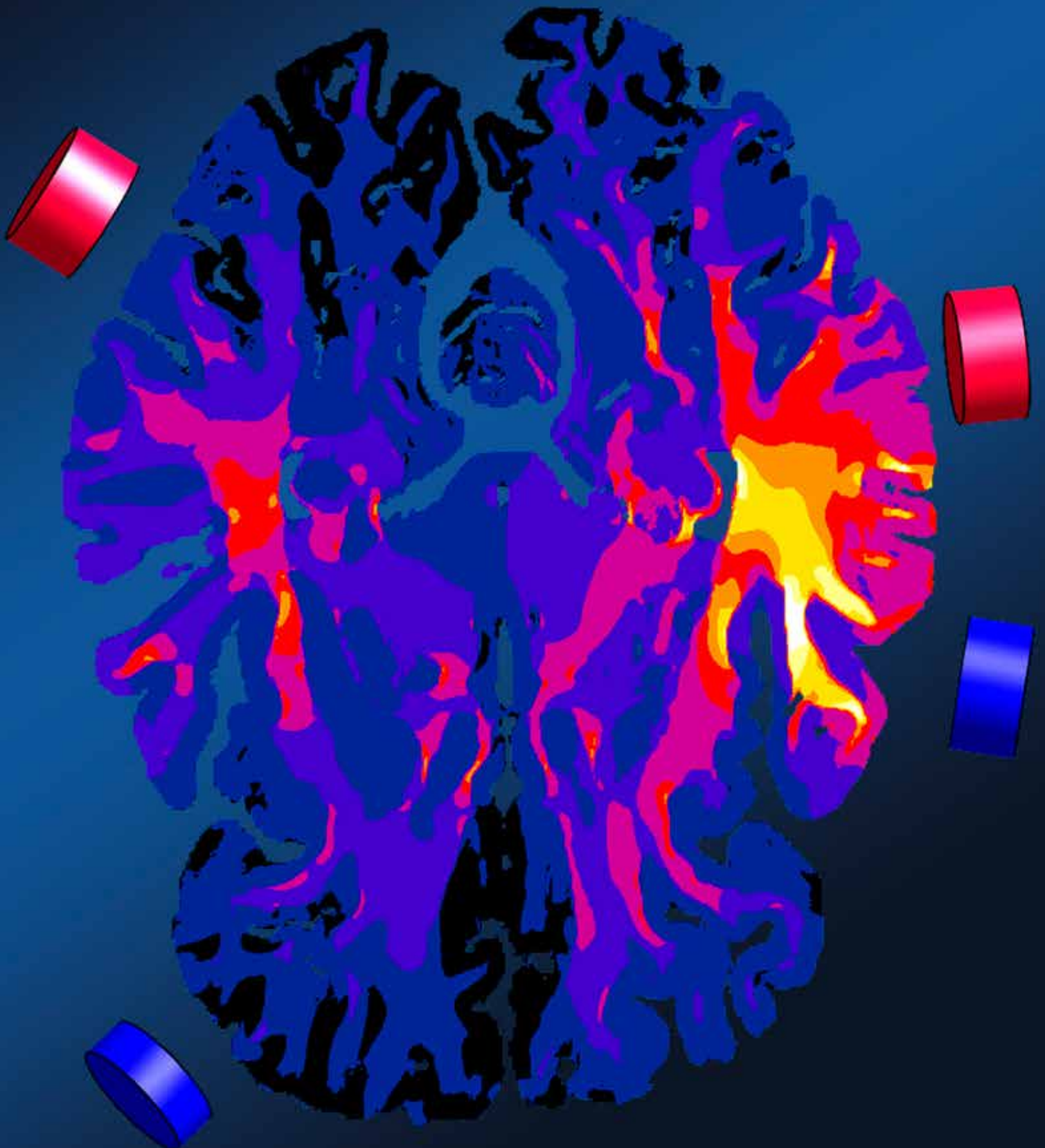


# **IT IS** FOUNDATION 2022



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*Cover: Temporal interference field distribution in the brain (represented by the color gradient) with anisotropic conductivity, using 2 electrode pairs. The center of the interference field is shifted toward the electrodes located on the right, due to a difference in the applied current amplitude.*

# 2022 – THE YEAR AFTER

In spring 2022, the Swiss government lifted all COVID-19 restrictions. We immediately resumed full on-site operations to re-establish our culture of spontaneous exchanges in the hallways, at the coffee bar, and at face-to-face R&D meetings. This was key for our achievements in 2022 as our success lies in the collective knowledge of our many talented colleagues which is nurtured through personal interactions between teammates and impromptu opportunities for brain-storming.

One of our most important research activities in the past year has been our work on temporal interference (TI) stimulation, which is prominently featured on pages 12–13. These activities have initiated a growing number of fruitful and new collaborations across a broad spectrum of research questions and medical applications. To support these investigations, we have developed, in collaboration with our latest spin-off company, TI Solutions AG, a high-precision, very flexible, and versatile stimulation device. In parallel, we are providing modeling support and developing a TI planning tool that is powered by our o<sup>2</sup>S<sup>2</sup>PARC technology. Mechanistic TI research has also been gaining more and more momentum, generating experimental input from multiple sources to support our ongoing efforts to elucidate the mechanisms of electromagnetic and acoustic interactions with neural electrophysiology at subcellular to network levels. We are always on the lookout for new partners to further explore mechanistic understanding of TI effects.

