Especialidad	
Física Teórica	TEO
Astrofísica	ASTRO
Física Nuclear y de Partículas	FNyP
Fotónica	FOTO

PROPUESTAS TRABAJO FIN DE MASTER EN FÍSICA AVANZADA (Curso 2020-2021)					
Núm	**Tema**	**Tutores**	**Email de contacto**	**Esp.**	**Breve descripción**
1	Termodinàmica de les solucions fluid perfecte esfèricament simètriques	Joan Ferrando	joan.ferrando@uv.es	ASTRO	El nostre grup d'investigació ha analitzat les condicions de realitat física que cal exigir a les solucions en el marc d'una teoria macroscòpica (condicions d'energia, equilibri termodinàmic local, condicions de compressibilitat), i ha desenvolupat mètodes que permeten imposar aquestes condicions a una família de solucions de les equacions d'Einstein ja coneguda. En aquest treball es pretén aplicar aquests mètodes a l'anàlisi de les solucions de les equacions d'Einstein amb simetria esfèrica. Un treball necessari per a desenvolupar aquesta tasca és l'anàlisi i classificació, tant des del punt de vista físic
2	Machine-learning classification of gravitational waves from core-collapse supernovae.	José Antonio Font/ Alejandro Torres-Forne	j.antonio.font@uv.es, alejandro.torres@uv.es	ASTRO	Gravitational waves from nearby supernovae might be detected in the upcoming observational campaigns of Advanced LIGO and Advanced Virgo or by the planned third-generation detectors such as the Einstein Telescope and the Cosmic Explorer. This project will analyze the automatic classification of gravitational waveforms from core-collapse supernovae, using a machine-learning technique based on the LASSO regression method. We will employ numerically generated supernova waveforms from publicly available catalogs that will be injected in Gaussian noise. The LASSO algorithm will be used to compute the coefficients that encode the probability distributions of the signals. Given those probabilities, confusion matrices will be computed in order to assess the feasibility of the approach. The results will be compared with published results based on Bayesian statistics.
3	Bayesian inference of neutron star properties with magnetar QPOs	Michael Gabler / Pablo Cerdá-Durán	michael.gabler@uv.es, pablo.cerda@uv.es	ASTRO	Neutron stars are the most compact object in the universe and a particular subclass of them have the strongest secularly stable magnetic fields observed in the universe. These magnetars, are believed to be sources of observed quasi-periodic oscillations (QPOs). The aim of this project is to connect these observations to theoretical models via a Bayesian interference analysis. We suggest the use of the library bilby (https://lscsoft.docs.ligo.org/bilby/). The new python code should use the observed frequencies of the QPOs with the corresponding uncertainties and the theoretical model to constrain properties of a single magnetar. The final goal is to combine information for different magnetars to arrive on more stringent constraints on neutron star properties in general.
4	Understanding the magnetic structure of just born neutron stars	Miguel Ángel Aloy Martin Obergaulinger	miguel.a.aloy@uv.es martin.obergaulinger@uv.es	ASTRO	The structure of the magnetic field in a neutron star sets the magneto-thermal evolution of the most compact objects in the universe (besides black holes). Our group has computed state-of-the-art models of just born neutron stars resulting from the core collapse of massive, fast-rotating, magnetized stars. The TFM will use these data in order to analyze the structure of the magnetic field and its evolution during the first seconds after core
5	Do jittering jets contribute to explode massive stars?	Miguel Ángel Aloy Martin Obergaulinger	miguel.a.aloy@uv.es martin.obergaulinger@uv.es	ASTRO	The so-called jittering-jets model states that very collimated tongues of plasma, which may change its direction on time scales of tens to hundredths of milliseconds, may be the mechanim that ultimately drives supernova explosions. These jets help breaking the spherical symmetry of an otherwise quasi-isotropic energy release, but their very same nature is controversial and, so far, just supported by theoretical speculations. Our group has worl-wide
6	Estudio de la emisión en radio de objetos ultrafríos.	José Carlos Guirado Puerta	Jose.C.Guirado@uv.es	ASTRO	Objetos ultrafríos (UCDs, por sus siglas en inglés), definidos como objetos espectralmente más tardíos que el tipo M5-9, son cada vez más abundantes. El interés creciente en UCDs viene dado al ser jerárquicamente objetos con más probabilidad de albergar planetas de pequeño tamaño. Recientes estudios demuestran que estos objetos son, sorprendentemente, fuertes emisores en radio, en particular emisión auroral y, quizá, superpuesta, emisión girosincrotrón. Esto abre la posibilidad de estudiar la interacción entre UCD y posibles objetos compañeros de baja masa que podrían certificar la presencia de exoplanetas.
7	Searching for new physics with neutrino telescopes	Juan Zúñiga Román	zuniga@ific.uv.es, zornoza@ific-uv.es	FNyP	Los telescopios de neutrinos submarinos como ANTARES y KM3NeT permiten explorar la posibilidad de nueva física. Por un lado, la búsqueda de materia oscura en el centro galáctico o en el sol. Por otro, buscando posibles desviaciones del Modelo Estándar en las oscilaciones de neutrinos atmosféricos.
8	Top physics at the Large Hadron Collider	Miguel Villaplana/Marcel Vos	marcel.vos@ific.uv.es, miguel.villaplana@ific.uv.es	FNyP	El quark top es la partícula elemental conocida más pesada, es un candidato perfecto para el estudio de la interacción fuerte y juega un papel esencial en muchas extensiones del Modelo Estándar. Este TFM se centrará en el estudio de las propiedades del quark top mediante la aplicación de técnicas avanzadas de análisis a datos del experimento ATLAS del LHC.
