PhDay Físicas 2023

Libro de abstracts

ESCUELA DE DOCTORADO
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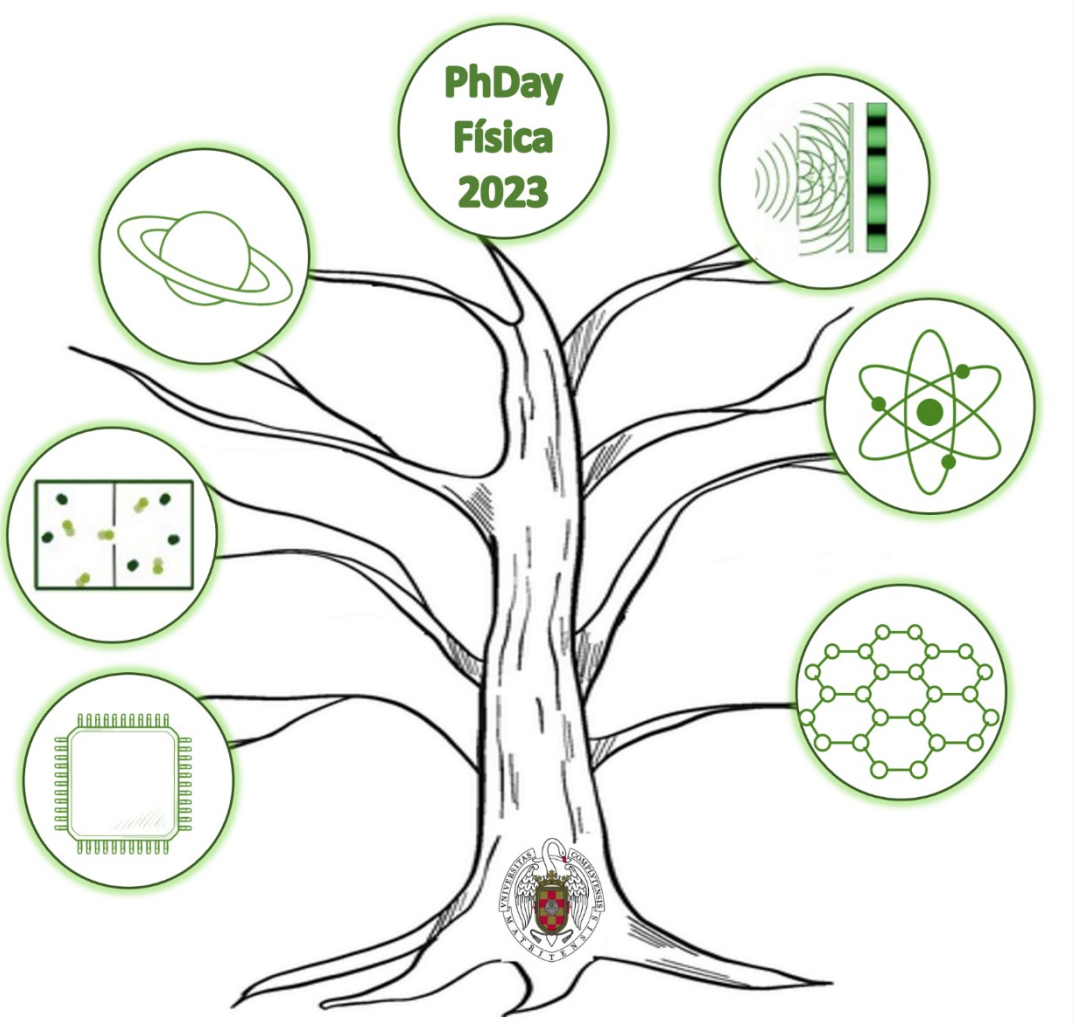

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Lista de abstracts

1. Particle creation in intense electromagnetic backgrounds

Álvaro Álvarez Domínguez

The Schwinger effect is a phenomenon in which particles are created out of vacuum when we apply a strong electric field. What we call 'vacuum' is actually not empty. Recent advances in modern laser facilities may lead to its experimental realization in the near future. In electromagnetic backgrounds what we call 'particle' is ambiguous: different quantizations can define different concepts of particles. We propose a measurement-motivated understanding of these theoretical ambiguities, justifying that they are indeed physical. In particular, we study a particular quantization whose vacuum minimizes the energy density when smeared in a chosen time interval. Finally, we show how the Schwinger effect prevents the creation of 'black holes of light'.