We have also made significant progress in other areas, especially the highly successful and resource-intensive o<sup>2</sup>S<sup>2</sup>PARC project funded by the U.S. National Institutes of Health (NIH). o<sup>2</sup>S<sup>2</sup>PARC moved into its second phase (2022 – 2025), where the focus will be on the evolution of the project and future sustainability.

Further, we have achieved breakthroughs regarding novel dosimetric probes for the frequency ranges below 4 MHz and above 10 GHz and, in collaboration with the Institute of Electromagnetic Fields of the ETH Zurich, have started to develop incident field sensors that operate at frequencies >100 GHz.

To address the scientific gaps created by the novel exposures in the frequency range 2 of 5G technologies (>24 GHz), we have been re-engaging in research on electromagnetic exposure and risk assessment by forming research consortia. The SEAWave project, funded by Horizon Europe, was kicked off in June 2022. We are also involved in several smaller projects funded by the Swiss Federal Office for the Environment. Our major tasks are the design, manufacture, installation, and maintenance of exposure systems, the development of dosimetry tools, and the execution of exposure assessments.

Success is a shared journey at IT'IS: creating a common purpose, building capabilities, and fostering ownership among our teams is vital to the successful achievement of our mission. The passion, commitment, and energy of all IT'IS researchers, students, and external advisors (page 5) are integral to our continued progress and lasting success. The insight and guidance of the IT'IS Foundation Board Members (page 4) foster our long-term vision and help set a clear course for the Foundation. Our productive collaborations with partner institutions (pages 8–9) draw on a diverse, complementary pool of scientific expertise that ensure insightful outcomes for continued innovation and growth. We especially thank Professors Alex Dommann, Nir Grossmann, Qiuting Huang, Silvestro Micera, Mathieu Luisier, Lukas Novotny, Rafael Polania and Klaas Prüssmann for sharing infrastructure and advising our joint PhD students and postdoctoral researchers. The clinical expertise of Professors Beatrice Beck Schimmer, Stephan Bodis, and Alvaro Pascual-Leone has also ensured informed and invaluable guidance and discussions.

The impactful and unwavering support of the funding agencies that support our work, particularly Innosuisse, the Swiss National Science Foundation, EUREKA, Horizon Europe, the NIH, and many sponsors and donors (page 10) is indispensable, allowing us to do what we love to do and what we do best: pioneering the future with innovation, curiosity, and perseverance.

*Prof. Niels Kuster*

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

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

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

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

# OUR TEAM



Niels Kuster, PhD, Prof., Director  
Myles H. Capstick, PhD, Associate Director  
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Antonino M. Cassarà, PhD, Project Leader (EEO)  
Nicolas Chavannes, PhD, Project Leader (EEO)  
Dahye Choi, PhD, Project Leader (EEO)  
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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)  
Katie Zhuang, PhD, Project Leader (EEO)  
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  
Carina Fuss, Application Engineer  
Manuel Guidon, PhD, Senior Software Engineer  
Elisabetta Iavarone, PhD, Support and Application Engineer

Dustin Kaiser, PhD, DevOps / Backend Software Engineer  
Lena Kranold, PhD, Postdoctoral Researcher  
Joel Macht, Junior 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  
Eduardo Valdés Cambero, PhD, Application Engineer  
Maksym Yushchenko, PhD, Postdoctoral Researcher  
Ninad Chitnis, PhD Student  
Alessandro Fasse, PhD Student  
Fariba Karimi, PhD Student  
Cindy Karina, PhD Student  
Redi Poni, PhD Student  
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Charlotte Roberts, Personal Assistant to the Director  
Mayuko Sasaki-Kuroiwa, Graphic Design  
Niklas Bachmaier, Intern  
Merle Backmeyer, Intern  
Jil Bürki, Intern  
Thomas Hinano Keller, 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

