UNIVERSITÀ degli STUDI di NAPOLI «Federico II»

DOTTORATO di RICERCA in FISICA – PhD program in Physics

Physics PhD courses catalogue

- 40th cycle, and till active ones –

(last updated on December 19th, 2024)

6. Biomedical physics

6.1 Advanced topics in environmental radioactivity and radiation protection **6.2** Monte Carlo and AI basis in Medical Physics

6.3 Biosensors

7. Geophysics

7.1 Computational seismology (1st year**)**

7.2 Advanced Earthquake Seismology (1st year)

7.3 Earthquake Early Warning (2nd year)

7.4 AI techniques for Geophysics (2nd year)

8. Interdisciplinary topics

8.1 Physics of the climate change

8.2 Statistical Methods for Data Analysis

8.3 Introduction to Labview Programming

8.4 Data Driven Science

8.5 Fundamentals of NMR and its applications for the diagnosis of infective disease

9. SOFT SKILLS

10.1 Scientific Writing

10.2 How to boost your PhD

10. SUPRA

SUPRA courses are offered (on-line) in the frame of the *Southern Universities Physics Research Agreement*, involving the University of Naples "Federico II", University of Campania "L. Vanvitelli" - Caserta, University of Bari, University of Salento – Lecce. They will be still active for next year and then deactivated because the contents will be totally covered by the internal course given by the PhD in Physics. More details may be found at the link reported in https://www.fisica.unina.it/corsi-dottorato

9.1. Fundamental interactions: QCD and BSM (IV - SUPRA 2024)

Perturbative QCD	(F. Tramontano - Unina)
Teoria di Regge	(C. Corianò - UniSalento)
Weak decays and effective Hamiltonian in the Standard Model and Beyond	(F. De Fazio - UniBa)

9.2. Multi-messenger and particle astrophysics of compact objects (III - SUPRA 2024)

Compact objects	(F. De Paolis - UniSalento)
Neutrino Oscillations	(D. Montanino - UniSalento)
Supernova Neutrinos	(A. Mirizzi - UniBa)
Gravitation, Relativity and Black Holes	(M. De Laurentis)
Physics and evolution of supermassive Black Holes	(M. Paolillo)
Gravitational Waves and Gamma-Ray Bursts	(T. Di Girolamo)

9.3. Experimental High-Energy Astroparticle Physics (VII SUPRA 2024)

Experimental Techniques in Astroparticle Physics	(G. Marsella - UniPa)
HE and VHE Observations from Extragalatic Sources	(L. Perrone – UniSalento)
HE Transients and the Multimessenger Context	(E. Bissaldi – UniBa)
Astrophysics with ultra-high-energy neutrinos and Neutrino Telescopes	(F. Loparco – UniBa)
Experimental techniques in Space Science	(B. Panico Unina)
Dark Matter in cosmology and astrophysics	**(**F. Iocco Unina)

9.4. Particle Detectors, Trigger and DAQ (I - SUPRA 2024)

Particle detectors (M. Primavera - UniSalento)

Photo-detection (E. Bissaldi - UniBa)

Trigger and DAQ for Particle Physics (M. Della Pietra)

Detection methods for nuclear astrophysics and applications (R. Buompane – UniCampania)

9.5. Higgs Boson and beyond at LHC (II - SUPRA 2023)

Higgs boson discovery and measurements at LHC (E. Rossi - UniNa)

Searches beyond Standard Model at LHC (F. Cirotto- Unina)

9.6. Signals formation and treatment in particle detectors (II - SUPRA 2024)

Signal formation (M. Abbrescia - UniBa)

Signals treatment (A. Aloisio)

9.7. Statistical Physics for Complex Systems (VIII - SUPRA 2024)

Active Matter and Complex Fluids (G. Gonnella – A. Lamura - UniBa)

Statistical Mechanics of Complex Systems (A. De Candia)

Stochastic Processes and Analysis of Correlations (E. Lippiello - UniCampania)