2. Iluminando el camino: Unificando la investigación fototérmica sobre nanopartículas de óxido de hierro en dos ventanas biológicas

Daniel Arranz López

En este trabajo se aborda el desafío de medir la fototermia y se busca una solución para mejorar la precisión de estas mediciones. Se destaca la dificultad de medir el Specific Absorption Rate (SAR), que es una medida de la eficiencia de un sistema de nanopartículas. Se señala que los resultados pueden variar significativamente según cómo se realice el experimento. El enfoque principal de este estudio se centra en identificar los factores externos que influyen en el comportamiento fototérmico de las muestras, como el volumen de la muestra, la incidencia del láser y la posición de la cámara termográfica. Una vez que se ha analizado este problema, se propone un método detallado para estandarizar las mediciones de fototermia. Además, se sugiere el uso de un compuesto comercial (colorante infrarrojo) como una muestra de referencia, con el objetivo de permitir a diferentes grupos de investigación comparar sus muestras y configuraciones experimental. Esto facilitará un avance más sólido y coherente en la investigación en esta área.

3. Quantum Metropolis Solver: A Quantum Walks Approach to Optimization Problems

Roberto Campos Ortiz

The efficient resolution of optimization problems is one of the key issues in today's industry. This task relies mainly on classical algorithms that present scalability problems and processing limitations. Quantum computing has emerged to challenge these types of problems. In this paper, we focus on the Metropolis-Hastings quantum algorithm that is based on quantum walks. We use this algorithm to build a quantum software tool called Quantum Metropolis Solver (QMS). We validate QMS with the N-Queen problem to show a potential quantum advantage in an example that can be easily extrapolated to an Artificial Intelligence domain. We carry out different simulations to validate the performance of QMS and its configuration.

4. Ruptura rígida del olivino desde la escala microscópica a la escala mesoscópica: Abordando el problema energético de los terremotos

Jaime de la Serna Valdés

Conocer con exactitud la energía total liberada por un terremoto representa un hito muy importante que, desafortunadamente, aún no se ha alcanzado. La sismología posibilita tener acceso a la componente de energía radiada por un terremoto, pero se desconocen los valores de otros términos de energía. Ser capaces de determinar la energía total liberada durante un terremoto tiene grandes implicaciones en el estudio del riesgo sísmico, desarrollo de la alerta sísmica temprana y, por ende, en la prevención de daños. Las zonas de subducción son estructuras tectónicas formadas en la convergencia de los límites de placas. El mineral común en las losas de subducción es el olivino, un ferrosilicato de magnesio. El propósito de este trabajo es investigar el proceso de ruptura rígida del olivino cristalino desde una perspectiva atomística y estimar la energía involucrada en este proceso. Este estudio se ha basado en cálculos ab initio según el esquema de la Teoría Funcional de la Densidad (DFT por sus siglas en inglés). Como primer paso, se ha calculado el mínimo de energía electroestructural de la celda unitaria del olivino a 24 GPa (a 700 km de profundidad). Para obtener curvas de esfuerzo-deformación, se ha sometido la celda unitaria relajada a distorsiones de cizalla. Así, se ha podido calcular la energía total teórica liberada durante una ruptura rígida a escala atomística. Para comparar el budget energético atomístico con un mecanismo de ruptura a macroescala (tamaño de la falla), se ha desarrollado un modelo de fractura a diferentes escalas. Con ello, ha sido posible simular múltiples rupturas de granos, en donde cada grano contiene diferentes direcciones cristalográficas. El enlace entre la micro y la macro escala se ha obtenido aplicado un esquema de simulación estocástica para las múltiples rupturas de granos y poder estimar la energía liberada por un terremoto. Los resultados se han comparado con datos de terremotos profundos en la zona de subducción peruana-brasileña