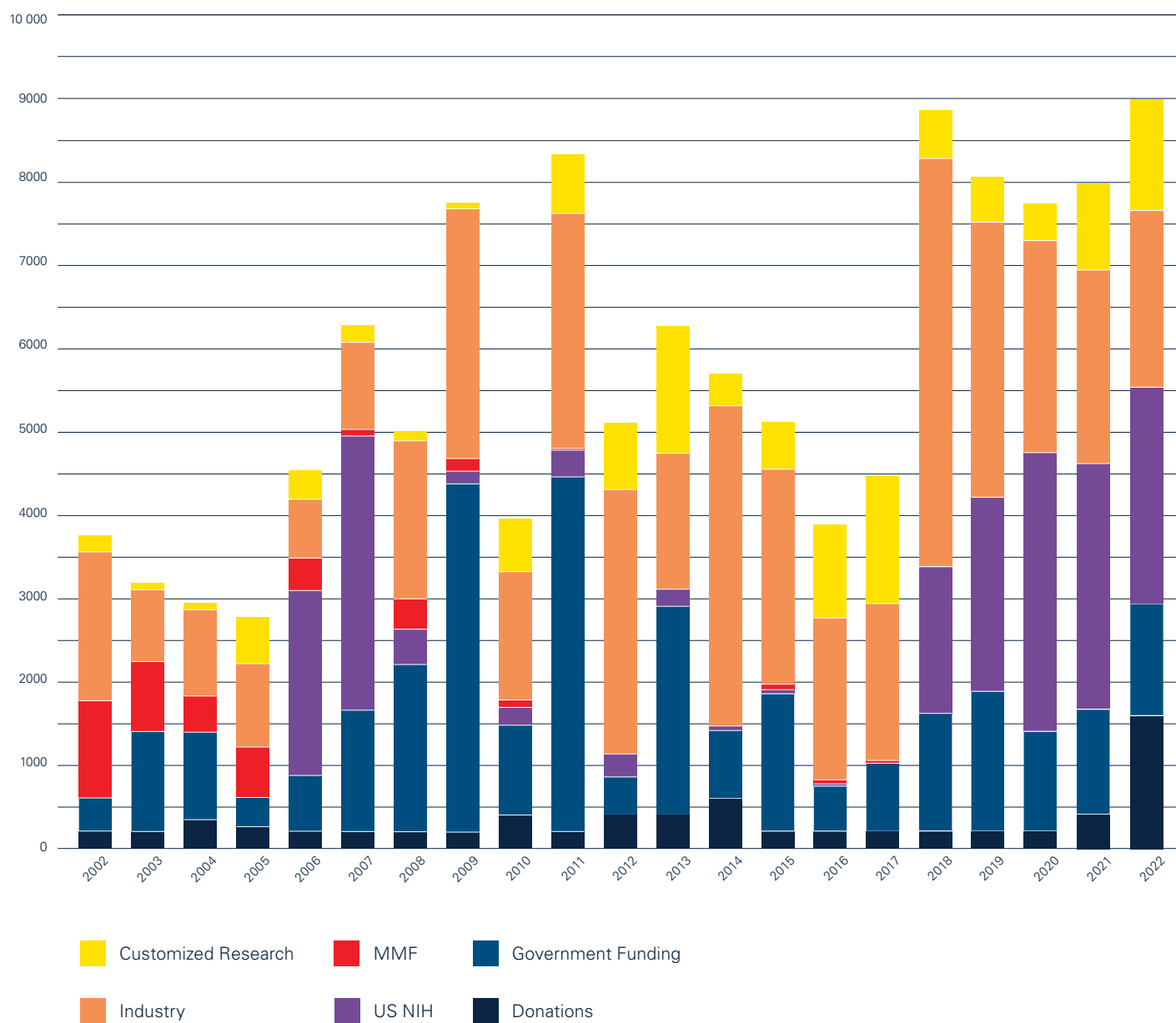
Sabine Regel, PhD, SR Scientific GmbH, CH  
Theodoros Samaras, PhD, Prof., Aristotle University of Thessaloniki, GR  
Roger Yew-Siow Tay, PhD, SG

## Former Employees and Advisors

Ross W. Adey, Alessandro Alaia, Michael Ammann, Veronica Berdiñas-Torres, Malika Bouterfas, Clémentine Boutry-Viellard, Kathrin Burckhardt, Michael Burkhardt, Barbara Bühlmann, Eugenia Cabot, Eduardo Carrasco Yopez, Kevin Ceresa, 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, 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, Valentin Keller, Sinan Köksoy, Georg Klaus, Anja Klingeböck, Axel Kramer, Amit Kumar, Adamos Kyriakou, Chung-Huan Li, Marco Lichtsteiner, Iaria 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, Davnah Payne, Marcin Pastewski, David Perels, Sergey Perov, Serge Pfeifer, 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, Mimi Sun, Magnus Sundberg, Iris Szankowski, Dominik Szczerba, Roger Yew-Siow Tay, Frederico Teixeira, Joseph Tharayil, David Trudel, Markus Tuor, Saskia Venema, Ioannis Vogiatzis Oikonomidis, Ondrej Voles, Michelle von Stubbs, Daniel Walser, Qiang Wang, Miriam Wanner, Martin Wälti, 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, Gu Zong

