Programa de Doctorado Ciencias y Tecnologías Físicas

"Doctoral Day" Programme–28 June 2021

Date and time: Monday 28 June, 08:50
Venue: `https://eu.bbcollab.com/guest/9db3578250634e8ba9b275b8beb806a3`

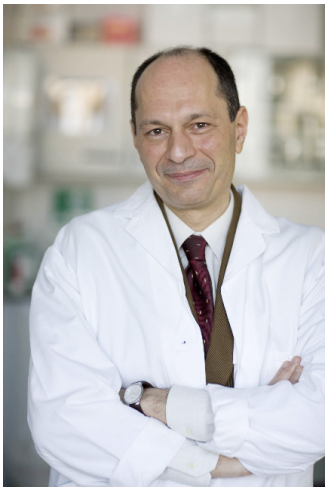
08:50-09:00.- Welcome (Joaquín Gómez Camacho, Programme Coordinator, Universidad de Sevilla; Antonio Prados Montaño, Academic Commmittee Member, Universidad de Sevilla)

09:00-10:00 Opening Talk

Heavy ions in therapy and space

Prof. Marco Durante

GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany



Research in the field of biological effects of heavy charged particles is needed for both heavy-ion therapy (hadrontherapy) and protection from the exposure to galactic cosmic radiation in long-term manned space missions. Although the exposure conditions (e.g. high- vs. low-dose rate) are different in therapy and space, it is clear that a substantial overlap exists in several research topics, such as individual radiosensitivity, mixed radiation fields, and tissue degenerative effects. Late effects of heavy ions are arguably the main health risk for human space exploration, and with the increasing number of cancer patients treated by heavy-ion therapy, including young adults and children, this issue is now becoming the main source of uncertainty for the success of hadrontherapy as well. Reducing uncertainty in both cancer and noncancer late risk estimates is therefore the first priority in heavy-ion radiobiology. In addition, researchers involved either in experimental studies on space radiation protection or heavy-ion therapy often use the same accelerator facilities. Several heavy-ion therapy facilities are now under construction or planned in Europe, USA, and Japan. Beamtime will be available at these facilities for clinical radiobiology and basic heavy-ion effects experimental research, as already happens since several years at the HIMAC in Japan. The NASA Space Radiation Laboratory (NSRL) in Brookhaven (Long Island, NY) provides beams of very heavy ions at energies around 1 GeV/n which are of specific interest for space radiobiology. In Europe, these very high energy beams are available at GSI in Germany, where the new Facility for Antiprotons and Ion Research (FAIR) is currently under construction. It is foreseeable that the availability of beamtime and the presence of many dedicated research programs will lead to great improvements in our knowledge of biological effects of heavy ions in the coming few years.

Marco Durante's Short CV: Prof. Dr. Marco Durante is Director of the Biophysics Department at GSI Helmholtz Center for Heavy Ion Research (Darmstadt, Germany) and Full Professor of Physics at the Technical University of Darmstadt. He is also Adjunct Professor of Physics at the University of Naples Federico II in Italy, and at the Gunma College of Medicine in Japan. Dr. Durante got his Ph.D. in physics in 1992 at the University Federico II and has worked as postdoc at the Lawrence Berkeley Laboratory (Berkeley, CA, USA), NASA Lyndon B. Johnson Space Center (Houston, TX, USA), and NIRS-QST (Chiba, Japan). He is generally recognized as world leader in the field of particle radiobiology and medical physics and is co-author of over 400 papers in peer-reviewed scientific journals (h-index=53) and one patent on proton therapy (EU patent WO2013083333). He is currently chair of the ESA Topical Team on Space Radiation, vice-chair of the Particle Therapy Co-Operative Group (PTCOG), member of the technical- scientific Committee of the Italian Hadrontherapy Center (CNAO) and of the Program Advisory Committee of the GANIL (Caen, France), KVI (Groningen, The Netherlands), iThemba (South Africa), and Rez (Czech Republic) accelerators. Dr. Durante was chair of the ESA Life Sciences Advisory Group 2016-2020 and President of the International Association for Radiation Research (IARR) 2011-2015, and is Associate Editor in several International scientific journals. He has received many grants to support his research, primarily by ESA, EU H2020, ERC, and BMBF.

Webs

- `https://www.gsi.de/biophysik`
- `https://en.wikipedia.org/wiki/Marco_Durante_(physicist)`

Research interests

- Radiation Biophysics.
- Particle therapy.
- Space radiation protection.