5. A systematic search for extreme gamma-ray blazars using Fermi-LAT

Adithiya Dinesh

Blazars are active galactic nuclei with relativistic jets pointing towards our line of sight. These sources are the most powerful persistent gamma-ray emitters in the Universe. The spectral energy distribution of blazars has two broad peaks, the lower energy one that lies in the IR-X-ray band, known as synchrotron peak and in the higher energy MeV-TeV band known as inverse-Compton peak. These sources can be classified by the position of their synchrotron peak, which goes from low synchrotron-peaked blazars to extreme synchrotron-peaked blazars with the peak lying at frequencies greater than 1017 Hz. Finding and characterizing these extreme blazars is an ongoing observational challenge in gamma-ray astrophysics since they are difficult to discover with current instrumentation. In this study, we systematically look for the most extreme of these blazars, by searching for a spectral hardening feature that could lie at the GeV energy range, where NASA's Large Area Telescope is most sensitive. We identify 4 sources with this spectral hardening feature in the gamma ray energy band with a significance greater than 3.

6. Impact of Proton Irradiation on TMO-Based Solar Cells

Sebastián Duarte Cano

Nowadays, the development of solar cells able to work under harsh conditions has drawn the interest of researchers due to its relevant role in space missions. Solar cells based on GaInP/GaAs/Ge reach an efficiency of 30% under Air mass 0 (AM0) conditions, but at very high cost. Therefore, Silicon based solar cells are a good alternative in order to reduce the budget. In that sense, TMO (transition metal oxides) heterojunction silicon solar cells are one of the most interesting alternatives. These materials can be manufactured at lower temperatures (100-200 ℃) than traditional silicon homojunction. The TMO heterojunction improves the long-term stability of the solar cell and has lower degradation. In this work, we evaluate the effect of proton irradiation in silicon solar cells with Vanadium Oxide (VOx) and Molybdenum Oxide (MoOx) selective contacts. The proton irradiation energy used in this study (15MeV) is representative of low Earth-Orbit (LEO) radiation conditions. We measured the I-V characteristics under AM0 illumination and dark conditions.

7. Deep-PRC: una herramienta de corrección del rango del positrón para imágenes PET/CT

Nerea Encina Baranda

La Tomografía por Emisión de Positrones (PET) es una técnica de imagen médica capaz de obtener una imagen funcional en 3 dimensiones. Al paciente se le suministra un trazador marcado con un radionucleido emisor de positrones, el cual se distribuye por el organismo concentrándose en ciertos órganos específicos o células, siguiendo la ruta metabólica de distintas moléculas, como la glucosa. El positrón emitido tras la desintegración β+ del radionucleido, tras perder toda su energía, interacciona con un electrón atómico de los alrededores dando lugar a la aniquilación de un electrón y de un positrón. En este proceso se emiten dos rayos gamma con energía igual a la masa en reposo de las partículas en sentidos opuestos (511 keV). Estos dos rayos son registrados por los detectores, localizando el lugar donde se produce la aniquilación, lo que nos permite reproducir una imagen de la actividad y, por ende, de la distribución del trazador en el organismo. A diferencia de otras técnicas por imagen anatómica, como la Tomografía Computerizada (CT) o Resonancia Magnética (MRI), el PET permite obtener una imagen metabólica de un organismo vivo. El rango de positrones (PR) es una de las fuentes más importantes de degradación de la resolución en PET. A pesar de ello, la mayoría de los programas de reconstrucción de PET no proporcionan una corrección precisa del PR (PRC, Positron Range Correction en inglés) específica para radionucleidos con gran PR como el 68Ga (incluyendo sólo una PRC para el 18F en agua), lo que afecta a la precisión de los estudios. En esta tesis se presenta Deep-PRC, una herramienta de PRC rápida y precisa basada en una Red Neuronal Convolucional (CNN) con arquitectura de U-NET, como paso posterior al procesamiento de imágenes PET reconstruidas para recuperar la resolución en estudios PET con radionucleidos como el 68Ga que emiten positrones con gran PR.

