

# South Africa - National Report 2021

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## Government Activities

The National Research Foundation (NRF) has taken over the role of WHO IAC country reporting and advisory body. The NRF is an entity of the Department of Science and Innovation (DSI). Its mandate is to promote and support research through funding, human resource development, and the provision of National Research Facilities in the fields of natural, medical, social sciences, humanities, and technology. The NRF serves as the National body responsible for adhering to a number of international bodies regulations, including the International Science Council's (ISC) requirements. Further details regarding the NRF can be accessed via the following link: <https://www.nrf.ac.za/about-nrf>.

Since 2015 the NRF has increased research efforts that have focused on developing science-based solutions to the effects of increased exposure to ionizing and non-ionizing radiation. This includes non-native electromagnetic (EM) fields (EMF), infrared, optical, and ultraviolet photons. The NRF has distinguished itself in emerging research, and has vast interdisciplinary experience having coordinated input from multiple fields. The NRF is committed to strengthening the civic role and social responsibility of the higher education sector and promoting the fundamental role of science and research in development. Further, it seeks to support policy formation through developing and nurturing expertise across disciplines. The benefit of more rigorous and fact-based standards will assist in achieving transparent, effective, and accountable government in South Africa.

## Research Activities

South Africa is part of multi-national research endeavors with, for example, the Netherlands (NL), France (FR), Italy (IT), Germany (DE), Poland (PL), Nigeria (NI), Russia (RU), and Hungary (HU) to name but a few.

Recommended updates to current research endeavors:

1. In multidisciplinary research endeavors with cost-reduction goals, projects should strive to achieve synergistic outcomes and employ non-linear statistical analysis for evaluation. For example, with the SharkSafe Barrier project, using static magnets demonstrates safer swimming areas, but when coupled with nanobubble generation and oyster banks it provides synergistic bio-restoration, marine farming, water treatment, storm wave surge protection, tourism, and medical solutions.

2. The COVID-19 pandemic has had an unprecedented economic impact on global health care, and there is a need for improving cost-effective treatment strategies. EM / sub-molecular medical science treatments can be implemented in an economically affordable and sustainable manner within the Climate Change Framework. For example, in orthopedics, patients that have been operated on initially achieve significantly better outcomes than those who do not undergo surgery. However, in the long term, just over half of the patients that undergo rotator cuff repair (for example) present a recurrent tear. As such, this subgroup has comparable outcomes to those individuals treated by physical therapy only. Hence, there is a stringent need to:
  - (1) develop a decision-making tool to identify patients that are more likely to heal and benefit from surgery than conservative non-invasive treatment in the mid to long-term;
  - (2) to investigate innovative cost-effective approaches to improve healing rates of patients that undergo surgery. Our current methodological and translational research project aims at grading and ranking risk factors to predict rotator cuff retear likelihood as well as investigating if a novel non-pharmacological add-on rehabilitation protocol can enhance the healing process.
3. Deuterium has been shown to be of importance in medical applications involving moving biological networks. It has the largest magnitude natural stable isotope related to discrepancy in behavior when compared to that of hydrogen in hydrogen bonding and moving biological networks. The deuterium's parent ion is a proton with extensive substitution-related kinetic isotope effects due to environmental exposures that medical science needs to address in the near future. Deuterium has an interesting relationship with ultraviolet (UV) photons and repels light absorption in the red and Near-Infrared Range (NIR). It is important for growth, but when in abundance or incorrect location can bring about mitochondrial dysfunction. Furthermore, MRI data interpretation can benefit from translational Deutenomics. Deuterium Metabolic Imaging is difficult to develop due to its loss to metabolic water within living organisms. New nuclear quantum event-based approaches offer hope as Deutenomics deals with proton binding and moving biological architectures in the presence of deuterium. These approaches mean one no longer needs to scan deuterium to see deuterium in proton binding networks.
4. Radiofrequency (RF) electromagnetic fields (RF-EMF) were shown to induce oxidative stress in cell cultures and in animal studies. This can lead to mtDNA damage as mitochondrial DNA is particularly vulnerable to reactive oxygen species (ROS). Besides the general effect on genome stability, affected organs include the brain and reproductive tract leading to impaired cognitive functions and decreasing fertility. In human epigenetic research, priority should be given to Mitochondrial DNA (mtDNA), and the role of coupled and uncoupled haplotype groups.
5. Magnetic field drop zone: NASA has been observing an unusually large weak spot in the Earth's magnetic field called the South Atlantic Anomaly, or SAA. Initially, over South America, it is migrating and extending over Southern Africa. Particle radiation in this SAA region can knock out onboard computers and interfere with the data collection of satellites that pass through it. Research groups must take into account current observations and model the behavior of the SAA in order to monitor and predict future changes. This will help prepare for future challenges to satellites, humans, and agriculture affected by the SAA. It is not only the magnetic field drop that is of importance but solar photon levels as well.

