Cód. Plan de formación Investigador	Investigador/a responsable	Proyecto	Descripción	Modalidad
JAE Intro ICU-2024-IFIC-01	Francisco Albiol Colomer	AI Generative Techniques Validation for Nuclear Waste Declassification	Applying innovative Monte Carlo and AI-based generative techniques for faster nuclear waste declassification. Initially for spectral analysis, these methods will evolve into GAMMA imaging, vital in medical physics.	AFNP
JAE Intro ICU-2024-IFIC-02	Marçà Boronat Arevalo - Benito Gimeno Martínez	Design of Beam Loss Monitors for the first stage of the LincDOS6+ medical accelerator	Accelerator physicist optimize the machine performance to generate high-quality particle beams, especially in medical accelerators, requiring appropriate instrumentation for the specific type of accelerator in use. The proposed work will involve the design of a Beam Loss Monitoring (BLM) system for the future hadron accelerator that is set to be constructed and operated at the IFIC.	AFNP
JAE Intro ICU-2024-IFIC-03	Fernando Hueso González	Fast gamma-ray detectors for application in clinical proton therapy	In proton therapy, gamma-ray detectors are deployed for treatment verification. We propose that the student participates in the development of a very compact scintillation detector capable of withstanding up to 10 million gamma-rays per second, using pile-up reconstruction techniques.	AFNP
JAE Intro ICU-2024-IFIC-04	Jorge Lerendegui Marco - César Domingo Pardo	GN-Vision: Dual Gamma-ray and Neutron imaging system for hadrontherapy	GN-Vision is a novel dual g-ray and neutron imaging system with potential applications in hadrontherapy and nuclear safety. The work will focus on the experimental development of the neutron imaging capability of GN-Vision. The student will also be able to participate in experiments in hadrontherapy centers and gain experience on simulations with Geant4.	AFNP

JAE Intro ICU-2024-IFIC-05	Javier Vijande Asenjo - Vicent Giménez Alventosa	Monte Carlo simulation of a CT scanner	The objective is to model the acquisition of a CT scanner to perform Monte Carlo simulations of radiation transport on medical images using the software penRed. To achieve this, students must study the parameters to be extracted from DICOM images and program a module in C++.	AFNP
JAE Intro ICU-2024-IFIC-06	Adrián Irles	Instrumentation of silicon calorimeters for higgs factories and extreme regime QED experiments (LUXE)	Introduction to experimental particle physics working in instrumentation of novel concepts of silicon-based highly-granular calorimeters. Work in the laboratory as well as analysis of data and simulations using novel advanced techniques will be conducted (https://aitanatop.ific.uv.es/)	FNPE
JAE Intro ICU-2024-IFIC-07	Salvador Martí García	From H to Z	The Higgs coupling to the Z boson is being studied with the data collected by the ATLAS experiment at the CERN LHC accelerator. The 4lepton (with electrons or muons) final state channel produces a very clean signal that allows to study the challenging Higgs to to muons coupling.	FNPE
JAE Intro ICU-2024-IFIC-08	Carlos Lacasta Llácer	Construction of the ATLAS Inner Tracker for the HL-LHC	Characterisation of the detector elements of the ATLAS Tracker for the HL-LHC at CERN. The work will include silicon strip sensors and associated readout electronics as well as local support structures for the sensors.	FNPE
JAE Intro ICU-2024-IFIC-09	María Moreno Llácer	Study of quantum entanglement in LHC collisions	Quantum entanglement has been studied in fundamental particles such as electrons and photons. However, to date, quarks have been elusive because they are almost always bound together, making it difficult to study them individually. Using data from CERN's LHC we will study quantum entanglement between pairs of top quarks.	FNPE

JAE Intro ICU-2024-IFIC-10	Joaquín Poveda Torres	Improving the electron identification in ATLAS for the High Luminosity LHC with machine learning technique	This project is devoted to the development of machine learning techniques to improve the electron identification capabilities of the ATLAS experiment, with the goal of increasing its robustness for the conditions of the High Luminosity LHC where there will be 200 simultaneous proton collisions every 25 nanoseconds.	FNPE
JAE Intro ICU-2024-IFIC-11	Arantxa Ruiz Martínez	Machine learning for Higgs boson pair production searches in ATLAS	This project will be devoted to machine learning developments to improve the sensitivity of the search for diHiggs production in the ATLAS experiment at the LHC, crucial analysis for understanding the Higgs boson self-coupling.	FNPE
JAE Intro ICU-2024-IFIC-12	José Francisco Salt Cairols	Evaluation of Systematic Uncertainties using Machine Learning methods in the Search for New Physics in the ATLAS experiment	The objective is the implementation and verification of procedures for evaluating systematic uncertainties associated with both experimental aspects and those that result from a priori ignorance of certain magnitudes in the context of the Search for New Physics in the ATLAS experiment (CERN). The methodology to be used will be Machine and Deep Learning.	FNPE
JAE Intro ICU-2024-IFIC-13	Marcel Vos	New interactions of the top quark	Run 2 of the LHC has observed top quark production process in association with the Higgs boson, the Z and W, and the photon. Measurements by ATLAS and CMS enable the first direct study of the Yukawa and electro-weak interactions of the top quark, that have been inaccessible until now. We will review the experimental result and extract the values of these fundamental couplings.	FNPE