9	Future colliders - physics potential of a Higgs factory	Adrian Irles/María Moreno Llácer	adrian.irles@ific.uv.es, maria.moreno@ific.uv.es, marcel.vos@ific.uv.es	FNyP	La próxima instalación en física de altas energías será una factoría de Higgs: un colisionador electrón-positrón a energías de entre 250 GeV y 1 TeV. El IFIC tiene amplia experiencia en los estudios del potencial científico de dicha máquina en las líneas de la física del quark top y sus compañeros más ligeros b/c, la física del bosón Higgs y física de jets. El estudiante contribuirá a los estudios de test de fiabilidad del Modelo Estándar de física de partículas y búsquedas de nueva física más allá de esta teoría mediante la extracción de acoplamientos electrodébiles de los quarks. Estos estudios ayudarán a estimar de forma cuantitativa los beneficios del la beneficios del futuro acelerador de partículas.
10	Advanced monolithic pixel detectors for collider experiments	Carlos Mariñas/María Moreno Llácer	cmarinas@ific.uv.es, maria.moreno@ific.uv.es	FNyP	CMOS radiation sensors are the key element for modern tracking devices. Several designs and architectures have been developed, most notably for upgrades in LHC, super flavor factories and future collider experiments.The student will perform a static characterization of a monolithic active CMOS pixel sensor prototype developed for the aforementioned applications, using advanced equipment in the clean room at IFIC research institute
11	Multi-messenger astronomy with neutrino telescopes	Juan de Dios Zornoza Gómez	zornoza@ific.uv.es	FNyP	Los nuevos mensajeros cósmicos han revolucionado el estudio del Universo. Las señales de neutrinos y de ondas gravitacionales han abierto la astronomía multi-mensajero para estudiar los fenómenos astrofísicos más violentos y nueva física en condiciones extremas. ANTARES y KM3NeT están tomando datos para detectar estos neutrinos cósmicos.
12	Neutrinoless double beta decay searches with the NEXT experiment	Neus López / Justo Martín-Albo	neuslopezmarch@gmail.com, justo.martin-albo@ific.uv.es	FNyP	Neutrinoless double beta decay experiments try to establish whether neutrinos are their own antiparticles by searching for an ultra-rare radioactive process with a half-life that may be longer than 1E26 years. This poses a formidable technical challenge that has prompted a diverse and dynamic worldwide experimental effort. The NEXT experiment uses high pressure xenon gas time projection chambers with electroluminescent amplification to search for the decay in Xe-136. Such detectors offer excellent energy resolution, tracking for the active suppression of backgrounds and scalability to large source masses. The current goal of the experiment is the construction, commissioning and operation of the NEXT-100 detector. We are planning as well a future tonne-scale detector — augmented with single molecule fluorescent imaging detectors for barium tagging — to explore half-lives up to 1E28 years. The proposed Master Thesis will consist in the analysis of data for the optimization of the experimental sensitivity of NEXT.
13	Analysis of the data collected by the large-scale DUNE prototype at CERN	Anselmo Cervera / Nadia Yahlali / Justo Martín-Albo	Anselmo Cervera / Nadia Yahlali / Justo Martín-Albo	FNyP	The Deep Underground Neutrino Experiment (DUNE) is the next accelerator-based mega-science project after the LHC. Its scientific program includes neutrino oscillations, with the Fermilab Long-Baseline Neutrino Facility (LBNF), nucleon decay searches, astroparticle physics (e.g. supernovae neutrinos) and a wide range of Beyond the Standard Model (BSM) Physics, as sterile neutrinos, non-standard interactions, and extra-dimensions. A prototype of the DUNE far detector, so-called ProtoDUNE, based on Liquid argon (LAr) technology, has been constructed and installed at CERN with the aim of developing DUNE far-detector technologies: a prototype of the Time Projection Chamber (TPC) with its cryogenic system, the cold readout electronics, the photon detector systems, the software for acquisition and data analysis. The Master Thesis will consist in the analysis of data collected by ProtoDUNE at CERN with particle beams, aiming at characterizing the TPC response to charge particles, in particular the analysis of particle tracks, energy and identification of background.
14	Design and optimization of the DUNE photon detectors	Anselmo Cervera / Nadia Yahlali / Justo Martín-Albo	acervera@ific.uv.es, Nadia.Yahlali@uv.es, justo.martin-albo@ific.uv.es	FNyP	The Deep Underground Neutrino Experiment (DUNE) is the next accelerator-based mega-science project after the LHC. Its scientific program includes neutrino oscillations, with the Fermilab Long-Baseline Neutrino Facility (LBNF), nucleon decay searches, astroparticle physics (e.g. supernovae neutrinos) and a wide range of Beyond the Standard Model (BSM) Physics, as sterile neutrinos, non-standard interactions, and extra-dimensions. A prototype of the DUNE far detector, so-called ProtoDUNE, based on Liquid argon (LAr) technology, has been constructed and installed at CERN with the aim of developing DUNE far-detector technologies: a prototype of the Time Projection Chamber (TPC) with its cryogenic system, the cold readout electronics, the photon detector systems, the software for acquisition and data analysis.