Our research team falls between the WHO teams for Environment, Climate Change and Health (ECCH) and Radiation and Health governed by the WHO Collaborative Effort Manifesto. EMF of a very broad range of frequencies represents one of the most common and fastest growing environmental influences. EMF has notably positive or negative effects, depending on the context it is employed in. EMF has been around since the birth of the universe, with light being its most familiar and significant form. Electric and magnetic fields are part of the spectrum of EM radiation, which extends from static electric and magnetic fields, through RF, UV, and infrared radiation (IR), to X-rays. Since 2017 there has been a growing consensus that Light EM has the most predominant effect on biochemistry both positive and negative.

The NASA Human Research Program (HRP) research methodology is employed by this research program and is beneficial in accelerating progress in our synergistic science-based research pedagogy. Small changes to terminology can have profound effects on research endeavors. Simple grammatical updates can lead to pedagogical improvements.

For example:

1. Lighting analysis research on plants, animals, and humans related to exposure regulations is mandated to shift the investigation approach from Energy Flux Models to Photon Flux Models.
2. UV radiation is better referred to as UV photons.
3. And, terms such as photosynthesis, photobiomodulation (PBM), and photodynamic therapy (PDT) are encouraged to include the letter “n” after the “photo”, thus referring to “photon” instead of “photo”.

## Completed research projects

1. F. Kyeyune, J.L. Botha, B. van Heerden, P. Maly, R. van Grondelle, M. Diale, T.P.J. Krüger. “Strong plasmonic fluorescence enhancement of individual plant light-harvesting complexes.” *Nanoscale* 11:15139-15146 (2019) <https://doi.org/10.1039/C9NR04558A>
2. Md. Wahadoszamen\*, T.P.J. Krüger\*, A.M Ara, R. van Grondelle, M.S. Gwizdala, “Charge-transfer states in phycobilisomes.” *Biochim. Biophys. Acta – Bioenergetics* 1861:148187 (2020) (\*equal contribution) <https://doi.org/10.1016/j.bbabi.2020.148187>
3. M. Gwizdala P.H. Lebre, G. Maggs-Kölling, E. Marais, D.A. Cowan, T.P.J. Krüger, “Sub-lithic photosynthesis in hot desert habitats.” *Environ Microbiol* XXXX (2021) <https://doi.org/10.1111/1462-2920.1550>
4. Chetty-Mhlanga, S., Fuhrimann, S., Eeftens, M., Basera, W., Hartinger, S., Dalvie, M.A. and Röösl, M., 2020. Different aspects of electronic media use, symptoms, and neurocognitive outcomes of children and adolescents in the rural Western Cape region of South Africa. *Environmental Research*, 184, p.109315.
5. Sabino, C.P., Ball, A.R., Baptista, M.S., Dai, T., Hamblin, M.R., Ribeiro, M.S., Santos, A.L., Sellera, F.P., Tegos, G.P., and Wainwright, M., 2020. Light-based technologies for the management of COVID-19 pandemic crisis. *Journal of Photochemistry and Photobiology B: Biology*, p.111999.
6. Adams, B. and Petruccione, F., 2020. Quantum effects in the brain: A review. *AVS Quantum Science*, 2(2), p.022901.
7. Dutch Hacking Health Award 2020: the SA-NL bi-lateral agreement produced the winning solution in the Dutch Hacking Health Awards. It is a means of converting ubiquitous devices such as smartphones, tablets, TVs, displays, projectors, monitors, and computers into PBM add-on therapy devices for managing sleep problems and neurological disorders. The current Apple OS facilitates the Minimum Viable Product (MVP). Google has been provided instructions to meet the same MVP requirements. The MVP demonstrates a significant reduction in user electrical consumption.

