PhD Candidates - Department of Physics - Univesity of Crete

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A/A	Last Name	First Name	Supervisor	Member 1	Member 2	Title	Abstract
1	Angelaki	Despoina	C. Fotakis	D. Charalampidis	A. Gravanis	Laser Interactions with bio-materials for tissue regeneration	The controlled adhesion, proliferation and outgrowth of cells of the nervous system are essential for tissue engineering applications. In this research we implement the direct ultrafast-laser structuring, as a simple and highly accurate technique for controlled and tunable patterning of culturing neuronal cells via fabricating biomimetic scaffolds on Si. For this purpose various pseudoperiodic morphologies including patterns of nano- and/or micro- structures on Si are used as culture substrates. As a proof of concept, murine Schwann (SW10) and neuro-2a (N2a) cells, both as single-cell culture and co-culture, are studied. It is shown that the different induced topographies led to significant differences in the cells response. As a consequence, arbitrary patterns of co-seeded cells can be converted to precisely organized ones, via appropriate structuring of the culture substrate. Our results suggest that the characteristics of the structured Si surfaces can influence the growth, adhesion and orientation of different types of cells of the nervous system.
2	Anastasopoulou	Konstantina	A. Zezas	V. Pavlidou	P. Reig	Identification and characterization of accreting binaries in nearby galaxies and measurement of their formation efficiency	In this thesis we will study in detail the X-ray binary populations of 10 nearby star-forming galaxies using observations from the NASA's Chandra X-ray Observatory as well as multi-wavelength data in the optical, ultraviolet, and infrared wavelengths from Space telescopes (e.g. Hubble, Spitzer, GALEX). These starburst galaxies contain large numbers of accreting X-ray binaries and a number of those are ultra-luminous X-ray sources (ULXs). This makes them perfect laboratories to study the X-ray emission of the binary population and ULXs in association to the physical properties of the stellar populations such as the age, the SFR, and the stellar mass even at sub-galactic scales. Finally, we will also study the contribution of ULXs to the synthetic X-ray spectrum of a galaxy, by combining a library of spectral energy distributions for Galactic black-hole X-ray binaries, based on RXTE spectra, with broad-band spectra of ULXs based on NUSTAR observations.
3	Brimis	Apostolos	K. Makris	D. Papazoglou	P. Rakitzis	Structured Wavepackets for Nonlinear and Topological Photonics	The main theme of our study will be the investigation of optical wavepackets with topological features (such as topological charge, phase singularities, angular momentum, spin, spin Hall effect for light) and their diffraction dynamics. In the context of singular optics and the recent discovery of accelerating structured light (Airy, ring-Airy and autofocusing beams), we will study the interplay between topological properties and optical acceleration. Another direction we will explore is their potential applications to nanophotonic applications (subwavelength supperresolution imaging methods) and nonlinear optics in complex media (high harmonic generation). The thesis will be theoretical (with strong analytical and computational components) but in close collaboration with experimental groups.
4	Gabritchidze	Bekari	E. Iliopoulos	A. Readhead	G. Deligeorgis	Design, Optimization and validation of high frequency low noise amplifiers for radio astronomy applications.	One of the defining instruments in Radio Astronomy is the Receiver. When the receiver is matched to the radiation field, it modulates the Radio Frequency(RF) signal to Intermediate Frequency(IF) signal, which is subsequently processed by low frequency circuit components. The sensitivity of the radio astronomy receiver is a defining factor, since it determines whether we are measuring useful signal or noise. The sensitivity of the radio astronomy receivers is primarily defined by Low Noise Amplifiers (LNA), which are built up as Monolithic Microwave Integrated Circuits(MMICs). This Doctoral Thesis will be focused on designing and characterization(S-parameters, Noise Temperature) at cryogenic temperatures of LNA-MMICs. A major concern of designing will be the further reduction of noise and the extension of the frequencies of operation of LNAs to W-Band [75-110 GHz] and above.