15	Search for new physics with the DUNE experiment	Anselmo Cervera / Nadia Yahlali / Justo Martín-Albo	acervera@ific.uv.es, Nadia.Yahlali@uv.es, justo.martin-albo@ific.uv.es	FNyP	The Deep Underground Neutrino Experiment (DUNE) is the next accelerator-based mega-science project after the LHC. Its scientific program includes neutrino oscillations, with the Fermilab Long-Baseline Neutrino Facility (LBNF), nucleon decay searches, astroparticle physics (e.g. supernovae neutrinos) and a wide range of Beyond the Standard Model (BSM) Physics, as sterile neutrinos, non-standard interactions, and extra-dimensions. A prototype of the DUNE far detector, so-called ProtoDUNE, based on Liquid argon (LAr) technology, has been constructed and installed at CERN with the aim of developing DUNE far-detector technologies: a prototype of the Time Projection Chamber (TPC) with its cryogenic system, the cold readout electronics, the photon detector systems, the software for acquisition and data analysis.
16	New physics search in the Higgs sector at the LHC with Machine Learning techniques	Luca Fiorini	fiorini@ific.uv.es	FNyP	El sector de Higgs es aún poco conocido y tiene un papel fundamental en muchas estensiones del Modelo Estándar. Se realizará la búsqueda de nuevas partículas previstas por dichos modelos con nueva técnicas de Aprendizaje Automatico en el análisis de Big Data del Large Hadron Collider.
17	Development of gamma imaging algorithms for real-time guided breast biopsy	Javier Vijande Asenjo, Luis Caballero Ontanaya	Javier.Vijande@uv.es, luis.caballero@ific.uv.es	FNyP	La persona interesada trabajará con novedosos detectores gamma tanto en su montaje y realización de medidas experimentales, como en la aplicación de algoritmos de reconstrucción de imagen gamma como parte del proyecto GAMUS para el desarrollo de un sistema híbrido de imagen GAMma y UltraSonidos para biopsia guiada en cáncer de mama
18	Medical physics studies with gamma-ray scanners.	Ana Ros García/Fernando Hueso González/ Gabriela Llosá LLácer	arosgar@ific.uv.es	FNyP	El/la estudiante desarrollará su trabajo en el grupo IRIS (http://ific.uv.es/iris). Este grupo trabaja en la monitorización del tratamiento para terapia hadrónica tanto mediante cámaras Compton como mediante conteo de fotones. Por otra parte, el grupo también lleva a cabo trabajos de investigación en PET (tomografía por emisión de positrones). En todos los casos se están desarrollando prototipos específicos. Se propone participar en estos desarrollos, en caracterización experimental de detectores, análisis de datos, simulaciones y/o reconstrucción de imágenes, según el interés de la/el estudiante.
19	Search for ttbar resonances in the ATLAS experiment applying ML techniques (* TFM asignado a becario JAE-ICU)	José F. Salt Cairols/ J. Lozano	jose.salt@ific.uv.es	FNyP	Estudio de la mejora en la sensibilidad en la busqueda de resonancias ttbar en el experimento ATLAS mediante la aplicación de métodos de ML para la clasificación de los jets procedentes de la desintegración de los pares t tbar
20	Search of new physics in the ATLAS experiment at CERN applying Machine Learning techniques	Jose Salt Cairols/Santiago González de la Hoz	Jose.Salt@ific.uv.es, Santiago.Gonzalez@uv.es	FNyP	Search for New Physics is a important subject in the ATLAS experiment. Last limits on different searches can be improved and one of the possibilities is the use of ML/DL techniques. The application of these techniques at different steps of the analysis can give better results in the accuracy and efficiency of the multicategory classification of the background and the signal.
21	Combined used of nanoparticles and proton beams for dose optimization in medical physics	Nuria Fuster/Maria Moreno Llácer	nuria.futer@ific.uv.es, maria.moreno@ific.uv.es	FNyP	Las nanopartículas de alto número atómico son potenciales radiosensibililizadores. Estudiar los mecanismos físicos detrás de la mejora en la localización de la dosis con haces de protones, así como su dependencia con las características del haz y de las nanopartículas es fundamental para poder optimizar e impulsar su aplicación.
22	Structure of exotic nuclei around 78Ni	Anabel Morales	aimolo@ific.uv.es	FNyP	Magic numbers represent a paradigm of nuclear structure. However the doubly-magic 78Ni, with 50 neutrons and 28 protons, has recently been pinpointed as the doorway to a new island of ground-state deformation that might extend up to the domain of the r-process progenitor nuclei. In order to check the robustness of the classical shell closures at N=50 and Z=28, you will study the structure of 81,82Ga from beta decay of 82Zn, a neutron-rich nucleus with only two neutrons and two protons out of the N=50 and Z=28 shell closures that has been produced at the RIBF laboratories in RIKEN (Japan).
23	The Higgs boson and the top quark as portals to new physics. Can they explain the matter-antimatter asymmetry in the Universe?	Maria Moreno Llácer	maria.moreno@ific.uv.es	FNyP	What happened to the antimatter after the Big Bang? This is one of the unsolved questions in physics and one of the most exciting fields at the frontier of fundamental physics research. New theories are being developed which aim to add new possible sources of CP-violation in extensions of the current models. These theories need validation with experimental data. New and novel measurements, such as the Higgs boson (the particle that gives mass to the other fundamental particles) interaction with top quarks (the heaviest elementary particle), are now possible thanks to CERN/LHC data and the objective of this MSc thesis. Sophisticated analysis tools (including machine learning) will be explored.
24	Identification of Long-lived particles in the ATLAS detector with Machine Learning techniques.	Emma Torró Pastor	emma.torro@ific.uv.es	FNyP	Long-lived particles are predicted in many BSM theories. Searching for them in the ATLAS experiment involve many challenges, one of them being their differentiation from non-standard backgrounds. Machine Learning techniques have been proven very useful in this regard. The student will make use of the newest ML techniques to optimize the identification of displaced jets in the low-pT regime.