## Further, ongoing research projects include:

- BATTLE Dementia (Using Biomodulation and AI to Trace and Target -- through a Living field labs intervention -- Early-stage dementia).
- Netherlands Police resilience training program.
- Cold / Ocean Joy biomodulation on cardiology, neurology, and urology.
- NLC project: Cellular and Molecular Mechanisms of PBM.
- NRF SARCHI Chair: Laser Applications in Health
- Translational model from plant to human photonsynthesis.
- Static magnetic fields on plant photonsynthesis.
- Static magnetic fields on human photonsynthesis
- The Effect of Risk Factors, Surgical Technique and Biomodulation on Tendon Healing after Rotator Cuff Repair.
- Weak static magnetic field combined with salinity and light provides (poly-)isotopic correction of metabolic abnormalities to enhance sub-cellular thresholds against deuterium concentrations.
- Analgesic effect of PBM in oral surgery and accelerated wound repair.
- Biomodulation on ameliorating cardiovascular risks in cyclists.
- Nanofluidic dynamics to EM Zeta potential water changes to improving Coffee machines.
- EM Zeta potential water and static magnetic fields to improve coffee plantations agriculture output.
- Nanofluidic dynamics to EM Zeta potential water changes in hair salons.
- The effect of poultry growth and sanitation through biomodulation.
- MRI scan methodologies: magnetic resonance spectra of protons and deuterons overlapping to study their ratios with kinetic isotope effects even at the levels found in human tissues.
- MRI and NMR radiologist and technician safety analysis.
- Deuterium analysis in foods, beverages and consumables.
- Tan through clothing and swimwear.
- Bioelectric enabled footwear.
- Shark Safe barrier, bio-restoration, and carbon sequestration.
- Deuterium GIS Wine, gravitational lensing, and ELF-UV.
- Global deuterium isotope GIS map dataset.
- Incorporation of Chinese Geomancy with GIS, a hydrological analysis with EM, and hydrogen/deuterium fractionation potentials.
- Valorization Startup Hub mentorship program, Amsterdam, NL.
- National Statistics, CENSUS, South Africa.
- The Ocean and River Cleanup Project.
- The Boring company.
- Nanofluidic EM polymers on wheelchairs. Enabling collapsible/foldable wheelchairs for lightweight travel (car, air, train, boat).
- Offshore cloud computing data centers.
- Bacteria used as a cleaning solution and replacement to chemical cleaning solutions.
- Marik's IV protocol for Sepsis as a cost-effective model to ameliorate hypoxia and mitochondrial failure.
- Analysis of cryptocurrency model as a social-ecological system (SES) in decentralized medicine, and agriculture.
- The Yarkovsky effect and colour pink on cancer development.
- Prisoner Reform Program (PRP).

## New policies and legislations regarding EMF exposure

SA still does not have an EMF projection standard in place, nor legislation to govern the import, use, and application of laser devices for medical applications. In the RF telecommunications domain, the Minister of Communications has instructed the telecommunications regulator ICASA to help establish such a guideline and or standard. Currently, there is a disagreement between operational management, civic duty, and the executive board regarding the design and roll-out of such a system. The 2017 government study - following reviews by multiple organs of state - does endorse a means of achieving a working EMF protection standard within 12-16 months. However, current political obstacles are curtailing this development. It is suggested that these obstacles are confronted in order to reduce social unrest and resource expenses related to increasing litigation.