JAE Intro ICU-2024-IFIC-14	Alfonso Andrés García Soto	Dimuons signatures in KM3NeT	This project employs Machine Learning to identify rare "dimuon" events in the KM3NeT/ARCA neutrino telescope. These events, linked to heavy quark production and exotic processes with supersymmetric particles, remain unobserved in such telescopes. KM3NeT/ARCA, currently collecting data, presents a unique opportunity for their detection.	FNPE
JAE Intro ICU-2024-IFIC-15	Sara Rebecca Gozzini	Physics beyond the Standard Model: a Target of Opportunity for the KM3NeT Neutrino Telescope	A number of "new physics" effects can be searched indirectly through the properties of neutrinos. We propose to test deviations from the Standard Model expectations using atmospheric neutrinos measured by KM3NeT with unprecedented statistics.	FNPE
JAE Intro ICU-2024-IFIC-16	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
JAE Intro ICU-2024-IFIC-17	Francisco Salesa Greus	Probing high-energy cosmic-ray accelerators with neutrino and gamma-ray observations	Multi-messenger astronomy facilitated the first identification of a cosmic neutrino source, blazar TXS0506-056, thanks to the combined detection of a high-energy neutrino and gamma rays. We propose to advance in this type of searches, combining observations of gamma rays from the HAWC observatory with neutrinos from the KM3NeT neutrino telescope.	FNPE
JAE Intro ICU-2024-IFIC-18	Juan Zúñiga Román	Search for new physics with the KM3NeT/ORCA neutrino detector	The KM3NeT/ORCA neutrino detector located in the Mediterranean Sea has started to take data. This project will consist on using this data to explore the existence of non-standard interactions (NSI) and new physics beyond the Standard Model, from the measurement of the oscillation of atmospheric neutrinos.	FNPE

JAE Intro ICU-2024-IFIC-19	Anselmo Cervera	Photon detectors R&D for the DUNE experiment	An ARAPUCA is a novel device created in the framework of the Deep Underground Neutrino Experiment to detect VUV photons in liquid argon. The candidate will participate in the construction and optimization of an ARAPUCA. He/she will perform optical measurements in the laboratory, using gas argon and cryogenic liquids, comparing data with simulations.	FNPE
JAE Intro ICU-2024-IFIC-20	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. The NA64 fixed target experiment set the most stringent limits on sub-GeV DM searches. The student will participate in the 2023 data analysis in close collaboration with people based at CERN and ETHZ.	FNPE
JAE Intro ICU-2024-IFIC-21	Neus López March	Machine Learning in the NEXT experiment to search for neutrinoless double beta decay	Experimental discovery of neutrinoless double beta decay would provide insights into the matter/antimatter asymmetry of the Universe. The goal of the proposed research is to develop a GNN based-approach to improve signal discovery sensitivity of the neutrinoless double beta decay ($0\nu\beta\beta$) search in the NEXT-100 detector.	FNPE
JAE Intro ICU-2024-IFIC-22	Pau Novella Garijo	Search for the neutrino-less double beta decay with NEXT-100	Search for the neutrino-less double beta decay with the NEXT-100 detector, operated in the Canfranc Underground Laboratory, by means of data analysis and simulations.	FNPE
JAE Intro ICU-2024-IFIC-23	Alejandro Algora	Studying the shape of beta transitions relevant for the calculations of the antineutrino spectrum in reactors	The role of first forbidden decays and what kind of shape corrections are needed for summation calculations of the reactor antineutrino spectrum was considered a possible explanation to the reactor anomaly. The student will analyze data from a recent experiment performed in Jyväskylä using the eShape setup	FNPE