25	Extending the searches for long-lived particles in ATLAS to new final states.	Emma Torró Pastor	emma.torro@ific.uv.es	FNyP	Long-lived particles are predicted in many BSM theories. In the ATLAS experiment, they give rise to unconventional signatures that the standard searches for new physics are not sensitive to. Specific analyses are designed to search for them based on a given final state. In our group we are experts in the search of displaced jets and we are extending the range of final states to be studied. The student will perform a study to determine the potential reach of new final states on different theory models predicting long-lived particles and will optmize the parameter space choice to maximize the sensitivity of the new search.
26	Searching for new physics in rare radiative decays	Arantza Oyanguren / Fernando Martínez Vidal	Arantza.Oyanguren@ific.uv.es, Fernando.Martinez@ific.uv.es	FNyP	Rare radiative decays have been demonstrated to be an excellent probe to search for new physics beyond the Standard Model. The photon polarization in decays of heavy hadrons involving b → s quark transitions is predicted to be left-handed, which means that a sign of an anomalous polarization would imply the presence of new unknown particles at loop level. This TFM work aims to study the sensitivity to the photon polarization using radiative decays that will be produced in the LHCb experiment during the next years.
27	Improving particle detection using heterogeneous computing	Arantza Oyanguren / Fernando Martínez Vidal	Arantza.Oyanguren@ific.uv.es, Fernando.Martinez@ific.uv.es	FNyP	With the increase of the luminosity in high energy experiments in the coming years, the use of new techniques to cope with the large amount of particles hitting the detectors becomes a need. The LHCb experiments at CERN is going to implement Graphics Processor Units (GPUs) in the first level stage of its trigger, for particle reconstruction and selection. This TFM work aims to develop in this framework new algorithms and to use machine learning tools to improve the detection capabilities, which is key for the discovery of new particles.
28	Searching for new physics with CP violation in charm baryon decays	Arantza Oyanguren / Fernando Martínez Vidal	Arantza.Oyanguren@ific.uv.es, Fernando.Martinez@ific.uv.es	FNyP	Among the measurements and observations indicating deviations from standard model (SM) predictions, several are related to the quark sector, remarkably lepton flavour universality in flavour-changing neutral current and charged-current B decays, and CP violation in charm hadron decays. The breaking of the CP symmetry in hadrons containing the charm quark is expected to be very small in the standard model, therefore it offers a unique route for probing beyond SM CP-violating phases, especially when considering single- and double-Cabibbo suppressed decays. Charmed baryons (produced with unprecedented rates at LHCb) decaying to multihadronic final states provide a plethora of open channels and rich phenomenology to explore not only CP violation in a variety of observables but also new matter states. This TFM aims to introduce in these experimental studies within the LHCb experiment.
29	Measurement of electromagnetic dipole moments of short-lived particles	Arantza Oyanguren / Fernando Martínez Vidal	Arantza.Oyanguren@ific.uv.es, Fernando.Martinez@ific.uv.es	FNyP	Magnetic and electric dipole moments constitute, along with the mass, the electric charge and the spin, fundamental static properties of the particles. In particle physics, dipole moments are proportional to the spin of the particle and provide information on its internal structure and shape, offering a unique probe of physics within and beyond the standard model (SM). Thus, the experimental and theoretical study of particles such as the proton, neutron, muon and electron has led to some of the most stringent tests of the SM, with as today notable anomalies in the case of the muon and electron magnetic moments. However, for particles of the second and third families, such as charm and beauty baryons, and the tau lepton, they have not yet been experimentally accessible due to the difficulties imposed by their very short lifetimes. This TFM aims to demonstrate the feasibility of their experimental measurement exploiting the spin precession phenomenon induced by compact, high intensity magnets with ultra-relativistic particles produced at CERN's LHC and SPS accelerators, and to assess the experimental sensitivity.

30	Exploring the top-Higgs connection at the LHC with tau leptons	Ximo Poveda	Joaquin.Poveda@ific.uv.es	FNyP	Este TFM usará los datos del experimento ATLAS en las medidas la sección eficaz de producción quarks top en asociación con el bosón de Higgs (ttH) en el caso que el bosón de Higgs se desintegra a leptones tau, incluyendo el desarrollo de algoritmos de análisis multivariante para mejorar la sensibilidad.
31	Exploring the top-Higgs connection at the LHC with light leptons	Ximo Poveda	Joaquin.Poveda@ific.uv.es	FNyP	Este TFM usará los datos del experimento ATLAS en las medidas la sección eficaz de producción quarks top en asociación con el bosón de Higgs (ttH) en estados finales con varios leptones ligeros (electrones, muones), incluyendo el desarrollo de algoritmos de análisis multivariante para mejorar la sensibilidad.
32	Dark matter search with the ATLAS detector at the LHC	Jose Enrique García / Carlos Escobar	Jose.Enrique.Garcia@ific.uv.es / Carlos.Escobar@ific.uv.es	FNyP	The Standard Model of particle physics is the theory that contains our best understanding of how elementary particles and three of the four known fundamental forces are related to each other. It has successfully explained almost all experimental results and precisely predicted a wide variety of phenomena, becoming one of the major achievements of fundamental science. Nevertheless, a number of theoretical and experimental reasons lead physicists to believe that this theory cannot be the ultimate answer in particle physics. Indeed, this theory just explains about 5% of the universe. The rest of our unknown vast universe is called as dark matter and dark energy. The goal of this TFM is, using machine learning techniques, to search for dark matter candidates produced in association with a top quark at the LHC with simulated data and data collected by the ATLAS detector. This scenario is highly motivated in many Beyond Standard Model models that assume that the mediator to the Standard Model particles is Higgs-like and therefore would preferentially couple to the top quark.