## Further areas of public concern and concomitant national responses

**Utilities SMART meters:** Similar to both FR and NL, in SA some members of the public, and municipal pilot projects have submitted complaints about SMART meter installations. One of the main complaints surrounds RF emissions. Both in FR, and the NLs some members of the public have been granted the “old” or digital meter system over the newer SMART meters. In the SA High Court 2017, it was suggested the primary setting default to ethernet (hardwire) for utility SMART meters. This brings about advantages synergistic with other promoted services, i.e. increased data security, faster-broadband infrastructure, and reduced RF spurious emissions. However, according to USA court case reviews, there may still be an issue of voltage transients. If this is still the case it can have detrimental effects on electronics and or sensitive medical or scientific research equipment.

**Energy transmission:** Similar to Germany, with increasing electrical energy demands and services the generation and transmission of power is requiring increasing proximity between the generating source, transmission line, and the population. This is also evident with the expansion of renewable energy and the upgrading of existing infrastructure. There is general consensus that additional precautionary and safety measures are required when erecting or significantly altering low-frequency installations and direct current installations. Possibilities must be exhausted to minimize the EM and EMF generated by the respective installation using state-of-the-art processes taking into account the circumstances within the respective installers’ sphere of influence. Installations of low-frequency electricity transmission infrastructure (with a frequency of 50 Hz and a rated voltage of 220 Kilovolt and more) which are being erected in new areas are not allowed to be erected over buildings or parts of buildings intended for the long-term occupation of humans. Recent advances in technology, unified with the requirements of the state promise substantial reductions in project CAPEX and ongoing operating costs.

**Electric vehicles (EV):** EVs require an expanded and accelerated rollout of necessary infrastructure. After reviewing the positive and negative concerns raised in the literature, there seems to be an emerging consensus that EVs design can be modified with minimal effort to address negative factors. In the context of the RSA, the opportunity to export EVs into the AU presents a number of economic opportunities. At the same time, it presents an opportunity to address environmental concerns related to EVs. EV’s are here to stay and the field must be addressed.

**Electrohypersensitivity (EHS):** Similar to findings in IT, FR, and the NLs, a number of individuals have reported a variety of health problems that they relate to EMF exposure at home and in the workplace. Rulings have acknowledged that EMF-related health issues could result in workplace-related accidents or illness. The biggest obstacle to date has been identified as the miscommunication of, and the misunderstanding of the specific interactions between EM and biological organisms. Different EM spectrums can bring about different symptoms. Population vulnerability and bio-adaptation vary between mtDNA haplotype groups. The use of the term Electromagnetic hypersensitivity (EHS) has brought about further confusion and miscommunication. This is a result of bodies not adhering to the Climate Change Framework scientific-technical analysis for compensation mechanisms which defines the parameters of classification as Sensitivity, Adaptability, and Vulnerability. This has been further explored in the 2017 SA govt. published study. The organs of state reviews have endorsed efforts toward adaptability strategies so that vulnerability can be reduced by strengthening adaptive capacity. It is for this reason that the decision has been taken to help update the teaching curriculum in medicine with biophysics in an effort to address these misunderstandings. The study into the model development surrounding “EHS” has not only brought about better understanding but also advanced cost-effective treatments into other epigenetic and genetic disease models.

In SA, the capacity of EMF to affect biological functions has been investigated and confirmed in reviews of the Ombudsman, Commission, Magistrate, and High Court. The WHO health and disabilities publication uses “disabilities” as an umbrella term to cover a wide range of conditions. The term “disabilities” covers impairments, activity limitations, and participation restrictions. An impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in life situations. Disability is thus not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person’s body (including physical, mental, neurological) and features of the society in which he or she lives. Overcoming the difficulties faced by people with disabilities requires interventions to remove environmental and social barriers. This makes it clear that people must be able to participate in society, function independently, and remain in their own living environment for as long as possible. Multiple international regulations confirm municipalities must promote this by virtue of providing facilities, assistance, and support. The government’s strategy toward bio-adaptation solutions is not only showing promise for persons with “EHS” type complaints but also has benefits in other spheres as well.