Awards/Grants

- 2020 ERC Advanced Grant, European Research Council, EU.
- 2020 Gioacchino Failla Award, Radiation Research Society (RRS), USA.
- 2019 Martin Schneider Memorial Award, UTMB, Galveston, TX, USA.
- 2013 Bacq&Alexander award, European Radiation Research Society (ERRS).
- 2013 IBA-Europhysics Prize for Applied Nuclear Sciences, European Physics Society (EPS).
- 2011 8th Warren K. Sinclair award, National Council for Radiological Protection (NCRP), US National Academy of Sciences.
- 2010 60th N.V. Timofeeff-Ressovsky medal, Medical Radiological Research Center (RAMS), Russian Academy of Sciences.
- 2004 Galileo Galilei Award, European Federation of Medical Physics Associations (EFOMP).

Morning Session

Date and time: Monday 28 June, 10:00
Venue: `https://eu.bbcollab.com/guest/9db3578250634e8ba9b275b8beb806a3`

Students' presentations

10:00-10:20.- José Antonio Galván Moreno, **"Quantifying radioactive particle transformation processes using an abiotic leaching protocol"**

Abstract: In ecosystems affected by the presence of radioactive particles, it is imperative to obtain information regarding transformation processes that affect them in order to properly evaluate not only their behaviour, but also the potential transfer of radionuclides between different compartments. A protocol for the abiotic transformation of radioactive particles has been developed within the framework of EC and IAEA research projects and has been applied on a range of particles from various sites. Methods for the characterisation of single radioactive particles pre- and post-leaching, using sub-micron resolution imaging techniques have been developed that enable the quantitative analysis of transformation processes..

10:20-10:40.- Pablo Jiménez Fernández, **"A low-power 26.56-GHz LC-based DCO for multi-gigabit communication systems"**

Abstract: This work is focused on the design of a Digitally Controlled Oscillator in TSMC 65-nm CMOS RF, which is part of a SerDes system for data transmissions in the order of tens of GHz (multi-gigabit applications). The design specifications are real and are framed within the automotive industry, defined by the Madrid-based company KDPOF, in order to develop data transmission speeds over plastic fiber increasingly closer to the speeds provided by optical fiber.

10:40-11:00.- Hamidreza Erfanijazi, **"Novel programmable single pulse generator for producing pulse widths in different time scales"**

Abstract: A novel programmable single pulse generator for producing a pulse in different time scales and amplitudes will be presented to drive integrate-and-fire neuron circuits. The proposed circuit generates pulses with controlled variable width from 1.3ns up to several milliseconds that coincide with a wide range of binary and analog memristor applications. The designed pulse generator is intended as a tool to precisely control the amount of charge injected in memristors devices so, that precise characterization of the memristors can be done without using external controlling circuitry.

11:00-11:20.- **COFFEE BREAK**

11:20-11:40.- Amir Khan, **"Performance assessment of inference on compressed samples"**

Abstract: Compressive sensing can help mitigating the curse of dimensionality in data acquisition. In contrast to Shannon-Nyquist theorem, it advocates that sparse signals can be reconstructed from a reduced number of samples. In image processing, compressed samples are linear combinations of pixel values that contain global image traits. That allows to think in realizing inference directly on them. In this work, I will exploit this property to develop a smart image sensor that can realize object classification on-chip. At this point, I have obtained promising results in simulation for face recognition using linear SVM with accuracy reaching up to 99%.

11:40-12:00.- Hossein Khosravi, **"Computing In-Memory for High-Efficient On-Chip Inference"**

Abstract: Artificial intelligence (AI) and machine learning (ML) are improving the way we interact with the world around us. Convolutional Neural Networks (CNNs) are one of the best architectures in machine learning, providing state-of-the art results in a wide variety of applications, ranging from speech recognition to image classification. A CNN consists of multiple CONV layers. Each layer uses simple mathematical operations, but the volume of these calculations is very large. At the inference level, where the neural network is already trained and ready to use, the optimal allocation of hardware resources to perform the specific tasks can be a very complex process. Storing the weights requires more space than the internal memory capacity of current microprocessors (CPUs and GPUs). As a result, we have no choice but to store neural network weights in an out of processor memory. In-memory computing (IMC) is an alternative method, where specific computational tasks are conveyed to the memory itself, organized as a computational memory unit. The purpose of this work is to identify the different architectures that lead to low-cost and high-efficiency in-memory computing. This will and bring the memory and the processor closer to each other, constituting an efficient in-memory computing unit.

12:00-12:20.- Paula de Navascués Garvín, **"CO_2 decomposition under ambient conditions by using a ferroelectric plasma reactor"**

Abstract: Carbon dioxide decomposition is nowadays an important concern in terms of worldwide green objectives to combat climate change. Non-thermal plasma reactors are a valuable technology for this purpose; they operate at ambient conditions with an easy scale-up, unlike traditional thermal processes. In this talk, we focus on the CO_2 splitting process in a packed-bed plasma reactor with ferroelectric components. To optimize the procedure we varied several operational parameters and monitored the changes using characterization techniques as OES, electrical diagnosis and mass spectrometry. Pure CO_2 and mixtures with oxygen and air were also studied to analyze the process under realistic conditions.