33	Development of a gamma-neutron camera and related Machine-Learning methods	Jorge Lerendegu Marco Javier Balibrea Correa Juan de Dios Zornoza Gómez	jorge.lerendegui@ific.uv.es/javier.balibrea@ific.uv.es/ zornoza@ific.uv.es	FNyP	A prototype of an innovative dual-camera for the spatial imaging of both neutron- and gamma-ray sources is being developed as a spin-off R+D transfer activity from the ERC-project HYMNS (High-sensitivitY Measurements of key stellar Nucleo Synthesis reactions, http://hymnserc.ific.uv.es/) at the Gamma & Neutron Spectroscopy Group of IFIC (http://webgamma.ific.uv.es/gamma/es). In this context, the student will work hands-on in the development of the dual gamma-neutron camera prototype, and she/he will explore the applicability of Machine Learning algorithms for an improved particle discrimination and image reconstruction. Our group has leading experts in both imaging and ML-techniques, and thus the student will have the opportunity to learn about these two aspects, and strengthen his/her knowledge in modern experimental nuclear physics.
34	Development of Machine Learning algorithms for nuclear astrophysics experiments at CERN.	Javier Balibrea Correa Jorge Lerendegu Marco Juan de Dios Zornoza Gómez	javier.balibrea@ific.uv.es/jorge.lerendegui@ific.uv.es/zornoza@ific.uv.es	FNyP	i-TED, an innovative detector with gamma-ray imaging capabilities, is being developed in the ERC-project HYMNS (High-sensitivitY Measurements of key stellar Nucleo Synthesis reactions, http://hymnserc.ific.uv.es/) at the Gamma & Neutron Spectroscopy Group of IFIC (http://webgamma.ific.uv.es/gamma/es). The goal of this work is the development of Machine Learning and Artificial Intelligence algorithms aimed to discriminate signal and background components in neutron capture experiments at CERN using the i-TED detector. These measurements are of interest in nuclear astrophysics, and in particular, for stellar nucleosynthesis.
35	Three-dimensional dark-field imaging through Fourier lightfield microscopy	Manuel Martínez corral	manuel.martinez@uv.es	FOTO	
36	Fabrication and characterization of an Erbium doped fiber amplifier.	Jose Luis Cruz	cruz@uv.es	FOTO	
37	Dynamical analysis of the dark currents and secondary electrons emission in an RF cavity for Hadrontherapy applications	Benito Gimeno Martínez	benito.gimeno@uv.es	FOTO	
38	Four-wave mixing in microstructured optical fibers	Antonio Díez	antonio.diez@uv.es	FOTO	
39	Strong light-matter interaction and exciton physics in 2D materials	Alejandro Molina / Alberto García	alejandro.molina@uv.es alberto.garcia@uv.es	FOTO	Semiconducting 2D materials exhibit remarkable physical properties due to their reduced dimensionality. The 2D character together with the weak dielectric screening enhances significantly the electron-hole Coulomb interaction, resulting in large exciton binding energies that dominate the optical response of the materials. Moreover, the strong Coulomb interaction leads to a rich many-body physics. In this TFM, prominently theoretical and computational, the student will apply ab initio methods to model excitonic states in 2D materials including effect from the spin-orbit interaction, interaction with dielectric substrates, change in the physical properties with the number of layers. The results will be compared with experimental data.
40	Morphologic and structural characterizzation of CdTe/CdO layers grown by MOCVD on sapphire substrates	Said Agouram / M. Carmen Martinez	Said.Agouram@uv.es	FOTO	La heterounión p-n (CdTe-CdO) tiene un gran potencial en la fabricación de células solares a base de CdTe. El uso de CdO, como semiconductor tipo n y óxido transparente conductor, permite evitar una tercera interfase. El trabajo a desarrollar consiste en la caracterizacion morfologica y estructural mediante miscroscopia electronica (SEM y TEM) y difracción de rayos X
41	AlN Nanowires for Ultraviolet LEDs: the effect of Mg/In and Mg/Si co-doping	Ana Cros	Ana.Cros@uv.es	FOTO	Se utilizarán nanohilos de AlN como alternativa a las capas delgadas y con el fin de eliminar dislocaciones, mejorar el dopado n y p y favorecer la extracción eficiente de luz. Para el desarrollo de LED UV-C se estudiará la incorporación de magnesio en nanohilos de AlN mediante el co-dopado con In y Si. Se empleará la técnica de dispersión Raman, que permite detectar modos normales de vibración asociados a la incorporación de Mg y correlacionar su intensidad con la cantidad de dopante incorporado. La formación de nano-uniones pn se estudiará mediante técnicas de microscopía de fuerza atómica (AFM), más concretamente mediante la medición del potencial de superficie de las nanouniones con la técnica de sonda Kelvin (KPFM), tanto en oscuridad como bajo iluminación. El trabajo se desarrolla en el marco del proyecto PROMETEO2018/123 Materiales avanzados para el uso eficiente de la energía (EFIMAT).