5	Daskalopoulou	Vasiliki	V. Amiridis	K. Tassis	V. Charmandaris	The impact of Triboelectrification on desert dust flow dynamics	On this dissertation, the effects of induced electric fields and atmospheric electricity on lofted dust layers are researched. The physical mechanisms leading to particle charging within the dust layers are parametrized, assuming that triboelectricity can induce an electric field that counteracts gravitational settling. The above will be achieved synergistically, utilizing in-situ measurements of the optical properties of lofted dust and the exploitation of UAV technologies that will advance our electric field strength measurements within the layer. Moreover, particle charge measurements will be conducted with Electric Field microsensors on board meteorological radiosondes. Further expanding the research, I will investigate the alignment of dust particles through modelling of irregularly shaped particles under electric torques and possible starlight dichroic extinction caused by orientation exploiting polarization measurements. Lastly, the effect of preferential particle orientation on the Earth's energy budget is investigated, using Radiative Transfer Models (RTMs) for irregularly shaped and possibly oriented dust particles.
6	Demeridou	Ioanna	I. Kominis, E. Stratakis	G. Kioseoglou		Pulsed Laser Induced Doping of Two Dimensional Crystals	Transition metal dichalcogenides (TMDs) bonded by weak Van der Waals forces between layers, can be mechanically exfoliated to a single layer. At monolayer limit, TMDs become direct-bandgap, light emitting semiconductors. Controllable irradiation of mechanically exfoliated WS_2 monolayers with UV nanosecond pulses in chlorine environment can affect the crystal's carrier density resulting in dramatic changes of Fermi level and consequently the PL emission of WS_2 single layers by incorporating Cl atoms on the monolayer's surface. Micro-Photoluminescence measurements show a significant shift of neutral exciton energy to smaller values and, at the same time, switching the relative intensity of neutral and charged exciton. This is an indication that chlorine acts as a p-type dopant in WS_2 and results in a reduction of its Fermi level. This technique offers the possibility of selective tuning of the crystal's band gap which is very important for exploiting the TMDs for optoelectronic and chemical sensing applications.
7	Doundoulakis	Georgios	A. Georgakilas	E. Iliopoulos	K. Zekentes	Processing and properties of vertical III-Nitride nanowire devices	The PhD thesis belongs to the field of nanoelectronics. It concerns the development of transistor devices, based on nanowires of GaN and related III-Nitride semiconductors, as well as the study of the physics of nanowires and their devices. A significant part of the dissertation focuses on vertical GaN nanowire transistors, based either on epitaxially grown nanowires by Plasma Assisted Molecular Beam Epitaxy (PAMBE), or on nanowires formed by etching planar heterostructures or GaN thin films, which have been grown on a suitable substrate. Another significant direction of research concerns the development of transistors based on horizontal conduction channels, consisting of nanostructures being either fins or nanowires of GaN. The thesis' research will advance critical techniques and methods for processing and fabrication of materials and devices at nanoscale.
8	Zampetakis	Michail	T. Tomaras	I. Papafilippou	K. Makris	Studies of non–linear and incoherent effects and their mitigation in low emittance rings	In the modern ultra-low emittance rings like the CLIC damping rings, magnet non-linearities including strong sextupoles, errors from variable bends and wigglers limit the dynamic aperture. Their interplay with other incoherent collective effects such as IBS and space-charge can degrade performance. The purpose of this PhD thesis is to build numerical tools and study the combination of these effects including synchrotron radiation in ultra-low emittance rings. Measurements of in operating rings are foreseen and will be supported by the ARIES-RULE network.