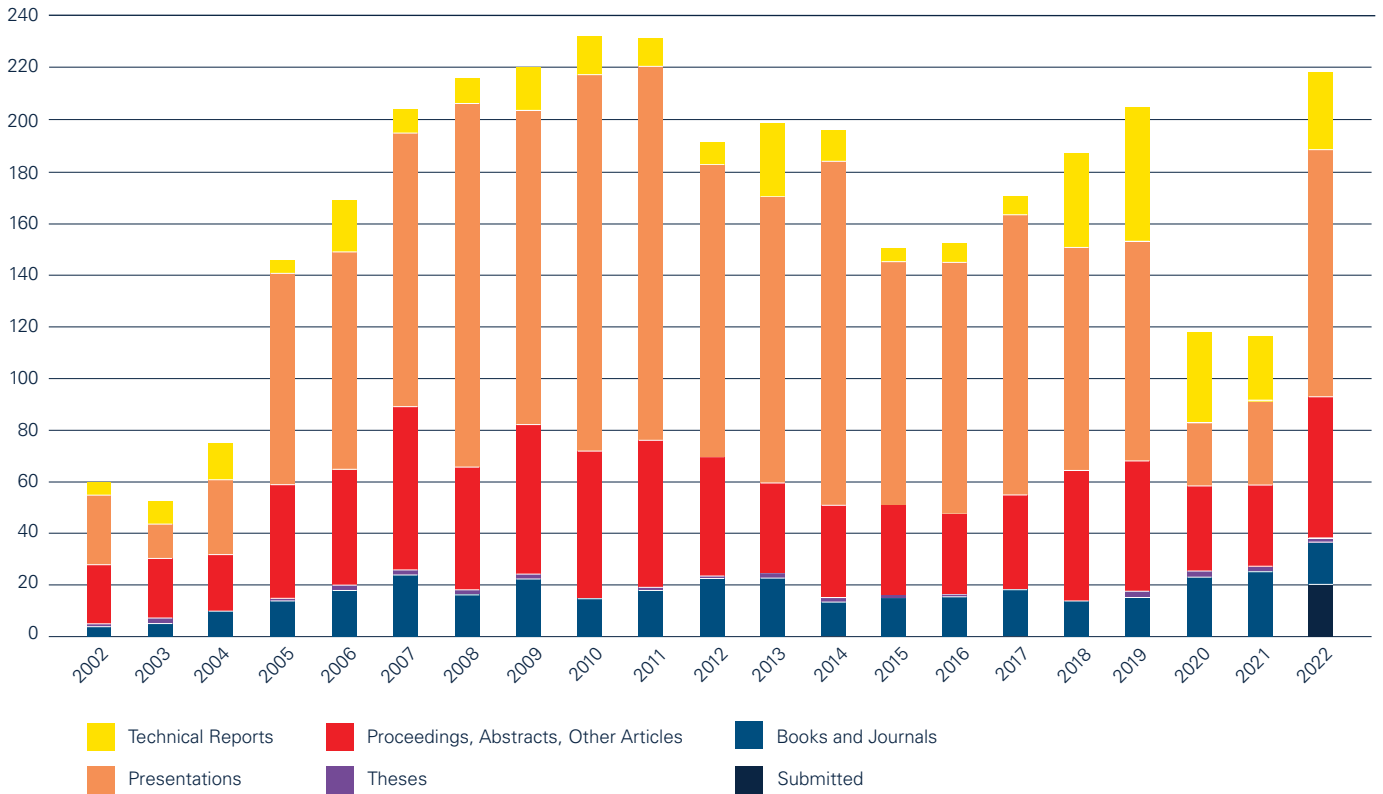
# KEY FIGURES

Level of Funding (in 1000 CHF)