JAE Intro ICU-2024-IFIC-24	Dolores Cortina Gil	Response of the R3B/FAIR CALIFA calorimeter to light charged particles	FAIR provides unique opportunities to determine access to heavy neutron-rich nuclei relevant to r-process nucleosynthesis. CALIFA is a key detector of the R3B/FAIR experiment, serving as g-spectrometer and calorimeter. It also provides the identification and energy of the Light Charged Particles. This work will help to calibrate CALIFA response to energetic LCP.	FNPE
JAE Intro ICU-2024-IFIC-25	Sonja Orrigo	Nuclear shape coexistence in odd Hg isotopes investigated by the Total Absorption Spectroscopy (TAS) technique	Shape isomers coexisting in the same nucleus will be studied for the very first time with the TAS technique. The student will analyze data from the IS707 experiment, performed at ISOLDE-CERN, to extract the beta-decay strength in Hg isotopes which, compared to theoretical calculations, allows to determine the nuclear shape.	FNPE
JAE Intro ICU-2024-IFIC-26	Ariel Tarifeño-Saldivia	Advancing Measurements and Instrumentation in (alpha, n) reaction studies	Engage in key (alpha, n) reaction experiments for astroparticle physics, nuclear technologies, and nuclear astrophysics. Contribute to campaigns, analyze data, and develop neutron detection techniques. Acquire proficiency in ROOT, along with Monte Carlo simulations using GEANT4 or FLUKA. The project will be developed using alpha beams produced by national ICTS.	FNPE
JAE Intro ICU-2024-IFIC-27	Andrea Donini	Dark Matter in Extra Dimensions	The student will understand the open problems of Particle Physics and how adding extra spatial dimensions may help in solving some of them. In particular, we will see how to explain the observed Dark Matter abundance in extra-dimensional frameworks and try to explain simultaneously the origin of neutrino masses.	FT

JAE Intro ICU-2024-IFIC-28	Juan Herrero García - Giacomo Landini	Entropy injection in dark matter production mechanisms	This Master's Thesis aims to scrutinize the impact of entropy injection, such as the late decay of a heavy particle, on the dark matter abundance, for different candidates. One interesting question that will be addressed is whether FIMPs avoid extremely small couplings and what are the phenomenological implications.	FT
JAE Intro ICU-2024-IFIC-29	Emilie Passemar	Implications of Lepton Flavour Violation on Non-Standard Neutrino Interactions	In this work we investigate how the stringent bounds from the flavour factories on lepton flavour universality and violation can allow us to constrain the neutrino non-standard interactions incorporating in particular for the first timeconstraints coming from lepton flavour violating hadronic Tau decays.	FT
JAE Intro ICU-2024-IFIC-30	Sergio Pastor Carpi	Non-standard neutrino physics in the early Universe	The implications for cosmology of non-standard neutrino physics, such as oscillations or new interactions, will be explored, including a calculation of the evolution of neutrinos in the stages before primordial nucleosynthesis and the potential bounds from observational data.	FT
JAE Intro ICU-2024-IFIC-31	Armando Pérez Cañellas	Noisy quantum walks at the era of NISQ devices	Quantum walks (QWs) can be used theoretically as discretizations of the Dirac equation. We propose to investigate the role of noise on QWs and its relation with relativistic diffusion.	FT
JAE Intro ICU-2024-IFIC-32	Jorge Portolés Ibáñez	Quantum vs Classical Effective Actions in particle physics	In field theory it is possible to establish a differential equation that relates the quantum and the classical effective actions. I propose the study and solution of that equation (and its relation with the equivalent path integral formulation), within elementary particle physics, to obtain the quantum action at one-loop.	FT

JAE Intro ICU-2024-IFIC-33	Germán Rodrigo García	Quantum entanglement in top quark pair production with a quantum algorithm	We propose to study the quantum entanglement between the spins of top quarks and top antiquarks produced at the LHC, and to construct a quantum analog by means of a quantum computing simulation.	FT
JAE Intro ICU-2024-IFIC-34	Bryan Zaldívar	Statistical mechanics of Brownian systems	This is an exploratory work, aimed at understanding the statistical properties of interacting particles with Brownian motion coupled to a heat bath. The work includes the study of the Langevin equation. The implications for the state-of-the-art astroparticle physics research program will be discussed.	FT
JAE Intro ICU-2024-IFIC-35	José Zurita	Dark showers from heavy Higgs bosons	New heavy scalars can be mediators to a strongly interacting dark sector, which can give rise to emerging jets. In this project we will explore the interplay between LHC constraints from direct scalar searches, with those derived from emerging jet searches.	FT