9	Kannis	Chrysovalantis	P. Rakitzis	D. Charalampidis	I. Kominis	Parity non-conservation in the HgH molecule	Precise measurements of violations of symmetries in atomic and molecular systems compose an effective method for testing the standard model of particle physics at low energy scale. This thesis is devoted to the study of parity violation which occurs in the weak interaction. Our ultimate goal is to measure the parity non-conservation (PNC) optical rotation of the HgH molecule. These measurements will be performed in a tabletop experiment, using a cavity enhanced technique. However, this technique is based on weak absorption associated with forbidden transitions. Thus, large molecular column densities are required in order to observe sufficiently large signals. Therefore, we study both electric (E1) and magnetic (M1) dipole transitions of the molecular mercury hydride as well as the appropriate conditions to achieve high-density molecular vapor.

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10	Karanikolopoulos	Dimitrios	D. Charalampidis	P. Loukakos	A. Lappas	Ultrafast Processes in Novel Solids with Strong Electronic Correlations.	This dissertation is concerned with studies of the ultrafast dynamical behavior of systems with strong electronic correlations. The evolution of electronic populations and distortion of the lattice towards the new equilibrium will be recorded by use of the pump-probe technique combined with fs pulses from a Ti:Sapph laser system. In these studies, Vanadium Dioxide (VO_2), a Transition Metal Oxide, will be used as a novel, model, material. The films-samples are of different synthesis and stoichiometry, tailored for advanced technological applications. We will study the alterations of their optical properties arising from changes of the intricate order parameters of the transition, the electronic landscape and lattice structure. Seeking new ways to exert control over the dynamics of the transition we will utilize spatio-temporally shaped laser pulses for sample excitation. We aim to promote understanding of the effects of doping in transition mechanisms for the development of advanced technological applications.
11	Katerinopoulou	Dimitra	G. Kiriakidis	E. Iliopoulos	I. Remediakis	Printed thin film temperature sensors	The aim of this project is to develop material systems suitable for achieving a printed temperature sensor exhibiting a stability sufficient enough to determine the temperature within 0.1°C. The work builds upon thermistors made up of ceramics well known of their temperatures dependences such as MnNiOx. This class of materials is used in commercial temperature sensors since they exhibit reproducible and large negative temperature coefficient (NTCs). In this work we try to develop a fabrication procedure where the performance of the ceramics is combined with the flexibility of a polymer binder. In order to understand the relation between the sensor performance and the ceramic particles, binder and device geometry, a systematic study is devised where the temperature-dependent electrical characteristics are studied and modeled. Another objective of this project is to evaluate the mechanical properties of the printed sensors. Mechanical bending, rolling and stretchability tests will be performed to evaluate the flexibility of the sensors.
12	Kovlakas	Konstantinos	A. Zezas	K. Tassis	P. Reig	X-ray Binary Population Synthesis Models	The first part consists in a study of ultraluminous X-ray source (ULX) populations in the Local Universe from archival X-ray data. The connection with host galaxy properties - such as star-formation rate, stellar mass and metallicity - is examined after compiling a galaxy catalog that encompasses multi-wavelength information from all-sky surveys. The second part is an investigation of the dynamical effects of the host galaxy gravitational field on the position of X-ray binaries, and its applicability to population synthesis models and observations.
13	Komis	Ioannis	K. Makris	G. Tsironis	I. Kominis	Non-Hermitian phenomena in photonic systems	It has been recently shown that a whole class of non-Hermitian Hamiltonians can in fact exhibit entirely real eigenvalue spectra as long as they respect parity-time (PT) symmetry. These ideas of mathematical physics were experimentally observed and implemented in the framework of photonics. In particular, coupled waveguides or microcavities that combine gain and loss in a particular way can realize PT-symmetric optical potentials. Such complex systems have novel functionalities and various applications in laser physics, sensing, imaging and integrated photonics. In the first part of my thesis, we examine the effect of Kerr type of optical nonlinearity in PT-symmetric lattices (soliton formation and modulation instabilities). Another important aspect is the sensitivity of these systems when they operate close to exceptional points (unique points of non-Hermitian degeneracy). Applications of exceptional point physics in various complex laser systems are also investigated.