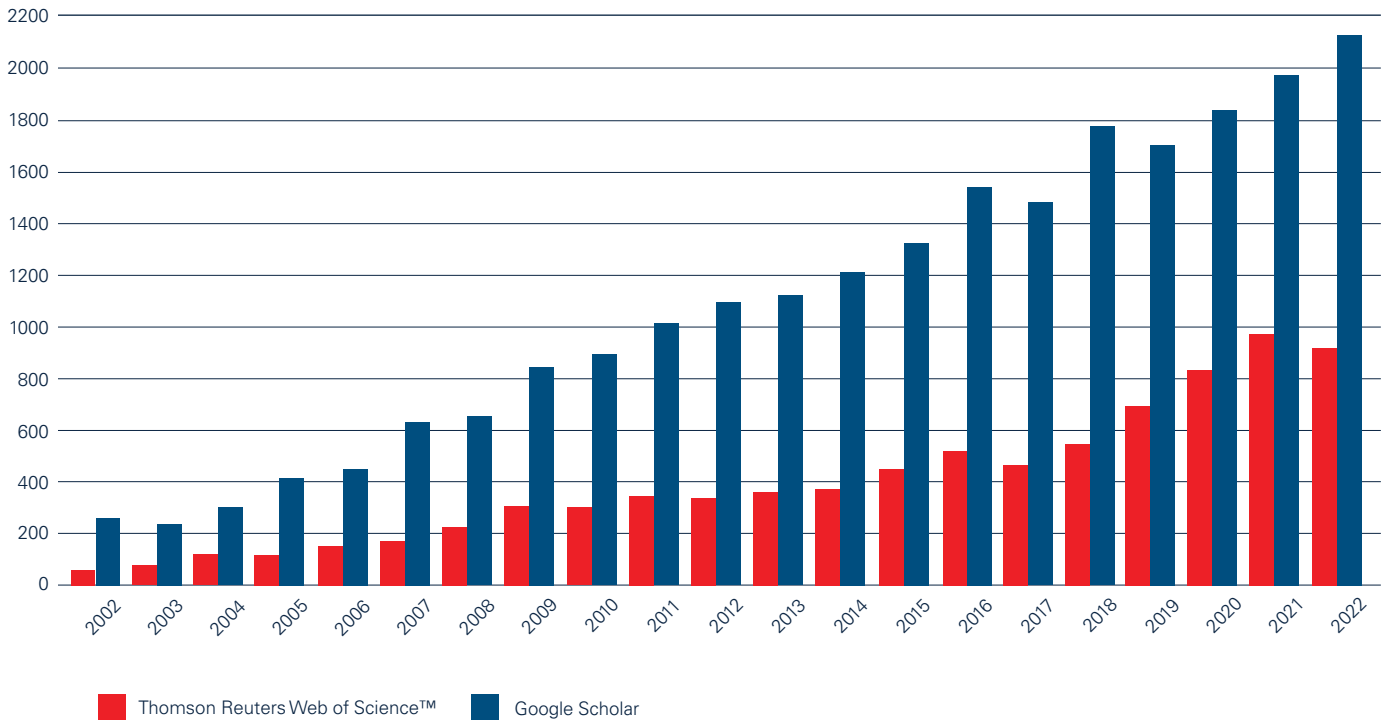


# KEY FIGURES

## 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 is for peer-reviewed publications, with self-citations excluded. 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  
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European Organization for Nuclear Research, CH  
Swiss Tropical and Public Health Institute, CH  
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Interuniversity Microelectronic Center, BE  
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University of Toronto, CA  
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Third Military Medical University, CN  
Zhejiang University, CN  
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Fraunhofer Institute for 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  
Institute of Biophysics, Leibniz University Hannover, DE  
International University of Applied Sciences, DE  
IPK – Leibniz Institute of Plant Genetics and Crop Plant Research, DE  
Ludwig Maximilian University of Munich, DE  
Max Planck Institute for Human Cognitive and Brain Sciences, DE  
Max Planck Institute for Neurological Research, DE  
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Danish Cancer Society, DK  
Department of Electronic Systems, Aalborg University, DK  
Technical University of Denmark, DK  
University of Aarhus, DK  
Autonomous University of Madrid, ES  
Centre for Research in Environmental Epidemiology, ES  
Institute of Cancer Molecular and Cellular Biology, University of Salamanca, ES  
ISGlobal – Instituto de Salud Global Barcelona, ES  
Research Centre for Energy Resources and Consumption, ES  
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Helsinki University of Technology, 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 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  
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National University of Ireland Galway, IE  
The Gertner Institute for Epidemiology and Health Policy Research, IL  
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Delft University of Technology, NL  
Erasmus University Rotterdam, NL  
Institute for Risk Assessment Sciences, Utrecht University, NL  
TNO Physics & Electronics Laboratory, NL  
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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  
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University Hospital Erlangen, Friedrich-Alexander-University, DE  
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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 MC – Daniel den Hoed Cancer Center, 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

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Federal Office of Communications, CH  
Federal Office of Public Health, CH  
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Swiss Federal Office of Energy, CH  
World Health Organization, CH  
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SITT, Industry Canada, CA  
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State Radio Monitoring Center, Ministry of Information Industry, CN  
Telecommunication Metrology Center, CN  
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National Frequency Agency, FR  
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Italian National Agency for New Technologies, Energy and Sustainable  
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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, JP  
SB-Kawasumi, JP  
Takeda Pharmaceutical Company, JP  
Toshiba, JP  
Dymstec, KR  
HCTM, KR  
ONWARD Medical B.V., NL  
Philips Medical Systems, NL  
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Flex, US/SG  
GE Healthcare, US  
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Qualcomm, US  
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Setpoint Medical, US  
Synchron, US  
Synopsis Inc., US  
WiTricity, US

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

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5<sup>th</sup>–9<sup>th</sup> Framework Programmes of the European Union, BE  
Centre for Technology Assessment, CH  
EUREKA, BE  
EUROSTARS, BE  
Innosuisse – Swiss Innovation Agency, CH  
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 National Science Foundation, CH  
The Netherlands Organisation for Health Research and Development, NL  
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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 Zurich, CH  
University of Zurich, CH  
Wyss Center for Bio and Neuroengineering, CH

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AMI Semiconductor, CA  
Association of Radio Industries and Businesses, JP  
Arizona Chemical, US  
Auden Techno Corp., TW  
Biotronik, DE  
Boston Scientific Corporation, US  
Cisco Systems, US  
Clarins Laboratories, FR  
Cochlear, US

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

## **Small and Medium Enterprises**

41Medical AG, CH  
Autem Medical, US  
Cardiatis S.A., BE  
Clarity, US  
Felsenmeer AG, CH  
Healtis, FR  
Mainstay Medical, IE  
maxwave AG, CH  
Medico S.p.A., IT  
Pharma Digital, CH  
Schmid & Partner Engineering AG, CH  
Sensimed AG, CH  
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
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
WPT4FOIL	Preventing chronic migraine with a novel wirelessly powered implantable bioelectronic foil

## EM Exposure and Risk Assessment

Brain in a dish	Effects of radiofrequency electromagnetic fields (5G) on brain development and neurodegeneration
FOEN – Sleep	A causal role for a voltage-gated Ca <sub>v</sub> 1.2 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 <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 – 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 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 – PREP2GO	Development of a pre-operative planning system for neuromodulation surgery for spinal cord injury rehabilitation
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
STASIS	Standardisation for safe implant scanning in magnetic resonance imaging
STANDARDIZATION	Participation in regulatory activities (standards committees and governments)
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

# TEMPORAL INTERFERENCE STIMULATION HARDWARE AND PLANNING SOFTWARE TO BOOST TRANSCRANIAL DEEP BRAIN STIMULATION RESEARCH

In 2017, the IT'IS Foundation, together with research partners MIT, Harvard, and Imperial College, published their seminal paper introducing non-invasive temporal interference stimulation (TIS), and since then, the topic has attracted a great deal of attention in the research community. TIS uses interfering high-frequency electrical fields to stimulate and/or modulate neural activity and is capable of targeting deep brain structures – without activating overlaying ones – via standard electrodes mounted on the head. The publication<sup>1</sup> has now been cited in nearly 400 papers, and the potential of the approach has been demonstrated in preliminary animal and human studies in a range of applications: (i) TIS in the brain to improve memory performance and motor learning and to kindle or suppress epileptic activity, (ii) TIS of the spinal cord for respiratory control, (iii) TIS of the peripheral nerves for sleep apnea management, and (iv) others<sup>2,3</sup>. The researchers at IT'IS have taken a prominent role in enabling and supporting TIS research and have been involved in numerous studies to provide optimized and sometimes personalized stimulation parameters.