8. Simulation of daily soft multifocal contact lenses using SimVis Gekko: from in-vitro and computational

Eduardo Esteban Ibánez

Multifocal contact lenses (MCLs) are one of the solutions to correct presbyopia, but their adoption is not widespread due to factors such as discomfort, lack of awareness, a lengthy fitting process and/or unexpected visual performance. To address this situation, visual simulators can be used to aid in refining the adaptation process. This study aims to obtain accurate simulations for a novel visual simulator (SimVis Gekko; 2EyesVision, Spain) of various daily commercial soft MCL designs from four different manufacturers. In-vitro characterization of these MCLs -for several distance powers and additions- was obtained using a NIMO TR-1504 instrument (Lambda-X, Belgium). From the averaged relative power profiles across distance powers, phase maps were reconstructed and Through-Focus Visual Strehl (TFVS) metric was calculated for each MCL design considering different optical diameters. The SimVis Gekko simulation corresponding to each MCL design and pupil diameter was obtained computationally and validated on bench. Finally, the MCL simulations were clinically validated in a pilot study involving presbyopic patients with different refractive errors and additions. The results of the clinical validation show a good agreement between the SimVis Gekko simulations and the real MCLs (for all the designs) when measuring through-focus visual acuity (TFVA) curves and VA at three real distances. All MCL designs showed a partial correlation (rxy,z) higher than 0.90 and a Root Mean Square Error (RMSE) below 0.07 logMAR between the TFVA of SimVis Gekko simulations and Real MCLs across subjects. The validity of the simulation approach using SimVis Gekko and using experimental measurements obtained with Nimo TR-1504 was therefore confirmed by the clinical results obtained in this study, what opens the possibility of using this visual simulator to assist and speed up the fitting process of MCLs.

9. Ferrita de Estroncio Nanoestructurada para Aplicaciones de Imanes Permanentes

Adrián Fernández-Calzado

Los imanes de ferrita podrían empezar a formar parte del sector de la electromovilidad gracias a la mejora de sus propiedades magnéticas combinada con la posibilidad del rediseño de partes específicas de la cadena de fabricación. Esta posibilidad contribuirá a aliviar la volátil dependencia europea de materias primas críticas en el sector de los imanes permanentes. Este estudio muestra la posibilidad de desarrollar polvo de ferrita de estroncio de alta coercitividad con un excelente rendimiento a baja temperatura y sin necesidad de materias primas críticas (por ejemplo, La y Co). Esto ha sido posible partiendo de una ferrita comercial y nanoestructurándola mediante el método de molienda-flash desarrollada dentro del grupo. La creación de un nanocompuesto de Sr-ferrita/hematita ha conducido a una coercitividad a temperatura ambiente superior a 475 kA/m con el aumento del tiempo de molienda. La adición de polvo de hematita (Fe_2O_3) antes del molido ha permitido reducir el tiempo de procesado necesario y obtener un nanocompuesto de alta coercitividad a baja temperatura: 430 kA/m medidos a -100ºC, allanando así el camino para futuras aplicaciones.

10. Fabrication and characterization of exfoliated high-temperature superconductor $Bi_2Sr_2CaCu_2O_8^+$ flakes for van der Waals heterostructures.