14	Kouroumpatzakis	Konstantinos	A. Zezas	I. Papadakis	V. Charmandaris	Retrieval and analysis of the Star Formation Reference Survey Hα emission line	The Star Formation Reference Survey (SFRS) is a representative sample of the great variety of star formation in the local Universe galaxies. It is selected from the PSCz parent sample of galaxies in order to span over a great range in basic characteristics like star formation rate (SFR), stellar mass, and dust temperature. We observe the SFRS galaxies in the Hα emission line, that is the SFR indicator that traces the most recent (~10 Myr) of star formation. Main goal of the thesis is to examine the relations among the various SFR tracers (Radio, T-IR, 8μm, 24μm, Hα, UV, SEDs) and the correlations of those with basic galactic characteristics (stellar mass, sSFR, ages of stellar populations, star formation histories, distribution of stellar populations, X-ray emission) in total galaxy emission and in sub-galactic level. We also study the galaxies morphology compared to these attributes.
15	Kousvos	Stefanos Robert	T. Tomaras	N. Tsamis	V. Pavidou	Exploring Field Theories via the Conformal Bootstrap	The subject of this PhD thesis is the numerical exploration of conformal field theories using the notion of the conformal bootstrap. The conformal bootstrap uses only the assumption that a field theory need be self consistent, to bound the parameter space of said field theory. An advantage of this method, is that it is non perturbative, thus one may use it to study strongly coupled theories. Knowing the global symmetry we wish our theory to posses we may impose bounds on its parameter space, eventually narrowing it down to an increasingly small island in said space. It is also noted, that this symmetry need not be continuous and may also be discrete.
16	Kopsacheili	Maria	A. Zezas	V. Pavlidou	I. Papadakis	A multi-wavelength study of galactic and extragalactic supernova remnants	The goal of this thesis is the detection and study of supernova remnants in galaxies NGC 7793, NGC 1313, NGC 45, NGC 55, M81 και NGC 3184. Using photometric observations (Hα, [S II]) we achieve the detection of supernova remnants and the study of their populations (i.e through their luminosity functions). Spectral observations are used for the investigation of their physical parameters (density, temperature, metallicity). Combining the aforementioned information with the distribution and the physical properties of the interstellar medium, allows us to study the interaction of supernova remnants with their environment and how they heat the interstellar medium.
17	Kypriotakis	Ioannis	K. Tassis	V. Pavlidou	A. Zezas	Instrumentation, commissioning and scientific exploitation of the WALOP optical imaging polarimeter	My PhD dissertation consists of three parts. First, is the full design (optical, electronical, mechanical, software) as well as the construction of the WALOP optical polarimeters, to be used by the PASIPHAE project to map the dust and magnetic field in the Galactic poles. The second part is to commission, adjust, calibrate, troubleshoot and proof said polarimeters at the destination telescopes. The third and last part is to use the first data of the survey to accomplish a scientific goal, outside the main goals of the project. The exact goal will be decided after the first data release but most probably will be the study of intrinsically polarized stars, pulsars and/or the interstellar medium.
18	Laoutaris	Angelos	T. Zouros	E. Benis	A. Lagoyannis	Zero-degree Auger projectile electron spectroscopy at the Demokritos 5.5MV tandem Van de Graaff accelerator	Using the new zero-degree Auger projectile electron spectrograph recently setup in the APAPES project and He-like ion beams such as Li^{+},B^{3+},C^{4+},N^{5+},O^{6+},F^{7+} supplied by the 5.5MV Demokritos tandem accelerator and specially prepared in the pre-excited $1s2s^3S$ state, we will measure K-Auger projectile electron spectra from 0.2-1.5MeV/u collisions with gas targets. Of particular interest is the determination of the cross section ratio, $R_m \equiv \sigma(^4P)/\sigma(^2P)$ for the production of the $1s2s2p^4P$ and $1s2s2p^2P$ states by electron transfer to the $1s2s^3S$ beam component. A value of $R_m=2$ is predicted by spin statistics, while for beams of F^{7+} and more recently for C^{4+}, R_m values as high as 9 have been reported in clear disagreement. Our proposed isoelectronic investigation and determination of R_m will shed further light on the role of various newly proposed population mechanisms such as the dynamic Pauli exchange interaction and the selective enhancement of the $1s2s2p^4P$ by cascade feeding.