42	GaN grown on Mica as a flexible substrate: optoelectronic properties at the micron scale	Ana Cros	Ana.Cros@uv.es	FOTO	Se propone el estudio de las propiedades optoelectrónicas de GaN mediante técnicas de superficie. En particular, se analizará el potencial de superficie de muestras crecidas sobre Mica muscovita y sobre muestras de grafeno, así como su variación bajo iluminación con distintas fuentes de luz (fotovoltaje de superficie), tanto por debajo como por encima del gap. El objetivo es analizar la interacción de las cargas de superficie con las fronteras de grano y su papel en la interacción del material con la luz. Para este estudio se utilizará un microscopio de fuerza atómica (AFM) y el métido de sonda Kelvin (Kelvin Probe Force Microscopy, KPFM). El trabajo se desarrolla en el marco del proyecto PROMETEO2018/123 Materiales avanzados para el uso eficiente de la energía (EFIMAT)
43	Biosensores fotónicos basados en dispositivos de fibra óptica	Martina Delgado	Martina.Delgado@uv.es	FOTO	Los sensores y biosensores fotónicos son dispositivos cuyo desarrollo está demostrando ser crucial para el diagnóstico de enfermedades, detección de contaminantes, aplicaciones agroindustriales, etc. Los biosensores fotónicos pretenden usar la luz y las guías ópticas como sistemas transductores para la detección de todo tipo de agentes biológicos. Los transductores de tipo fotónico como pueden ser los dispositivos de fibra óptica presentan ventajas específicas, como su capacidad de miniaturización, fácil lectura o la no interferencia con otro tipo de señales. Un dispositivo basado en fibra óptica puede funcionalizarse para que sus propiedades ópticas sean sensibles a la presencia de una molécula, virus, bacterias, proteínas... De esta forma, la respuesta óptica del dispositivo se verá afectada por la presencia del analito, y su presencia se traducirá en una variación de las propiedades de la luz guiada en la fibra (intensidad, longitud de onda…) Son múltiples los trabajos de investigación publicados en este campo, las patentes registradas, e incluso algunas soluciones provenientes de este campo ya están en proceso de industrialización.
44	Estudi analític de ressonàncies no lineals dinàmiques en la generació d'espectres supercontinuus	Enrique Silvestre / David Castelló Lurbe	enrique.silvestre@uv.es, david.castello-lurbe@uv.es	FOTO	L'evolució no lineal de polsos òptics pot induir la formació de ressonàncies espectrals. Tradicionalment, aquest procés requeria de dinàmiques que eventualment esdevenien incoherents. Recentment, però, s'ha demostrat que aquest fenomen pot també tenir lloc en escenaris més estables que preserven la coherència. Així, en aquest treball es planteja com a objectiu la determinació analítica de condicions on aquest procés resulta eficient en règims estables i la seua demostració numèrica.
45	Gold nanoparticles synthetized by laser ablation for surface-enhanced Raman scattering	Gladys Mínguez Vega/Núria Garro	gminguez@uji.es/nuria.garro@uv.es	FOTO	Surface-enhanced Raman spectroscopy (SERS) is as a sensitive and non-destructive analytical tool with a wide range of applications which relies in the magnification of the electromagnetic field in the surrounding of metal nanoparticles (NPs). When NPs have been prepared using surfactants, these might cause undesired SERS signal.This project explores the performance of Au NPs synthetized by laser ablation and therefore clean of surfactants or reductants as SERS substrates for a variety of samples. The role of NP size and homogeneity will be investigated. Hybrid SERS substrates consisting of Au NP decorated graphene oxide (GO) will be prepared and compared with bare Au NPs. In the final part of the project, the influence of Au in the electrical properties of GO will be studied with nanometer spatial resolution taking advantage of scanning probe microscopy.
46	Electric characterization of 2D materials for spintronics	Marta Galbiati	marta.galbiati@uv.es	FOTO	En este trabajo nos centraremos en el estudio de las propiedades eléctricas de nuevos materiales 2D aún por explorar (como algunos dicalcogenuros metálicos de transición, trihaluros magnéticos, etc...) para su integración en dispositivos, con especial atención a su interés en espintrónica. El campo de la espintrónica utiliza el espín como vector de información, además de la carga de electrones, y proporciona aplicaciones que van desde memorias de almacenamiento de datos hasta la computación cuántica. El estudiante aprenderá a aislar autónomamente capas finas de los materiales bajo estudio mediante técnicas sencillas como la exfoliación mecánica (con el simple uso de cinta adhesiva) y a caracterizar las capas obtenidas con ayuda de un microscopio óptico, un microscopio de fuerza atómica y mediante espectroscopía Raman, para sondear su grosor y calidad química y estructural. Luego, aprenderá los procesos de litografía de haz electrónico que le permitirán integrar capas finas de estos materiales en dispositivos. Finalmente, se realizarán medidas eléctricas a temperatura ambiente y criogénica de los dispositivos fabricados, para estudiar las propiedades de magneto-transporte de estos materiales.
47	Gravity as a double copy of Quantum Chromodynamics	Germán Rodrigo	german.rodrigo@ific.uv.es	TEO	Establecer la dualidad color-cinemática para describir gravedad como copia doble de QCD y estudiar sus implicaciones fenomenológicas en el LHC.
48	Finding symmetries in Nature using Machine Learning techniques	Veronica Sanz/Gabriela Barenboim/Johannes Hirn	veronica.sanz@uv.es	TEO	Uso de tecnicas de ML para descubrir simetrias en distribuciones de datos, por ejemplo simetrias continuas y discretas en potenciales fisicos.