One of the challenges of TI research is that well-controlled, targeted stimulation requires high-end hardware and powerful planning tools, which should also allow sensitivity analysis. Further, as TIS is a relatively new type of transcranial electrical stimulation, a careful safety evaluation should be performed for each experiment.

**TIS Hardware:** TIS places high demands on hardware that are not met by other electric stimulation technologies currently available. These include up to 8 synchronized channels, a high degree of channel isolation, excellent suppression of inter-modulation products, a wide frequency range (0 – >100 kHz), as well as flexible temporal pulse shapes and phase modulation. Compatibility with electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) acquisition is highly desirable. In December 2019, IT'IS and its MIT, Harvard, and Imperial College

partners, together with NF Technology Holding AG, founded TI Solutions AG in Zurich to jointly develop high-quality and flexible hardware to be made available to researchers for a small fee to boost both basic research and potential therapeutic applications. An Early Adopter Program, set up specifically for this purpose, allows interested research groups to submit study proposals for evaluation by the TI Solutions' Review Board. Applicants with projects that meet criteria for quality and that have good prospects for success can lease TI devices for a monthly fee. As many as 100 devices, including support, will be made available to qualifying research groups in 2023.

**TI Planning Tool:** The IT'IS team has established a TI brain stimulation modeling pipeline that (i) makes use of artificial intelligence, i.e., convolutional neural networks, to segment medical image data and create detailed, accurate, and personalized anatomical models and mapping of brain heterogeneity and anisotropy from diffusion tensor imaging (DTI); (ii) positions the electrodes according to the international 10-10 system of electrode placement; and (iii) applies the advanced solvers of ZMT's [Sim4Life](#) simulation platform to compute the magnitude of the induced electromagnetic fields and interactively optimize treatment parameters with multiple targets. Furthermore, the tool also supports DTI-based extraction of brain network connectivity, modeling of brain activity with and without stimulation based on mean field or neural mass in collaboration with the researchers from [The Virtual Brain team](#), and a reciprocity theorem-based approach for predicting measurable brain signals such as EEG. This advanced workflow is used both for in-house research and to support our experimental and clinical partners. However, to ensure that the broader community has access to TIS planning without having to be experts in computational modeling, IT'IS has leveraged its cloud-based [o<sup>2</sup>S<sup>2</sup>PARC](#) platform, developed under the [NIH SPARC program](#) to advance bioelectronic medicine, to release a user-friendly, step-by-step guided, interactive, and visual planning tool.



New hardware for temporal interference research, consisting of the *Intelligent Current Source* (left) with its unique specifications (see text) and hardware-based safety features, which delivers precise currents to up to eight electrode pairs via an *Electrode Connection Box*. The setup also includes a computer, two emergency stops, and electrical trigger inputs and outputs, all connected via an optical interface. Any type of experimental protocol can be scripted by means of the *Application Programming Interface*, and all relevant information (stimulation protocol, currents, voltages, impedances, inputs) is continuously recorded and displayed in a standardized monitoring window.

The first version of the tool, [TIP V1.0](#), makes use of pre-computed fields on standard anatomical models from the [IT'IS Virtual Population](#). In parallel, research has been conducted to quantify the various sources of uncertainty involved in TIS modeling.

TIS Safety: Recently, a [Zurich43](#) working group was established to develop comprehensive [guidance](#) outlining safety concerns and establishing thresholds for the safe use of TIS. To this end, literature on well-established transcranial and invasive electrical brain stimulation methodologies and adverse events was reviewed, safety-relevant interaction mechanisms and associated exposure metrics were identified, and dosimetric simulations of classical stimulation scenarios were applied to derive thresholds for safe use of TIS, taking into account the underlying biophysics. It is hoped that this guidance<sup>4</sup> will not only assist researchers in their experiments on the use of TIS but will also inform the submission of study protocols to review boards.

At IT'IS, we continue to be excited about the potential and intricacies of TIS and believe that, in time, TIS will prove to be successful and achieve sustainable adoption. To that end, we will continue to facilitate TIS research with the best hardware and software tools toward developing viable TIS-based approaches for minimally invasive treatment of patients.

<sup>1</sup> Grossman *et al.*, *Noninvasive Deep Brain Stimulation via Temporally Interfering Electric Fields*, *Cell*, 169(6):1029–1041, 2017; doi: <https://doi.org/10.1016/j.cell.2017.05.024>

<sup>2</sup> Vassiliadis *et al.*, *Non-Invasive Stimulation of the Human Striatum Disrupts Reinforcement Learning of Motor Skills*, *bioRxiv* 2022.11.07.515477; doi: <https://doi.org/10.1101/2022.11.07.515477>

<sup>3</sup> Violante *et al.*, *Non-Invasive Temporal Interference Electrical Stimulation of the Human Hippocampus*, *bioRxiv* 2022.09.14.507625; doi: <https://doi.org/10.1101/2022.09.14.507625>

<sup>4</sup> Cassarà *et al.*, *Safety Recommendations for Temporal Interference Stimulation in the Brain*, *bioRxiv* 2022.12.15.520077; doi: <https://doi.org/10.1101/2022.12.15.520077>

# 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<sup>2</sup>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
- 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
- 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 Amplifiers, ZHL42, 700–4200 MHz
- 2 Mini-Circuit Amplifiers, ZVE-8G, 2–8 GHz
- 1 Nuclitudes ALP336 Amplifier, 1.5–2.5 GHz
- 2 Ophir 5141, 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<sup>2</sup>S<sup>2</sup>PARC:
  - (3 nodes) each 64 core AMD 2.25 GHz, 256 GB RAM, 500 TB storage (total)
  - 1 Extension of o<sup>2</sup>S<sup>2</sup>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 Network Data Storage Servers, QNAP
- 8 Servers; from Dalco
- 9 Miscellaneous Peripherals, e.g., network devices, printers, scanners, etc.