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19	Lingos	Panagiotis	I. Perakis	N. Flytzanis	G. Kioseoglou	Ultrafast Quantum Manipulation of Advanced Complex Materials	We present control of the ferromagnetic order in (Ga,Mn)As, using non-adiabatic optical manipulation of electron-hole photoexcitations to create fs carrier-spin pulses with controllable direction and time profile. By tuning the nonthermal populations of exchange-split, spin-orbit-coupled semiconductor band states, we can excite fs spin-orbit torques that control complex magnetization pathways between metastable states. Sequences of clockwise or counterclockwise fs spin-orbit torques, photoexcited by shaping two-color laser-pulse trains, can be used to timely suppress or enhance magnetic ringing and switching rotation in magnetic memories. We investigate the possibility of phase transitions induced by ultrafast optical laser pulses. Creating suitable superpositions of quantum states, femtosecond laser–excited coherence between spin/orbital/charge states can switch magnetic order, by instantly breaking the balance between competing phases of manganites. We present a microscopic theory based on density matrix equations of motion for composite fermion Hubbard operators, instead of bare electrons, that take into account the strong spin and charge local correlations. Spin fluctuations driven by photoelectrons during 100fs reduce the energy gap by quasi-instantaneously deforming the AFM background of CMR manganites which open a conductive electronic pathway via FM correlation. We examine also the change of the lattice displacement parameters induced by non-thermal populations.
20	Madesis	Ioannis	T. Zouros	E. Benis	S. Harissopulos	Atomic Physics with Accelerators: Projectile Electron Spectroscopy at the Tandem accelerator of the NCSR «Demokritos».	A new experimental station for atomic physics has been developed at the Tandem accelerator of the NCSR «Demokritos» for the study of energetic ion – atom collisions. The high-resolution Zero-degree Auger Projectile Spectroscopy (ZAPS) technique is used to detect Auger projectile electrons, emitted at 0^o degrees with respect to the ion beam direction. The goal is to study the mechanisms for the production of the doubly excited 1snln'l' ionic states during ion - gas target collisions. Such mechanisms are the Resonant (RTE) and Non-resonant (NTE) Transfer Excitation, along with direct electron Transfer to pre-excited, metastable He like ions ($1s2s\ ^3S$). The investigation focuses on the production of the $1s2s2p\ ^4P, ^2P.$ and $^2P_*$ states due to Transfer to the metastable $1s2s\ ^3S$ beam component and its deviation from the expected spin statistics ratios of 8:1:3, along with its dependence on gas target, ion energy, and possible contributions from cascade feeding.
21	Makos	Ioannis	D. Charalambidis	P. Tzallas	I. Kominis	XUV pump-XUV probe of electron correlation in H2/D2	My PhD thesis will focus on time resolved studies of ultrafast dynamics in molecular systems utilizing attosecond resolution XUV-pump-XUV-probe measurements. Since no CEP stabilized many cycle laser pulses will be used, CEP tagging approaches will be implemented and thus the duration of isolated high energy attosecond pulses will be determined via the 2^{nd} order IVAC technique. Exploiting these pulses, through CEP tagging, XUV-pump-XUV-probe studies of electronic-nuclear wave-packet and dissociation dynamics in H_2/D_2 will be performed by coherent excitation of the molecular system to its all optically allowed bound states. The studies will be extended to investigation of the temporal evolution of the hydrogen migration and isomerization in the molecule of acetylene (C_2H_2).