**PBM:** All hospitals and clinics are required to make use of PBM within their patient care and treatment options. The degree of PBM intensity is variable. Solutions are available to be cost-effective and efficient. SA does hold the resources for further R&D, and script regulatory requirements.

**Nanobubble water (NBW):** All hospitals and clinics are required to install and or retrofit existing installations to produce high concentration of NBs with increased dissolved oxygen (DO) content. DO are not to be produced using water electrolysis. All greywater systems require NB application prior to discharge into the environment.

**Consumable beverages isotope labeling:** Consumable liquids/beverages require the placement of bulk deuterium levels in ppm on their label packaging or else a link to a web display. Deuterium depleted water (DDW), SA has the facilities to produce and export reduced deuterium concentration levels in water.

**Pesticides:** glyphosate is to be phased out with immediate effect. UVC photons is an effective and endorsed replacement.

**Diabetes & Tuberculosis (TB):** PBM, NBW, and DDW all demonstrate cost-effective strategies toward alleviating the burden of diabetes and TB. They are to be utilized and propagated into use as much as possible.

**ICD code billing guidance and encompassed treatments within medical/health insurance schemes:** Plans are underway to work toward bringing forward advances in medicine related to the domain of this report. For example, rTMS, PBM, PDT, cryotherapy, NBW, DDW, electro-, etc... Completing this task not only provides relief on healthcare costs but also stimulates the economy, research and facilitates regulation of the use of such modalities and or treatment protocols.

The number of EMF and Climate Change related complaints received by various government departments has been increasing over time. In the past, these have not been handled optimally, but there is now a general consensus to strive toward cooperative solutions and synergy. One of the proposed means employed is to increase both technical and non-technical communication strategies. This will encourage the nation's inhabitants to become citizen scientists in a pedagogy that is aligned with this committees' voice.

## New public information initiatives

A single idea in quantum mechanics can be taken and put into practical application in the research sphere of EMF. The three (3) proposed quantum research spheres of the EMF project are:

1. Sub-molecular medical sciences.
2. Sub-molecular agricultural sciences.
3. Simulation, predictive modeling, and legislative policy development.

Examples of the application of sub-molecular medical sciences include:

1. Training of medical doctors (CPD training).
2. Improvement of medical services.
3. Improvement of human and animal health by mitigating environmental effects, and developing resilience programs to combat climate change and EMF.
4. Development of updated teaching curricula for 1st and 2nd-year medical students in biophysics.

In this regard, we propose developing the first set of courses aimed at Masters, PhDs, and Professionals to provide European Course credits in January 2022. These are:

1. Introduction to sub-molecular medical sciences.
2. Introduction to sub-molecular agricultural sciences.

## Public citizen science engagement and accelerated learning projects

Plans are currently underway to develop a cost-effective animated education series; DIY projects for at-home and/or government projects; and a Netflix series. The strategic reason for these communication mediums is a move toward enhancing accessibility requirements and making the material available in multiple languages, with subtitles, and other features addressing disability needs.

We thank the South African people and foreign agencies for their financial contributions via taxes and direct donations. With your support, our researchers have been able to provide and share the findings above which you have made possible through your investments and contributions.

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This report was commissioned by the WHO International EMF Project IAC - ZA and ISC. committee. Further details regarding the review committee can be accessed via the following [link](#).