49	Reconstructing the Equation of Motion of physical systems with Deep Learning	Veronica Sanz	veronica.sanz@uv.es	TEO	Dada una dinamica, e.g. la evolucion de un fluido, determinar la ecuacion de movimiento con tecnicas de Deep Learning
50	Unsupervised Anomaly Awareness applied to Dark Matter searches	Veronica Sanz	veronica.sanz@uv.es	TEO	Desarrollo de una nueva técnica de detecion de anomalias (Anomaly Awareness) en busquedas de Nueva Física. Basado en tecnicas de Unsupervised Machine Learning.
51	Multiloop scattering amplitudes for the production and decay of the Higgs boson	Germán Rodrigo	german.rodrigo@ific.uv.es	TEO	Obtener una representación manifiestamente causal de las amplitudes de scattering que describen los procesos de producción y desintegración del bosón de Higgs, y analizar sus simetrías y propiedades matématicas.
52	Coherent Elastic Neutrino-Nucleus Scattering as a probe of new physics	Valentina De Romeri	deromeri@ific.uv.es	TEO	La/el estudiante investigará el proceso de dispersión elástica coherente neutrino-núcleo para sondear la existencia de física más allá del Modelo Estandár.
53	An effective field theory for Electroweak Baryogenesis	Jorge Portolés	Jorge.Portoles@ific.uv.es	TEO	We will study the possibility of generating electroweak baryogenesis through an extension of the scalar sector of the Standard Model. We will construct the effective theory at one loop for very massive scalars and study its features.
54	Classical versus quantum effective actions	Jorge Portolés	Jorge.Portoles@ific.uv.es	TEO	The study of the differential equation that relates the classical and the quantum effective actions wil be considered and solved, perturbatively, up to one loop.
55	MoEDAL-MAPP: feasibility studies on dark sector scenarios and beyond	Vasiliki Mitsou / Oscar Vives	vasiliki.mitsou@ific.uv.es	TEO	MAPP es el nuevo subdetector del experimento MoEDAL previsto a tomar datos durante el Run3 del LHC en el CERN. Está diseñado para detectar partículas de vida media larga de baja ionización o neutrales que se desintegran dentro el volumen del detector. Se estudiará su potencial de descubrir señales de nueva física incluyendo teorías de materia oscura y extensiones del sector de neutrinos.
56	Magnetic monopoles in di-photon events at the LHC	Vasiliki Mitsou / Vicente Vento	vasiliki.mitsou@ific.uv.es	TEO	Interpretación de los resultados de ATLAS+CMS de light-by-light scattering para poner cotas en la producción indirecta de monopolos magnéticos y la producción de monopolia.
57	Excited states of the nucleon with strangeness content	Raquel Molina Peralta	Raquel.Molina@ific.uv.es	TEO	Aplicación de la teoría quiral de perturbaciones de mesones y bariones para estudiar la interacción entre un meson y un barión ambos con extrañeza con objeto de estudiar los posibles estados excitados del nucleón que pueden acoplarse fuertemente a estos canales. Análisis de datos de reacciones experimentales para estudiar las propiedades de la N*(1535) y N*(1650) de acuerdo con la teoría.
58	Relic abundance of Multi-component Dark Matter	Juan Herrero-Garcia / Oscar Vives	juan.herrero@ific.uv.es, oscar.vives@uv.es	TEO	Estudio de la materia oscura del Universo asumiendo que hay mas de una partícula estable (como en el Modelo Estándar) y que su abundancia viene de freeze-out y/o de una asimetría (como los bariones). Estudiar las abundancias de las diversas partículas de materia oscura y analizar cómo de natural es que tengan densidades de energía comparables.
59	Parameter extraction in Long-Lived Particle Signatures	José Zurita	josefranciscozurita@yahoo.com	TEO	Long-Lived particles appear in theories addressing the big puzzles of the Standard Model (dark matter, neutrino masses, naturalness problem, strong-CP, baryon asymmetry). The goal of this project is to study the expected accuracy of a putative signal in the HL-LHC run, and its possible interpretations.
60	Reinterpretation of disappearing track searches at current and future colliders	José Zurita	josefranciscozurita@yahoo.com	TEO	Disappearing tracks are a distinticve signature of compressed / feeble interacting dark sectors. The current project aims at reinterpreting the ATLAS and CMS results in a large class of dark sector scenarios, and also make a rough estimation of the reach of the next generation of colliders (e.g: FCC, CEPC, ILC)
61	Di-Higgs and Dark Matter at the LHC	José Zurita	josefranciscozurita@yahoo.com	TEO	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.
62	Radiative Neutrino Masses and Dark Matter in Extra-Dimensional Theories	Juan Herrero-Garcia / Andrea Donini	juan.herrero@ific.uv.es, donini@ific.uv.es	TEO	En teorías con dimensiones extras, estudio de modelos en los que los neutrinos adquieren masas a loops, y que contienen un candidato de materia oscura. Cálculo de la abundancia de la materia oscura, por ejemplo de los singletes fermionicos en el Scotogenic Model, y análisis de las implicaciones fenomenológicas.
63	Lepton Flavor Violation in the Type-III seesaw	Claudia Hagedorn/Jacobo López Pavón	claudia.hagedorn@ific.uv.es, jacobo.lopez@uv.es	TEO	The Type-III seesaw model is one of the most minimal extensions of the Standard Model (SM) that can account for light neutrino masses: only SU(2) fermion triplets are added to the SM field content. Lepton Flavor Violating (LFV) processes are particularly interesting probes of this model since they can occur already at tree level. This includes, for instance, rare lepton decays, as the decay of the muon into three electrons, or decays of the Z boson into two leptons with different flavor. The main goal of this project is to review the neutrino mass generation mechanism in this model, study the most relevant LFV processes that can constrain the Type-III seesaw and, in particular, estimate the sensitivity of future colliders to LFV decays of the Z boson.