# SELECTED PUBLICATIONS

- M. Steiner, *Personalized Brain Stimulation Planning and Correlation with Functional and Behavioral Responses in a Temporal Interference Stimulation Trial*, Master Thesis, ETH Zurich, March 2022.
- N. R. Datta, B. M. Jain, Z. Mathi, S. Datta, S. Johari, A. R. Singh, P. Kalbande, P. Kale, V. Shivkumar, and S. Bodis. *Hyperthermia: A Potential Game-Changer in the Management of Cancers in Low-Middle-Income Group Countries*, *Cancers*, 14(2):315, January 2022.
- A. Rowald, S. Komi, R. Demesmaeker, E. Baaklini, S. D. Hernandez-Charpak, E. Paoles, H. Montanaro, A. Cassarà, F. Becce, B. Lloyd, T. Newton, J. Ravier, N. Kinany, M. D'Ercole, A. Paley, N. Hankov, C. Varescon, L. McCracken, M. Vat, M. Caban, A. Watrin, C. Jacquet, L. Bole-Feysot, C. Harte, H. Lorach, A. Galvez, M. Tschopp, N. Herrmann, M. Wacker, L. Geernaert, I. Fodor, V. Radevich, K. Van Den Keybus, G. Eberle, E. Pralong, M. Roulet, J. B. Ledoux, E. Fornari, S. Mandija, L. Mattera, R. Martuzzi, B. Nazarian, S. Benkler, S. Callegari, N. Greiner, B. Fuhrer, M. Froeling, N. Buse, T. Denison, R. Buschman, C. Wende, D. Ganty, J. Bakker, V. Delattre, H. Lambert, K. Minassian, C. A. T. van den Berg, A. Kavounoudias, S. Micera, D. Van De Ville, Q. Barraud, E. Kurt, N. Kuster, E. Neufeld, M. Capogrosso, L. Asboth, F. B. Wagner, J. Bloch, and G. Courtine. *Activity-Dependent Spinal Cord Neuromodulation Rapidly Restores Trunk and Leg Motor Functions after Complete Paralysis*, *Nature Medicine*, 28:260–271, February 2022.
- E. Stutz, E. Puric, A. Ademaj, A. Künzi, R. Krcek, O. Timm, D. Marder, M. Nötter, S. Rogers, S. Bodis, and O. Riesterer. *Present Practice of Radiative Deep Hyperthermia in Combination with Radiotherapy in Switzerland*, *Cancers*, 14(5):1175, February 2022.
- A. Cabré-Riera, L. van Wel, I. Liorni, M. Elisabeth Koopman-Verhoeff, L. Imaz, J. Ibarluzea, A. Huss, J. Wiart, R. Vermeulen, W. Joseph, M. Capstick, M. Vrijheid, E. Cardis, M. Röösl, M. Eeftens, A. Thielen, H. Tiemeier, and M. Guxens. *Estimated All-Day and Evening Whole-Brain Radiofrequency Electromagnetic Fields Doses, and Sleep in Preadolescents*, *Environmental Research*, 204(Part C):112291, March 2022.
- K. Iranshahi, J. Schoeller, N. Luisier, M. Chung, S. Hashemi Zadeh, G. Fortunato, T. Defraeye, and R. Rossi. *Improving Needleless Electrospinning Throughput by Tailoring Polyurethane Solution Properties with Polysiloxane Additives*, *ACS Applied Polymer Materials*, 4(3):2205–2215, March 2022.
- S. Bodis, P. Ghadjar, and G. van Rhoon. *Oncologic Thoranradiotherapy: Need for Evidence, Harmonisation, and Innovation*, *Cancers*, 14(10):2418, May 2022.
- 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):22441547, June 2022.
- R. Poni, E. Neufeld, M. Capstick, S. Bodis, and N. Kuster. *Rapid SAR Optimization for Hyperthermic Oncology: Combining Multi-Goal Optimization and Time-Multiplexed Steering for Hotspot Suppression*, *International Journal of Hyperthermia*, 39(1):758–771, June 2022.
- J.-F. Aubry, O. Bates, C. Boehm, K. Butts Pauly, D. Christensen, C. Cueto, P. Gelat, L. Guasch, J. Jaros, Y. Jing, R. Jones, N. Li, P. Marty, H. Montanaro, E. Neufeld, S. Pichardo, G. Pinton, A. Pulkkinen, A. Stanzola, A. Thielscher, B. Treeby, and E. van 't Wout. *Benchmark Problems for Transcranial Ultrasound Simulation: Intercomparison of Compression Wave Models*, *Journal of the Acoustical Society of America*, 152(2):1003, August 2022.
- E. Acerbo, A. Jegou, C. Luff, P. Dzialecka, B. Botzanowski, F. Missey, I. Ngom, S. Lagarde, F. Bartolomei, A. Cassara, E. Neufeld, V. Jirsa, R. Carron, N. Grossman, and A. Williamson. *Focal Non-Invasive Deep-Brain Stimulation with Temporal Interference for the Suppression of Epileptic Biomarkers*, *Frontiers in Neuroscience*, 16: 945221, August 2022.
- K. S. Cujia, A. Fallahi, S. Reboux, and N. Kuster. *Experimental Exposure Evaluation from the Very Close Near- to the Far-Field Using a Multiple-Multipole Source Reconstruction Algorithm*, *IEEE Transactions on Antennas and Propagation*, 70(9):8461–8472, September 2022.
