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PROPUESTAS DE TRABAJO DEL IFIC PARA LAS BECAS JAE INTRO ICU 2025

Cód. Plan de formación Investigador	Investigador/a responsable	Proyecto	Descripción	Modalidad
IFIC-01	Francisco J. Albiol Colomer	New technologies for dark matter detection	Observing in space within the MeV range is key to detecting signals of dark matter annihilation or decay. This energy range allows the study of non-thermal processes in extreme astrophysical environments, identifying potential spectral signatures associated with massive particles and exploring their distribution in the structure of the universe.	AFNP
IFIC-02	José Benlliure Anaya	Laser-plasma particle acceleration and derived medical applications	Particle acceleration with ultra-intense lasers is a disruptive technology playing a key role in both basic and applied research. Our research group is involved in the development of this technology and in derived medical applications such as the production of radioisotopes for imaging, flash radiotherapy or phase-contrast X-rays imaging.	AFNP
IFIC-03	Luis Caballero Ontanaya	AI-based methods for enhancing medical gamma imaging	The student will participate in the study and development of AI-based methods for image enhancement in Compton gamma images with medical applications such as early cancer detection by optimizing image quality and reducing the risk of false negatives.	AFNP
IFIC-04	Gabriela Llosá Llácer	Development of an imaging system for medical applications	The IRIS group (http://ific.uv.es/iris) develops instrumentation, simulations and image reconstruction algorithms for medical physics applications. The student will participate in the development of a Compton camera for the visualization of radiopharmaceuticals inside the patient's body, in collaboration with La Fe hospital.	AFNP

IFIC-05	Pablo Torres Sánchez	3D Compton Imaging with Machine Learning for Advanced Medical Applications	Design and experimental validation of 3D Compton Imaging algorithms with innovative detection systems, integrated with machine learning techniques, and development of an experimental setup for measurements in demanding clinical conditions.	AFNP
IFIC-06	Ariel Tarifeño-Saldivia	Space Weather Monitoring Using Data From the HENSA++ Neutron Spectrometer	HENSA++ is a high-efficiency spectrometer designed to study cosmic-ray-induced atmospheric neutrons (www.hensaproject.org). Operating since 2024, HENSA++ allows for studies of space weather and neutron dosimetry. This project explores HENSA++ monitoring capabilities during solar storms. The student will gain experience in advanced data analysis techniques and Monte Carlo simulations using Geant4.	AFNP
IFIC-07	Susana Cabrera Urbán & Carlos Escobar Ibáñez	Exploring quantum entanglement and Bell inequalities with LHC top/anti-tops in the ATLAS experiment	The ATLAS experiment has recently observed quantum entanglement between the spin states of top and anti-top quarks at the LHC [Nature 633, 542–547 (2024)]. A breakthrough bridging high-energy physics and quantum information science. This marks the beginning of a new era, where the challenge ahead lies in pushing experimental limits and testing Bell inequalities.	FNPE
IFIC-08	Anselmo Cervera Villanueva	DUNE, the Deep Underground Neutrino Experiment	DUNE will use the charge and light produced by particles traversing its deep underground liquid argon detectors to reveal mysteries about neutrinos. The student will analyse the data being collected by its prototypes at CERN. This work could be combined with detector R&D in the DUNE laboratory at IFIC.	FNPE