22	Maragkakis	Georgios Miltiadis	E. Stratakis	K. Makris	G. Kioseoglou	Experimental and Theoretical Study of Nanomaterials and 2D Materials using Nonlinear Imaging	Two-dimensional (2D) materials have been established as new class of materials with characteristics that make them a highly attractive scientific field, for both fundamental and technological studies. On a different frontier, nonlinear imaging has been demonstrated as a powerful tool for research on nanomaterials. In the present thesis, we develop novel nonlinear imaging techniques, and study experimentally and theoretically 2D materials. We envisage that this work can contribute to further insight into the physical mechanisms underlying their properties, and application-potential.
23	Mouloudakis	Konstantinos	I. Kominis	P. Rakitzis	D. Charalambidis	Quantum Fluctuations of Spin in Hot Alkali Vapors	Alkali metal vapors in thermal equilibrium have an expectation value of spin equal to zero which rises from the dissipative character of the interactions that take place between different atoms. The most common and important interaction in such atomic gases is the spin-exchange interaction. Although spin exchange collisions conserve the total electronic spin, they can mix different ground state hyperfine manifolds and lead to decoherence. On the other hand, every dissipative process is followed by fluctuations around the equilibrium value. The scope of my phD thesis is to understand and measure the quantum character of such spin fluctuations (spin noise). Specifically, we use the paramagnetic Faraday Effect to monitor the spin fluctuations due to spin exchange between Rubidium and Cesium atoms in natural abundance. We also apply a controlled magnetic gradient and we measure correlations between the spin noises of the two species.
24	Orfanos	Ioannis	D. Charalambidis	P. Tzallas	P. Rakitzis	Development of an intense attosecond pulse source and its use in the study of electronic dynamics with the XUV-pump-XUV-probe technique	The aim of my PhD thesis which is entitled "Development of an intense attosecond pulse source and its use in the study of electronic dynamics with the XUV-pump-XUV-probe technique ", relies on the generation and implementation of intense asec pulses in studies of multiple ionization and ultrafast dynamics of atoms. The research is focused on I) the develop and characterize a table-top XUV asec source with the high XUV intensity and II) the utilization of this source for XUV-pump-XUV-probe studies in the non- linear XUV regime. More precisely, studies on the multiple ionization of atoms in the non-linear-XUV region and time-delay spectroscopic studies of atoms which are coherently excited in energetically non-degenerated manifold of bound and/or autoionizing states, are the main subjects of my thesis.
25	Papadopoulou	Parthena - Stefania	T. Tomaras	I. Papafilippou	G. Tsironis	Bunch characteristics evolution for lepton and hadron machines under the influence of the Intra-beam scattering effect	A model including the effects of intrabeam scattering, synchrotron radiation, elastic scattering and luminosity burn-off is used for the LHC luminosity studies. A comparison of the results given by this model with the measured ones revealed an extra (on top of the model) transverse emittance blow up in the measured data. One of the attempts to explain this blow up is to quantify the impact of the non-Gaussian distribution shapes on the emittance and luminosity evolution. The benchmarking of a Monte-Carlo simulation code (SIRE) with the analytical IBS formulas gave encouraging results with respect to the idea of employing a novel distribution function to study IBS for various machine parameters, including the HL-LHC upgrade. After the comparison with experimental data, the fact that SIRE takes into account the variation of the particle distribution showed that it is a very useful tool for estimating the actual emittance and luminosity evolution.
26	Patatoukos	Kokkimidis	K. Makris	T. Tomaras	G. Tsironis	Topological, Hermitian and non-Hermitian Photonics	We are studying optical systems with topological properties, but also non-Hermitian optical systems. The concept of topology in photonics was introduced through the realization of photonic topological insulators. These insulators have the property that the conduction of electrons occurs only on its surface, not within the bulk, and that conduction is topologically protected, which means that the conducting states are robust with respect to defects. We are attempting to implement the idea of topology in optical systems, and study the optical properties of such systems, robust defect states, transfer properties etc. We also study non-Hermitian PT-symmetric Hamiltonians that can be used to fabricate semiconducting structures and optical lattices. This class of systems exhibits abrupt phase transitions between phases of real eigenvalue spectrum and complex conjugate pairs of eigenvalues, exceptional points where these transitions happen, non-trivial band structures where bands overlap and asymmetrical diffraction patterns.