- B. Botzanowski, M. J. Donahue, M. Silverà Ejneby, A. L. Gallina, I. Ngom, F. Missey, E. Acerbo, D. Byun, R. Carron, A. M. Cassarà, E. Neufeld, V. Jirsa, P. S. Olofsson, E. D. Glowacki, and A. Williamson. *Noninvasive Stimulation of Peripheral Nerves using Temporally Interfering Electrical Fields*, *Advanced Healthcare Materials*, 11(7):2200075, September 2022.
- G. Castellanos, S. De Ghesellea, L. Martens, N. Kuster, W. Joseph, M. Deruycka, and S. Kühn. *Multi-Objective Optimisation of Human Exposure for Various 5G Network Topologies in Switzerland*, *Computer Networks*, 216:109255, October 2022.
- A. Christ, A. Fallahi, E. Neufeld, Q. Balzano, and N. Kuster. *Mechanism of Capacitive Coupling of Proximal Electromagnetic Sources with Biological Bodies*, *Bioelectromagnetics*, 43(7):404–412, October 2022.
- 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, December 2022.
- M. Colella, D. Z. Press, R. M. Lahrer, C. E. McIlduff, S. B. Rutkove, A. M. Cassarà, F. Apollonio, A. Pascual-Leone, M. Liberti, and G. Bonmassar. *A Study of Flex Miniaturized Coils for Focal Nerve Magnetic Stimulation*, *Medical Physics*, December 2022.
- 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*, December 2022.
- 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 Thalamocortical Circuit Model of Wakefulness and Sleep*, submitted.
- 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*, submitted.
- 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. *LTP-Like Noninvasive Striatal Brain Stimulation Enhances Striatal Activity and Motor Skill Learning in Humans*, submitted.
- 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*, submitted.
- 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*, submitted.
- M. Solihin Zulkefli, K. Zhang, M. Sarestoniemi, S. Myllymäki, W. G. Whittow, S. Kühn, N. Kuster, S. Yan, and P. J. Soh. *Design and Experimental Wireless Link Assessments of an Ingestible PIFA for Biotelemetry*, submitted.
- C. Bujard, E. Neufeld, M. Douglas, J. Wiart, and N. Kuster. *A Gaussian-Process-Interpolation-Model-Based Approach for Robust, Independent, and Implementation-Agnostic Validation of Complex Multi-Variable Measurement Systems: Application to SAR Measurement Systems*, submitted.
- J. Rintoul, E. Neufeld, C. R. Butler, R. O. Cleveland, and N. Grossman. *Remote Encoding and Decoding of Electric Fields through Acoustoelectric Heterodyning*, submitted.
- J. B. A. Brus, J. A. Heng, V. Beliaeva, F. Gonzalez, A. M. Cassara, E. Neufeld, M. Grueschow, and R. Polania. *Causal Rhythmic Control of Feature-Based Attention in Human Prefrontal Cortex*, submitted.
- A. Fallahi, S. Hashemi Zadeh, and N. Kuster. *Dielectric Spectroscopy of High Permittivity Thin Solids Using Open-Ended Coaxial Probes*, in: *Proceedings of the 16<sup>th</sup> European Conference on Antennas and Propagation (EuCAP 2022)*, Madrid, Spain, March 27 – April 1, 2022.
- N. Kuster and A. Yao. *EM Exposure Risks for Persons with Implants: A Neglected Population?*, in: abstract program of the 1<sup>st</sup> Annual Meeting of the BioEM Society (BioEM 2022), Nagoya, Japan, June 19 – 24, 2022 (invited oral presentation).
- F. Karimi, E. Neufeld, A. Fallahi, M. H. Capstick, A. Spiegelberg, A. Boraschi, J. J. M. Zwanenburg, V. Kurtcuoglu, and N. Kuster. *Towards a Non-Invasive Craniospinal Compliance Biomarker*, in: abstract program of the 1<sup>st</sup> Annual Meeting of the BioEM Society (BioEM 2022), Nagoya, Japan, June 19 – 24, 2022.
- N. Chavannes, E. Neufeld, M. Guidon, O. Maiz, and N. Kuster. *An Open, Collaborative, Reproducible, Cloud-Based, and FAIR Future for EM Modeling and CLS: The o<sup>2</sup>S<sup>2</sup>PARC Platform*, in: *Proceedings of the IEEE International Symposium on Antennas & Propagation & USNC-URSI Radio Science Meeting (IEEE AP-S/URSI 2022)*, Denver, USA, July 10 – 15, 2022, (invited oral presentation).
- A. M. Cassarà, E. Neufeld, S. J. Regel, and N. Kuster. *Analysis of Prediction Uncertainty Assessment of Treatment Planning for Non-Invasive Brain Stimulation Techniques*, in: abstract program of the 51<sup>st</sup> Annual Meeting of the Society for Neuroscience (Neuroscience 2022), San Diego, USA, November 12 – 16, 2022.



## *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".

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

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