12:20-12.40.- Valentín Gutiérrez Gil, **"SeT detection for space applications"**

Abstract: Space is a rough environment. Integrated Circuits (IC) are exposed to large temperature variations, power failures, radiation, and yet the demands on reliability are among the highest. For this reason, testability and error detection could help solving some of the mains problems that could appear during a mission. On this presentation we are going to talk about the Single-Event detector implemented to evaluate the feasibility of the detection of transient variations induced by radiation and extract the sensibility statistics of the system.

12:40-13:00.- COFFEE BREAK

13:00-13:20.- Pablo Pérez Maroto, **"Development of a multi-target passive neutron spectrometer for CERN n_TOF NEAR commissioning."**

Abstract: A new experimental area for neutron time-of-flight experiments is under construction at CERN: NEAR. As the commissioning will start this summer/fall, and considering the limitations of the experimental room, several techniques have been proposed for the measurement of the beam energy spectrum. Our choice is the so-called "Multifoil Bonner Sphere Spectrometer", based on the activation of ^{197}Au samples with thermalized neutrons.

13:20-13:40.- Adrián García Osuna, **"Study of plasma effects and gain suppression in LGAD detectors using a nuclear microprobe"**

Abstract: For the HL-LHC (High-Luminosity Large Hadron Collider) upgrade at CERN, detectors that measure the arrival time of minimally ionising particles (MIP) are needed. For this purpose, Low Gain Avalanche Detectors (LGADs) will be used. These detectors have a moderate intrinsic gain, providing an ultrafast current signal (in the order of ns).

Recent studies have shown that a high enough charge density generated in the detector active volume can cause the gain value to decrease. The aim of this work is to study an LGAD with a micrometric ion beam at different angles of incidence in order to better understand the mechanisms that cause this gain suppression.

13:40-14:00.- Javier Arcenegui Almenara, **"Secure Management of IoT Devices Based on Blockchain Non-fungible Tokens and Physical Unclonable Functions"**

Abstract: One of the most extended applications of blockchain technologies for the IoT ecosystem is the traceability of the data and operations generated and performed, respectively, by IoT devices. In this work, we propose a solution for secure management of IoT devices that participate in the blockchain with their own blockchain accounts (BCAs) so that the IoT devices themselves can sign transactions. Any blockchain participant (including IoT devices) can obtain and verify information not only about the actions or data they are taking but also about their manufacturers, managers

(owners and approved), and users. Non Fungible Tokens (NFTs) based on the ERC-721 standard are proposed to manage IoT devices as unique and indivisible. The BCA of an IoT device, which is defined as an NFT attribute, is associated with the physical device since the secret seed from which the BCA is generated is not stored anywhere but a Physical Unclonable Function (PUF) inside the hardware of the device reconstructs it. The proposed solution is demonstrated and evaluated with a low-cost IoT device based on a Pycom Wipy 3.0 board, which uses the internal SRAM of the microcontroller ESP-32 as PUF. The operations it performs to reconstruct its BCA in Ethereum and to carry out transactions take a few tens of milliseconds. The smart contract programmed in Solidity and simulated in Remix requires low gas consumption.

Flash Talks

14:00-14:05 Pablo Sarazá Canflanca: Towards a defect-centric model for time-dependent variability in CMOS technologies.

14:05-14:10 Eusebio Rodríguez: Non-monotonic spin-phase gathering induced by curvature in spintronics circuits.

14:10-14:15 Manuel Jiménez: Hardware implementation of Oscillatory Neural Networks.

14:15-14:20 Farnaz Faramarzi: Analog PROcessing of bioinspired Vision Sensors for 3D reconstruction.

14:20-14:25 Pedro Martín Holgado: Study of TID-SEU synergistic effects on SRAMs combining gamma and neutrons.

TIMETABLE

	Morning Session
08:50-09:00	**Welcome**
09:00-10:00	**Opening talk** **Marco Durante**
	Students' presentations
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10:20-10:40	Jiménez
10:40-11:00	Erfanijazi
11:00-11:20	COFFEE BREAK
11:20-11:40	Khan
11:40-12:00	Khosravi
12:00-12:20	Navascués
12:20-12:40	Gutiérrez
12:40-13:00	COFFEE BREAK
13:00-13:20	Pérez
13:20-13:40	García
13:40-14:00	Arcenegui
14:00-14:25	FLASH TALKS