Ignacio Figueruelo Campanero

2D van der Waals materials are one of the most interesting and richest topics in condensed matter physics during the last decade due to their fascinating properties, including emergent phenomena which can arise from stacking materials with different properties. $Bi_2Sr_2CaCu^2O_8^+$ (BSCCO-2212) is a van der Waals high-Tc superconductor in which, depending on the hole doping, different quantum phases appear. Thickness determination is one of the first steps in the fabrication of complex van der Waals systems. However, scanning techniques, such as AFM are time consuming and expose the material to ambient conditions that can damage the structure of very thin exfoliated materials altering their properties. In particular for the material under study, BSCCO-2212 loses its superconducting properties and becomes an insulator under environmental fabrication conditions. In this work, we report characterization and fabrication of exfoliated BSCCO-2212 flakes, with the final aim of fabricating van der Waals heterostructures based on high-Tc superconductors. Optical microscopy was used for thickness identification together with optical contrast to extract the refractive index of the flakes. A Fresnel multilayer model is used to calculate the best Si/SiO2 substrates for the identification of one monolayer of this material. Raman spectroscopy was used to study how vibrational modes change with thickness, showing a relation that can also be used to check thickness. By magneto-transport measurements as a function of temperature and in presence of high magnetic fields, the electrical properties of BSCCO-2212 flakes have been studied. The results show that depending on the fabrication process (including optical lithography, electron beam lithography and viscoelastic stamping on pre-patterned electrodes in controlled N2 atmosphere) and the exposure to ambient conditions, the flakes exhibit either superconducting or insulating behavior.

11. Star Formation Histories and Chemical Enrichment Using Neural Networks

Enrique Galcerán García

We present spatially resolved Star Formation Histories and Chemical Enrichment on nearby galaxies using Convolutional Neural Network. We infer SFH and Chemical Enrichment from a combination of MUSE optical spectroscopy and HST photometry in the UV range. Combined with the high-resolution CO emission information, this analysis will allow inferring the timescales for star formation and cloud destruction in different galaxy environments, providing clues about the dominant mechanisms of stellar feedback. The Convolutional Neural Network has been trained with simulated spectra, generated based on observational data from the PHANGS catalogue. One of the main challenges of this work resides in the degeneracy in the resulting spectra as a result of combinations of Star Formation History and Metallicity. To break this degeneracy, Ultraviolet photometric observations from HST are added to the Neural Network's input. This additional information allows the Convolutional Neural Network to improve the prediction and distinguish between different Star Formation Histories and Metallicities. The outputs are weighted favoring younger star formation, as these are the star formation histories, we are interested in using further on.

12. A systematic study of the multi-wavelength properties of extreme gamma-ray blazars

María Láinez Lezáun

Among blazars, active supermassive black holes whose relativistic jet is pointing towards us, extremely high synchrotron peaked (EHSP) blazars are the most energetic ones, with synchrotron peaks reaching frequencies of nu_sync > $10^{1?}$ Hz. The number of known sources of this class is still limited to a few dozen, yet they are critical to understanding the acceleration processes in jets, the emission mechanisms, and their limits. In this work, we search for EHSPs within a selection of more than 600 high-synchrotron-peaked (HSP, nu_sync > $10^{1?}$ Hz) blazars and blazar candidates by studying their broadband spectral energy distribution (SED). We use archival public data from the Space Science Data Center SED Builder service to obtain the multi-wavelength broadband spectral energy distribution of the selected sources, as well as our own analysis of archival optical and X-ray data. After modeling their SEDs, we identify new EHSPs and analyze their structure, physical properties, and possible evolution in the context of the more general population of blazars.

13. Polarized emission from space particles in the Earth's upper atmosphere

Jennifer López Viejobueno

Tons of space particles enter the Earth atmosphere every year. Most of these particles are leftovers and debris from comets and shattered asteroids. The estimates of this extraterrestrial material influx rely upon the measurements carried out by the networks monitoring short-duration fireball events and meteor showers, and by some spatially limited ground-based meteorite searches. Unfortunately, a global space-based survey is still missing. We propose the detection of these particles in the showers using satellites in low Earth orbit. Space dust in the Earth's upper atmosphere is expected to be aligned by radiative torques (RATs). Depending on the dust properties and the environmental conditions, the axis of alignment will be the direction of the solar radiation field or the direction of the Earth's magnetic field. This grain alignment will produce linearly polarized thermal emission. In this work, we study the grain alignment mechanisms in the Earth's atmosphere and we compute for the first time the expected microwave signal of these aligned infalling particles and its polarization, in order to assess its detectability from space. We have used the RADMC-3D code to simulate the polarized microwave thermal emission of dust particles with different compositions: silicates, carbonates and irons, which are commonly present in comets and asteroids. We have built a grid of models that covers several size distributions assuming a constant particle number density of 0.22 cm?3. The simulations show that some specific particle populations might be detectable even with a small probe operating in low Earth orbit at 80?220 GHz. Moreover, we see that it would be possible to use the polarization curves to better constrain dust properties. Earth observation could be a rich source of information about near-Earth bodies prior to their fragmentation in the Earth's atmosphere and their later shock with the surface.