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27	Pavlis	Alexandros	X. Zotos	P. Lambropoulos	N. Papanikolaou	Dynamics of Integrable Quantum Many Body Systems in Low Dimensions	The problem of thermal transport by topological excitations in one-dimensional quantum magnets has been studied extensively in recent years. Current progress in the field, established a novel mode of thermal transport by topological excitations of these magnets, such as spinons, using models that can be approximated by integrable spin chain models. The aforementioned progress indicates an ambiguity: The integrability of the underlying models, such as, the Heisenberg chain model, intrinsically implies ballistic transport at all temperatures, whereas in all experimental cases the mentioned scattering processes inevitably render the transport non-ballistic. This thesis is devoted to solve this ambiguity by developing a Landauer type, scattering theory for topological excitations in quantum magnetic systems out of equilibrium, using the mathematical methods of algebraic and thermodynamic Bethe Ansatz. This study aims to contribute to our further understanding of quantum many body systems and to the future application of these models to the area of spintronics.
28	Politakis	Charalampos	A. Zezas	I. Papadakis	N. Kylafis	Identification of discrete X-ray sources in nearby galaxies in correlation with the local star formation history	Spatial distribution of High Mass x-ray binaries in nearby galaxies and their correlation with the local star forming activity. Classification of the discrete X-ray sources by identifying the companion star in each binary using optical data and diagnostics in all regions of the electromagnetic spectrum. Reconstruction of the spatial distribution of HMXBs with respect to their birthplace using the Monte Carlo method as well as modelling and fitting applications. Displacement of HMXBs due to SN kicks. The contribution of kicks is treated as a smearing gaussian that broadens the spatial distribution of HMXBs. The standard deviation of the smearing provides the average displacement of HMXBs from their birthplaces and is estimated using the maximum likelihood method. Measurement of the center of mass velocity of HMXBs.
29	Serpetzoglou	Efthymios	D. Charalambidis, E. Stratakis	C. Fotakis		Ultrafast laser processing and spectroscopy of organic photovoltaic polymers.	The purpose of this PhD thesis is the study of the ultrafast physical phenomena that are taking place in organic photovoltaics (OPVs) and perovskite solar cells (PSCs), with a view to understanding the charge carrier transport mechanisms in these materials and developing new photovoltaic devices with enhanced energy efficiency. Transient Absorption Spectroscopy (TAS) is used, among other techniques. This technique has the ability to visualize the excitation, transport and recombination processes of charge carriers with unique time accuracy of the order of hundreds of femtoseconds. The study and comparison of the spectra of the photovoltaic devices being investigated provide useful information about the excitation and conduction mechanisms between the active layer, transport layers and the electrodes. Since these mechanisms are directly related to the energy efficiency of photovoltaic devices, the characterization applied in this study is particularly important for the fabrication of new more efficient materials and devices.
30	Skalidis	Rafail	K. Tassis	V. Charmandaris	A. Zezas	Studying the interaction of the diffuse Interstellar Medium with the galactic magnetic field at high latitude regions	At high Galactic latitudes diffuse interstellar clouds exist. Of particular interest are the clouds in the halo of our Galaxy. Theories support that these clouds have been left over from the Galaxy formation. According to other theories they are material recycled by our Galaxy, while others support that they have been attracted from adjacent galaxies. It is still unexplored how these distant diffuse clouds interact with the Galactic magnetic field. A common way to measure magnetic field in the interstellar medium is through optical starlight polarization. We are going to carry out optical polarization observations at high Galactic latitude regions. Combining polarization measurements with data from HI surveys and Gaia we can obtain a 3D tomographic map of the Galactic magnetic field and study the interaction of the magnetic field with the halo clouds.