64	Connection of Neutrinos and Asymmetric Dark Matter	Claudia Hagedorn/Jacobo López Pavón	claudia.hagedorn@ific.uv.es, jacobo.lopez@uv.es	TEO	Neutrinos are singled out among the elementary fermions, since they are much lighter than all the others, do not carry electric charge and are colour-neutral. The smallness of their mass can be explained with several different mechanisms that usually involve new particles. Experiments have shown that Dark Matter (DM), an important component of our Universe, cannot be made of Standard Model particles and most likely does not interact with photons and gluons, similar to neutrinos. This hints at a possible connection of neutrinos and DM. The goal of this project is to explore such connection in the case of Asymmetric DM (ADM), where the DM particles carry a (new) quantum number that distinguishes them from their antiparticles.
65	Renormalización en presencia de gravitación y el problema de la constante cosmológica/energía oscura	José Navarro-Salas	jnavarro@ific.uv.es	TEO	Se estudiará la renormalización de la acción efectiva y el tensor energía-momento para campos de Dirac y escalares en presencia de gravitación. Se analizarán las distintas soluciones de la energía de vacío en diferentes esquemas de renormalización y se analizarán estos resultados en el contexto del problema de la constante cosmológica. Se estudiará también la rotura espontánea de simetría de un campo escalar interaccionando con fermiones de Dirac en un espacio curvo, calculando el tensor energía-momento total y se analizará el resultado dentro del contexto del problema de la constante cosmológica.
66	Aspectos no-perturbativos de la acción efectiva de gravitación, QED y teorías gauge no-abelianas	José Navarro-Salas	jnavarro@ific.uv.es	TEO	Estudiar la expansión de Schwinger-DeWitt de la acción efectiva y sus posibles sumas parciales para extraer información noperturbativa en gravitación (energía oscura), QED y teorías no-abelianas. Se analizarán configuraciones que permitan solubilidad exacta y la posible factorización del lagrangiano efectivo. El estudio implicará también el análisis de la creación espontánea de partículas y la renormalización de la acción efectiva.

67	Dark matter in warped extra-dimensions with type-I seesaw neutrino masses	Andrea Donini	donini@ific.uv.es	TEO	It has been recently shown that the observed Dark Matter relic abundance can be explained in through WIMP-like particles with O(TeV) masses interacting gravitationally with the SM in extra-dimensional space-times. The possibility that the DM particles may, at the same time, provide mass to light neutrinos through a type-I seesaw is explored, with particular interest to the understanding of the parameter space once bounds from LHC, DM searches and neutrino oscillation experiments are included.
68	Matter-antimatter asymmetry and neutrino masses	Pilar Hernández	m.pilar.hernandez@uv.es	TEO	The origin of the abundance of matter over antimatter in the Universe could be connected to the origin of neutrino masses. We will explore further this connection.
69	Neutrino masses in exotic inverse seesaw models	Avelino Vicente	avelino.vicente@ific.uv.es	TEO	The origin of neutrino masses stands among the most important open questions in fundamental particle physics nowadays. The Standard Model predicts vanishing neutrino masses and therefore needs to be extended with a mechanism that not only induces non-zero neutrino masses, but also explains their tiny values. The inverse seesaw constitutes a popular example of such mechanism. In this master thesis the student will become familiar with the neutrino mass problem and study the most common setups for the generation of neutrino masses, including the inverse seesaw. We will finally focus on an exotic version of the inverse seesaw, study its properties and derive phenomenological conclusions.
70	Low-energy imprints of new physics scenarios with DsixTools	Avelino Vicente	avelino.vicente@ific.uv.es	TEO	There are many good reasons to conclude that the Standard Model of particle physics cannot be the ultimate theory. In fact, many extensions have been proposed along the years, with new particles and interactions. These explain some of the open problems in the Standard Model, like the origin of neutrino masses, the flavor puzzle or the unification of fundamental interactions. In this master thesis, the student will become familiar with the basic techniques behind effective field theories and how they can be used to study specific new physics scenarios. The imprints of such scenarios at low energies will be derived with state-of-the-art tools, like the DsixTools package, that allows for an easy renormalization group running and matching at the electroweak scale.
71	T-matrix studies of charm and beauty states	Juan M Nieves/ M. Albaladejo	jmnieves@ific.uv.es, miguelalbaladejo@gmail.com	TEO	The goal is to apply T-matrix formalisms and Effective Field Theory to study exotic mesons with open or hidden charm and beauty flavor. The emphasis will be in the learning of the mentioned methods and in the development by the student of some acquaintance with the phenomenology of hadron interactions.
72	Particle creation in curved space-times with non-Riemannian geometric structures	Gonzalo Olmo / Adrià Delhom		TEO	Particle creation in non-trivial gravitational backgrounds is a well known phenomenon that leads to important predictions in cosmological and black hole space-times, such as the generation of primordial perturbations and Hawking radiation, respectively. An analog phenomenon occurs in flat space-time in the presence of background time varying electric fields (Schwinger effect). We propose to study the quantisation of matter fields in backgrounds in which, in addition to curvature (specified by a given space-time metric), other geometric entities such as torsion and/or non-metricity could be present. The student will be guided to extend the well known techniques and results of typical curved space-times to scenarios with these extra elements associated to the existence of a non-trivial affine connection. The construction of toy models in 1+1 dimensions with Minkowskian and de Sitter causal structures will be our priority.