14. Stratosphere-Troposphere Coupling during Sudden Stratospheric Warmings with Different North Atlantic Jet Response

Verónica Martínez Andradas

Sudden stratospheric warmings (SSWs) are extreme disruptions of the wintertime polar vortex that can alter the tropospheric weather for over 2 months. However, the reasons why only some SSWs have a tropospheric impact are not yet clear. This study analyses the tropospheric impact of SSWs over the Atlantic region as measured by the latitudinal displacement of the North Atlantic eddy-driven jet following SSWs. We use reanalysis data for the period 1950-2020 to examine differences in the stratospheric and tropospheric circulation for SSWs with an equatorward (EQ) or a poleward (POLE) shift. Our results show a stronger and more persistent Northern Annular Mode (NAM) signal in the lower stratosphere for EQ than for POLE, beginning 2 weeks before the onset date. In the troposphere, we find precursory signals of the Atlantic jet behavior over Siberia, consistent with previous studies, and also over the central North Pacific and central Europe. In particular, our results suggest that the noncanonical poleward jet shift response to SSWs is in part modulated by circulation anomalies over the central North Pacific, and that these are in turn connected to the cold phase of El Niño Southern Oscillation. Further analysis of the enhanced predictability given by these precursors suggests that the sign of the lower-stratospheric NAM and the geopotential anomalies over the central North Pacific significantly affect the probability of having an EQ or POLE response of the Atlantic jet.

15. Exploring Topological Effects and Frustration in Different Artificial Spin Ice Geometries

Ana Parente Campos

Artificial spin ices (ASIs) are examples of magnetic interacting nanostructures which have opened a way to study topological phenomena such as frustration, emergent magnetic monopoles and phase transitions. Geometric properties of the ASI are key to determine the dynamics of the magnetic charges and the possible energetic configurations, which can also have an influence on the magnetic textures present in these systems. The main goal of this work is to characterize the magnetic properties, spin textures and frustration in ASIs with different geometries and its influence in the formation and ordering of magnetic features. ASIs with different geometries and types of topological protection will be presented. Different geometries of ASI systems had been fabricated by combining nanolithography techniques (optical and electronic lithography) and DC magnetron sputtering. Nanostructures were characterized using different microscopy techniques (AFM and SEM), magnetic force microscopy (MFM), magnetotransport and micromagnetic simulations in Mumax3.

16. Complete Calibration of the VLBI Global Observing System (VGOS)

Víctor Pérez Díez

The current algorithms used for the calibration and analysis of geodetic observations with the VLBI Global Observing System (VGOS) do not properly account for the instrumental and source-intrinsic polarimetry. In addition to this, the data products are not suitable for their astronomical use, since closure information is lost in the baseline-based fringe-fitting process. Our aim is to develop a calibration pipeline for VGOS, where full-polarization information can be retrieved. The products from this pipeline can be used to obtain valuable astronomical information from the observed sources, as well as to improve the geodetic results. We use the algorithm PolConvert, to write the correlation products in a basis of circular polarization that is compatible with the standard VLBI calibration procedures. In addition to this, we have implemented a wide-band global fringe-fitting algorithm, which accounts for dispersive effects (ionospheric delay) and allows to perform a full-polarization deconvolution of all the observed sources, covering the whole frequency band of VGOS. Furthermore, we have developed a new imaging algorithm based on RML methods that extracts the most probable image from the data of these observations. In this work, we present the results of our pipeline applied to a global IVS VGOS epoch of observations and present full-polarization images of some representative sources.