IFIC-09	Dolores Cortina Gil	Nuclear reactions in inverse kinematics at R3B	Development of advanced sensors and analyzing pioneering nuclear reactions experiments at FAIR as part of the R3B Collaboration. Design, and characterization of innovative ALPIDE-based detectors, particularly testing delta electron effects. Engaging in international mobility at the world-leading FAIR research facility to enhance experimental capabilities and drive advancements in nuclear physics.	FNPE
IFIC-10	Alfonso Andrés García Soto	Investigating the origin of the most energetic neutrino ever detected	Observed by the KM3NeT/ARCA experiment on February 2023, this event challenges our current understanding of cosmic neutrino sources. The project will focus on the development of a machine learning-based event reconstruction to identify the flavor of this neutrino.	FNPE
IFIC-11	Santiago González de la Hoz	Application of DNN (Deep Neural Networks) to improve reconstruction algorithms of ttbar decays in events of the ATLAS experiment	The reconstruction of events with ttbar in the ATLAS experiment could still be improved at different levels both from the point of view of the use of optimization of the information coming from the detectors and by using DNN. This work aims to develop and implement these updates. This will allow a better sensitivity in the search for new physics, such as ttbar resonances.	FNPE
IFIC-12	Rebecca Gozzini	Searches for dark matter with the KM3NeT neutrino telescope	The KM3NeT neutrino telescope can be used as a dark matter detector. Different phenomenological models predict a dark matter particle and a specific strategy is used to delineate the search for each signal. This project aims in particular at exploiting the energy reconstruction power of KM3NeT to identify neutrino events from dark matter pair annihilation.	FNPE
IFIC-13	Adrián Irles Quiles	Particle physics: instrumentation and data analysis	The student will work in R&D for Particle Flow calorimetry concepts proposed to scrutiny the nature of the Higgs Field at future colliders but also to explore uncharted quantum regimes and the search of Dark Matter in the LUXE experiment at DESY-Eu.XFEL.	FNPE

IFIC-14	Miriam Lucio Martínez & Fernando Martínez Vidal	Search for Feebly Interacting Particles with very displaced vertices at LHCb	Feebly-interacting particles (FIPs) represent an alternative to traditional searches of new physics at the LHC. The large range of couplings and masses require many facilities. The possibility for the upgraded detector to trigger on very displaced vertices opens the opportunity to make LHCb one of the leading experiments for the years to come. The student will be introduced to the triggering and data analysis aspects of these studies.	FNPE
IFIC-15	Justo Martín-Albo Simón	Searching for new physics with ProtoDUNE	Liquid argon TPCs are excellent detectors to search for long-lived, weakly interacting particles predicted by extensions of the Standard Model. The ProtoDUNE detectors at CERN may provide a unique opportunity for such discoveries. The student will contribute to ongoing research assessing the sensitivity of this experimental setup to various new-physics models.	FNPE
IFIC-16	Laura Molina Bueno	Hunting Dark Matter with NA64 experiment at CERN	The origin of Dark Matter (DM) is one of the most pressing questions in particle physics. NA64 fixed target experiment set the most stringent limits in sub-GeV DM searches. The student will participate in the 2024 data analysis in close collaboration with people based at CERN and ETHZ.	FNPE
IFIC-17	Sonja Orrigo	Study of the beta decay of shape isomers coexisting in the same nucleus	The candidate will analyze data from the IS707 experiment, performed at CERN with the Total Absorption Spectroscopy technique. The goal is to study the beta decay of odd Hg isotopes, the first known case in the entire nuclear chart where two different shapes are expected to coexist within the same nucleus.	FNPE
IFIC-18	Joaquín Poveda Torres	Using machine learning to identify electrons in ATLAS during the High Luminosity LHC	This project is devoted to the development of machine learning techniques for the identification of electrons at the ATLAS experiment, with the goal of improving its performance at the High Luminosity LHC where there will be 200 simultaneous proton collisions every 25 nanoseconds.	FNPE