31	Skoufaris	Kyriakos	T. Tomaras	I. Papafilippou	G. Tsironis	Evolution of Transverse beam distributions during collisions in the LHC and HL-LHC	My PhD thesis focuses on the study of the particles dynamics in the presence of different non-linear effects. These non-linearities, that include non-linear magnetic fields (sextupoles, octupoles, current curing wires), magnet imperfections and incoherent beam-beam effects dominate the evolution of the transverse tails of the beam distributions at the LHC flat top energy and its high-luminosity upgrade (HL-LHC). In order to quantify the impact of all these different effects, an analytical calculation of the beam lifetime and its contribution to the collider luminosity evolution is performed. The results are cross checked with the ones obtained from single-particle tracking simulations, using novel high order symplectic integrators with only positive steps. Also measurements taken during machine development periods are used for validation.
32	Spiliotis	Alexandros	P. Rakitzis	B. Loppinet	D. Charalambidis	Optical rotation in thin films via Cavity Ring-Down Polarimetry	Measuring chirality is of primary importance for a variety of scientific fields, from Pharmacology to fundamental Physics, but also for industries such as Pharmaceutical and Cosmetics Industry. In spite of the importance of precise and sensitive measurement of chirality, the methods used for that purpose have not been developed in the last decades. In this work, methods aiming to improve the sensitivity of the measurement of chirality by orders of magnitude, are presented and analyzed. This way, particularly small chirality signals can be detected. The technique presented is based on conventional polarimetry, combined with an optical cavity, and a number of signal reversals, producing a sensitive and absolute measurement, without the need of background extraction. Even though these techniques have been tested at a proof-of-concept level, this has been done using pulsed lasers. Using continuous-wave lasers, the sensitivity of the measurement can be largely enhanced.
33	Tsafas	Vasileios Gerasimos	C. Fotakis	D. Charalambidis	N. Tavernarakis	Non linear imaging microscopy for the delineation of sub cellular structures and processes of biological samples	In the framework of the current thesis subcellular structures and functions in a variety of biological specimens are studied by employing non linear microscopy techniques. Specifically, it is possible to observe *in-vivo* at microscopic level biological specimens through the implementation of second harmonic generation (SHG), third harmonic generation (THG) and multiphoton excitation fluorescence (MPEF) imaging modalities. Moreover, the dependence of these phenomena to the incident laser polarization can give us the ability to derive additional quantitative information at molecular level about the specimen under investigation. This study is expected to contribute in the better understanding of aging mechanisms and also in the early reliable diagnosis and treatment of some serious diseases such as cancer and neurodegenerative disease. Finally, applications of non-linear imaging microscopy techniques to Cultural Heritage objects will be investigated.
34	Chatziathanasiou	Stefanos	D. Charalambidis	P. Tzallas	I. Kominis	Visualization of induced molecular alignment using time gated ion microscopy in XUV spectral range	High order harmonic generation process induced by the interaction of strong infrared (IR) laser pulses with atoms/molecules led to immersive applications in ultrafast XUV science. The majority of these studies have been performed by spectrally resolving the high harmonics exiting the gas medium, while the understanding of the HHG process in the harmonic generation medium is based on theoretical calculations taking into account the single-atom/molecule response and the propagation effects. In this thesis the HHG process in the generating medium is studied using Time Gated Ion Microscopy method. The studies have been performed for harmonics generated from the interaction of IR pulses both with atoms (Ar) and aligned molecules (N_2,CO_2). The molecular alignment induced with the development of a pump-probe experimental set up at IESL-FORTH. The pump-probe set up was used for the generation of circularly polarized XUV radiation from aligned molecules. The record of the spatial distribution of harmonic intensity in the generation medium led to important results for the dynamics of molecular alignment and the dependence of the HHG process on the IR beam characteristics in the generation medium.