17. Simulating the glacial cycles of the Pleistocene with a low complexity model

Sergio Pérez Montero

Although the ultimate trigger of glacial cycles is Milankovitch insolation cycles, there are still uncertainties concerning their timing and transitions. These unknowns are believed to be due to intrinsic nonlinearities in the climate system, and there is a deep interest in their solution. However, the longer timescales involved make it infeasible to use comprehensive climate models because of the large computational cost involved. In this context, conceptual models are built to mimic complex processes in a simpler, computationally efficient way. Here we present the Physical Adimensional Climate-Cryosphere mOdel (PACCO), which aims to study these outstanding paleoclimatic topics. PACCO represents ice sheet dynamics by using common assumptions as in state-of-the-art ice-sheet models, adapted to its spatial-dimensionless nature, and it solves surface mass balance processes and the aging of snow and ice. In this way, PACCO is able to run several glacial cycles in seconds and produces results comparable to those of paleoclimatic proxies. Preliminary results indicate nonlinearities related to both ice dynamics and snow aging that determine the timing and shape of deglaciations.

18. Selective contacts for undoped photovoltaic cells fabricated by high pressure sputtering

Francisco José Pérez Zenteno

In the contemporary context, solar photovoltaic energy stands out as one of the foremost alternatives for mitigating greenhouse gas emissions. Over the past decade, the cost per kilowatt-hour generated by photovoltaic systems worldwide has significantly decreased, plummeting from $0.445 to $0.049 in the last decade. This remarkable achievement can be primarily attributed to the advanced technological maturity of silicon-based semiconductors. Numerous researchers have been exploring novel materials and structures to circumvent the inherent limitations of homojunction technology, including the utilization of toxic or hazardous chemicals and high-temperature processes. One particularly promising avenue that has gathered substantial attention is the adoption of heterojunction structures. The fabrication of such cells necessitates the existence of structures capable of inducing carrier selectivity, electrons towards the Electron Selective Contact (ESC) while repelling holes and vice versa. Transition Metal Oxides (TMOs) are among the materials exhibiting this desirable behavior. To deposit TMOs onto silicon wafers, several techniques are available, including Atomic Layer Deposition, Chemical Vapor Deposition, and sputtering. However, it is worth noting that these technologies might compromise the interlayer between the deposited thin film and the substrate, consequently diminishing the cell's efficiency due to increased carrier recombination. One viable approach to mitigate such damage is to thermalize the atoms before they reach the substrate's surface. This can be achieved by elevating the working pressure through the unconventional method known as High-Pressure Sputtering (HPS). In this presentation, I will present the findings of my research concerning the deposition, electrical properties, and structural characteristics of TMO thin films, with a specific emphasis on their potential to function as selective contacts, particularly TiO_x that behaves as ESC.

19. Unveiling heat waves in southern South America: a regional analysis

Solange Suli Silicaro

This study describes the climatological characteristics of regional heat waves (HWs) over southern South America (SSA) for the warm seasons (October-March) of 1979-2018 based on daily maximum temperature series from 131 weather stations. Clustering of stations with high co-occurrence of simultaneous HW days is employed to identify regional HW events over five homogeneous regions: northern, central-eastern and southern SSA regions, central Argentina, and central Chile. When all regions are considered, we find a mean frequency of ∼4 HWs per year. Northern SSA, central-eastern SSA and central Argentina are characterised by longer, albeit less intense, HWs than the southernmost region (southern SSA), whereas central Chile events display the lowest duration, intensity and extension. The assessment of long-term changes reveals significant increases in the frequency of regional HW days over central Argentina and central Chile only. We find similarities and differences in the synoptic circulation patterns associated with regional HW events. Southern SSA HWs have the most distinctive signatures, related to extratropical high-pressure systems blocking the westerly flow. In the remaining regions, HWs are associated with anomalies in the South Atlantic (northern SSA, central-eastern SSA and central Argentina) or South Pacific (central Chile) High, and the intensification of the northerly low-level flow by regional thermal lows and South American Low Level Jet events. Finally, we calibrate and evaluate a novel semi-lagrangian algorithm that focuses on the spatial pattern of extreme temperatures and its evolution. It expands the HW analysis perspective, enabling us to study the changing patterns of HW events throughout their life cycle. When comparing the HWs identified by the algorithm with observed regional HWs, we find that the algorithm accurately represents regional HWs in SSA. Therefore, it provides a valuable tool for studying these extreme events from a new perspective