IFIC-19	Agustín Sánchez Losa	Machine Learning techniques for cosmic source detection in KM3NeT	During this decade, neutrino telescopes are on the brink to clarify the origin of cosmic rays by the identification of the first cosmic neutrino sources. Machine Learning techniques are revolutionizing background cancelation on data selection. This project will exploit them in KM3NeT to improve even more its performance for discovery.	FNPE
IFIC-20	Jose Javier Valiente Dobón	Gamma spectroscopy a helping hand to neutrino physics	Experimental studies of nuclear matrix elements (NMEs) for neutrinoless double-β decay (DBD) and astroneutrino inverse β decay (IBD) are crucial for neutrino physics. NMEs can be probed via gamma transitions from isobaric analog states (IASs). This project involves GEANT4 simulations and data analysis from the first experiment.	FNPE
IFIC-21	Juan Zúñiga Román	Machine-learning enhanced search for new physics using KM3NeT/ORCA	This project will consist on using data from the KM3NeT/ORCA experiment to explore the existence of new physics beyond the Standard Model. To do so, we will test atmospheric neutrinos oscillations using machine-learning techniques to classify different event signatures in the detector.	FNPE
IFIC-22	Leandro Cieri	Advancing Precision Calculations in High Energy Physics: Development and Application of Optimized Subtraction Methods for LHC Phenomenology	This project aims to revolutionise precision calculations at the LHC by developing and implementing highly optimised subtraction methods for next-to-next-to-leading order (N3LO) QCD corrections. With a focus on minimising CPU consumption, we will exploit and extend the capabilities of DYTurbo (one of the most used Monte Carlos at the LHC) to create powerful new tools. These tools will be applied to benchmark Standard Model processes (Drell-Yan, Higgs, diphoton, top quark pair production, etc.), enabling fast and accurate phenomenological predictions and establishing N3LO as the new standard for LHC precision. This research falls under the modality of Theoretical and Computational High Energy Physics.	FT

IFIC-23	Jacobo López Pavón	Exploring matter-antimatter asymmetry in models of neutrino masses	The main goal of this proposal is to study new CP asymmetries involving leptons that might be connected to neutrino masses and the baryon asymmetry of the universe. As a possible example we will consider the case of heavy neutrino oscillations and explore the associated asymmetries.	FT
IFIC-24	Raquel Molina Peralta	Hunting flavor exotic baryons	In the recent years several exotic particles have been discovered in facilities like the LHCb. Even though the list of exotic mesons discovered lately is long and continues increasing, we have scarce evidence for flavor exotic baryons. We propose to study meson-baryon scattering with EFT's to predict such structures.	FT
IFIC-25	Miguel Nebot Gómez	Light states in symmetric multi-Higgs models	In the context of beyond the Standard Model extended scalar sectors shaped by symmetries, the project addresses the possibility to infer, through basic requirements on the scalar potential, properties of the spectrum such as the presence of particles with masses bounded by the electroweak scale.	FT
IFIC-26	Gonzalo J. Olmo Alba	Energy cascades and singularity formation in gravity theories	This project explores the dynamical formation of energy cascades and their connection to singularities in gravity models. The student will combine analytical techniques and Physics-Informed Neural Networks (PINNs) to analyze the underlying mechanisms governing these cascades. By leveraging PINNs, the project aims to enhance the understanding of complex gravitational phenomena.	FT
IFIC-27	Verónica Sanz González	Searching for Fundamental Laws with AI	In this project we use unsupervised machine learning to analyze physical data and identify potential principles or conservation laws. We will train and explore algorithms with unsupervised machine learning to analyze physical data and explore the latent space of these algorithms. The goal is to identify hidden conservation laws and underlying principles that may not be evident through traditional analysis methods.	FT

IFIC-28	María A. Tórtola Baixauli	Neutrino telescopes sensititvity to atmospheric neutrino oscillations	In the near future, neutrino telescopes will be essential for addressing key open questions in neutrino oscillations, such as the neutrino mass ordering and the octant of the atmospheric mixing angle. This project will analyze the sensitivity of neutrino telescopes to these parameters and their impact within the global three-neutrino oscillation framework.	FT
IFIC-29	Vicente Vento Torres	The physics of monopoles	Dirac demonstrated that the existence of a single magnetic monopole in the universe could explain the discrete nature of electric charge. Magnetic monopoles naturally arise in most grand unified theories. However, the extensive experimental searches conducted thus far have not been successful. We will analyze their properties and study new means for their detection both in laboratory experiments and astronomical observatories.	FT
IFIC-30	José Zurita	Di-Higgs and Dark Matter at the LHC	The current project aims to construct viable models of dark matter featuring the novel di-Higgs plus missing energy signature, and study the complementarity and interplay between standard collider "MET" searches, direct detection and indirect detection. The use of Machine Learning techniques to improve the sensitivity is envisioned.	FT