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# **World Health Organization International EMF Project South African National Committee**

## **Overview**

The international electromagnetic field (EMF) project of the World Health Organization (WHO) is a collaborative effort of the WHO teams for Environment, Climate Change and Health (ECCH) and Radiation and Health (ionizing and non-ionizing). The purpose of the effort is twofold. Firstly it seeks to create and house a database of legislation pertaining to EMF exposure. Secondly, it seeks to promote dialogue on the risks related to EMF exposure.

The establishment of the EMF Project is motivated by the fact that EMF of a very broad range of frequencies represents one of the most common and fastest growing environmental influences on human health. EMF may have notable positive or negative effects on health, depending on the exposure context. EMF has been around since the birth of the universe, with light being its most familiar form. Electric and magnetic fields are part of the spectrum of electromagnetic radiation, which extends from static electric and magnetic fields, through radiofrequency, ultraviolet, and infrared radiation, to X-rays.

Various Organs of State have reviewed the research endeavors of the NRF in this emerging field and found that the research is innovative and strongly aligned with South Africa's national interests. The EMF project is a multidisciplinary research endeavor integrating efforts from multiple sectors. Of particular import to South Africa is research into EMF exposure risks, EMF shielding modifications, and bio-adaptation mitigation options related to climate change. The EMF Project is endorsed by the Surgeon General<sup>1</sup> and the Nation's doctor is provided with the best available scientific information on how to improve health outcomes and reduce the risk of illness and injury. The mission of the EMF Project is to protect, promote, and advance the health of our Nation.

## **EMF Project Initiatives**

**The three (3) research spheres of the EMF project are:**

1. Sub-molecular medical sciences.
2. Sub-molecular agricultural sciences.
3. Simulation, predictive modelling and policy development.

**Examples of the application of sub-molecular medical sciences include:**

1. Training of medical doctors (CPD training).
2. Improvement of medical services.
3. Improvement of human and animal health; mitigating harmful environmental effects of EMF radiation; and developing resilience programmes to combat climate change and EMF radiation.
4. Development of updated teaching curricula for 1<sup>st</sup> and 2<sup>nd</sup> year medical students in biophysics.

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<sup>1</sup> SG/R/311/5/13

## **Promotion of Revenue Streams:**

1. Accelerating implementation and procedure billables for advances in medicine utilising ICD-10/11 billing codes registered with the Board of Healthcare funders of SA, who hold responsibility for Sub-Saharan Africa.
2. Initiation and communication of international training scholarships.
3. Aid in securing research grants and partnerships with industry (domestic & abroad) in compliance with South Africa Revenue Services (SARS) regulations.

## **Legislative development:**

1. Provide consultant advisory services to South Africa, the World Health Organization, and [International Science Council \(ISC\)](#) committees.
2. Top-down and bottom-up initiatives: Top-down communication and consultancy with Parliament and its legislative drafting unit. Bottom-up are court applications and/or reviews that aid towards accelerating policy development that advance the safety and security interests of the Republic of South Africa.
3. Use of artificial intelligence (AI) to cost-effectively conduct predictive modelling and scenario mitigation options.

## **Scientific communications:**

1. Domestic and international media efforts (e.g. Netflix series), to inform the general public about conference or workshop outcomes.
2. Cost-effective animation suites, coupled with AI technology to take a single source script and animation and produce multiple versions instantly in various languages, accents, voices, and gender combinations.
3. Valorization programmes.
4. Taking a single idea in quantum mechanics putting it into practical application

## **Domains the EMF Project Addresses:**

Architecture, medicine, legislative development, sport, environment, tourism, water, pedagogy, police, military applications, agriculture, fisheries, social development, education, transport, climate change, power generation, advertising, aerospace, city planning, medical insurance, diagnostics, Artificial Intelligence (AI).

# National committee members 2021



## James Lech

WHO International EMF project representative – SA (Director & Chair).  
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## Prof. Tjaart Krüger



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## Nuclear Energy Regulator South Africa

- No response yet.



## Prof. Thomas Monsee

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## Prof. Heidi Abrahamse



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## dr. Adejoke Obajuluwa



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## Prof. Francesco Petruccione



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