20. Creando Imanes a Escala Industrial: Evolución de la Coercitividad en Aleaciones de MnAlC

Jorge Vergara Ortega

MnAl es un excelente candidato a imán permanente libre de tierras raras debido a sus propiedades como el (BH)max estimado de 12 MGOe a temperatura ambiente y su densidad de 5.2 g/cm3 (comparado con 7.6 g/cm3 para Nd2Fe14B). Mediante el uso de ?casting? y posteiror pulverizado por ?hammer milling?, Less Common Metals (LCM) ha sido capaz de producir polvo con tamaño de particula inferior a 90 ?m and 300 ?m. Se confirmo, gracias al uso de medidas VSM y XRD, que el polvo producido industrialmente tiene un contenido de fase ?-MnAlC de casi un 100 %. El método ? flash-milling? de IMDEA fue usado para un primer grupo de experimentos, con tiempos de molienda entre 30 y 840 segundos. Este procesado permitió duplicar la coercitividad respecto al precursor, manteniendo una coecitividad de 34 Am2kg-1. Pruebas de ?High-energy ball milling (HEBM)? fueron realizadas con un proceso propiedad de MBN a escla de planta piloto (limitado a 0.5 kg por prueba), demostrando la viabilidad de escalar el proceso y del tamaño de particula del precursor, consiguiendo una coercitividad máxima de 0.35 T (i.e. cuadruplicando con respecto al material de inicio) en tiempos menores a 1 hora. Considerando resultados anteriores, el polvo fue calentado a temperature moderada (550°C por 10 min) en atmosfera de N2 con la intención de recristalizar la fase ? y desarrolar la fase ? para optimizar las propiedades magnéticas. Un studio de corrosion se realizo con agua desionizada a temperatura ambiente y calentando al aire a 550°C, mostrando resultados prometedores después de 190 días en agua y 10 min calentado en aire respectivamente.

Reconocimientos

Los autores reconocen la ayuda de EU Horizon 2020 research and innovation programme mediante el proyecto PASSENGER (grant agreement N° 101003914). IMDEA agradece el apoyo de MICINN a través del proyecto NEXUS (PID2020-11521RB-C21). E.M.P. Reconoce la ayuda de AEI - Juan de la Cierva - Incorporación program (IJC2020-043011-I/MCIN/AEI/10.13039/501100011033

21. Tornados eléctricos con memoria: arquitectura de vórtices y antivórtices en láminas ferroeléctricas 2D rotadas.

Víctor Zamora Castro

Los óxidos complejos correlacionados son materiales cuánticos que presentan una amplia variedad de estados básicos electrónicos cuyas diversas propiedades funcionales pueden controlarse mediante estímulos externos (luz, campos magnéticos/eléctricos, deformación, etc.). El crecimiento epitaxial (cubo sobre cubo) sobre un número limitado de sustratos monocristalinos impone estrictas restricciones a las configuraciones de deformación disponibles experimentalmente. El reciente éxito en la separación de los óxidos epitaxiales del sustrato ha creado interesantes posibilidades de ajuste de la deformación que van más allá de las capacidades del proceso epitaxial y que introducen esta familia de materiales al mundo de los materiales 2D. Aquí demostramos como la superposición rotada de dos láminas del ferroeléctrico $BaTiO_3$ origina un patrón de Moiré en la intercara atómica. Este patrón, por deformaciones periódicas de la red cristalina de ambas láminas, induce en los dipolos eléctricos del sistema una estructura no trivial de vórtices y antivórtices. Esta estructura tiene propiedades topológicas únicas ya que los centros de giro de los vórtices exhiben únicamente dos orientaciones posibles. Esto abre la puerta a un nuevo tipo de memorias digitales no volátiles de alta densidad.