9.8. Artificial Intelligence and Machine Learning (V- SUPRA 2024)

Machine Learning: basics and applications (G. De Nunzio, G. Palma – UniBa)

Data Modelling (N. Amoroso - UniBa)

Artificial Intelligence for Social Good (L. Bellantuono – Uniba)

9.9. Biophysics for Health and Environment (IX- SUPRA 2024)

Biophysical mechanisms and therapeutic implications of human exposure to ionising radiation (L. Manti)

Bio-photonics for clinics and environment (M. Lepore - UniCampania)

1. Theoretical Physics

Modern Topics in Theoretical High Energy Physics	
Lecturers	Module 1: Profs. P. Santorelli/S. Morisi (pietro.santorelli@unina.it) Module 2: Dr. G. D'Ambrosio (gdambros@na.infn.it)
Credits	6 CFU
Planned hours	36
Planned schedule	To be arranged in discussion with students
Prerequisites	usual courses of a master degree in Physics
Description	Module 1 (3CFU) The standard model Effective field theories Physics beyond the standard model Grand unified theories Large-N QCD Module 2 (3CFU) Neutrino Physics Baryon asymmetry of the universe Flavour physics Non-leptonic decays of baryons and mesons Phenomenology of EW theory Dark energy and dark matter problems Strong CP problem Collider phenomenology Precision physics

Modern Topics in General Relativity, Gravitation and Cosmology	
Lecturers	Module 1: Dr. G. Chirco (goffredo.chirco@unina.it) Module 2: Prof. G. Mangano (gianpiero.mangano@unina.it)
Credits	6 CFU
Planned hours	36
Planned schedule	To be arranged in discussion with students
Prerequisites	usual courses of a master degree in Physics
Description	Module 1 (3CFU) Spinorial approach to General Relativity Asymptotic structure of spacetime and the BMS (Bondi-Metzner-Sachs) group Quantum fields in curved spacetime (Bogoliubov transformation, quantum fields in Schwarzschild space time, Hawking effect, Vacuum states, Unruh effect) Approaches to quantum gravity Module 2 (3CFU) Inflationary Cosmology Metric, scalar and matter perturbations in inflationary cosmology Black holes Hawking radiation and black holes entropy Neutrino astronomy, neutrino cosmology Dark matter

Modern Topics in Statistical Mechanics	
Lecturers	Module 1: Dr. M. Conte (mattia.conte@unina.it) Module 2: Dr. A. Esposito (andrea.esposito2@unina.it)
Credits	6 CFU
Planned hours	36
Planned schedule	To be arranged in discussion with students
Prerequisites	usual courses of a master degree in Physics
Description	Module 1 (3 CFU) Advanced Theoretical SM: Statistical Field Theory and Renormalization. Non-equilibrium SM and disordered systems. SM of topologically constrained systems (polymers, etc.). Module 2 (3 CFU) Computational and applied SM: Computational methods in SM (adv. Monte Carlo, clustering algorithms, HMM, etc.). Machine Learning in SM and data-driven inference. SM of neural networks and applications. Applications to biological and soft matter systems

Advanced Quantum Field Theory	
Lecturers	Module 1: Dr. C. Sleight charlotteemily.sleight@unina.it Module 2: Dr. R. Marotta raffaele.marotta@na.infn.it
Credits	6 CFU
Planned hours	36
Planned schedule	To be arranged in discussion with students
Prerequisites	usual courses of a master degree in Physics
Description	Module 1 (3 CFU) Non-abelian gauge theories; Faddeev-Popov method and BRST symmetry. Conformal symmetry in arbitrary spacetime dimensions. Conformal field theory. AdS/CFT. Nonperturbative QFT. Instantons. Anomalies Module 2 (3 CFU) Supersymmetry. SuperYang-Mills theories. Supergravity. String theory

2. Nuclear and Particle Physics

High energy physics with accelerators: Higgs, searches and flavor	
Lecturers	Module 1: Dr. F. Cirotto (francesco.cirotto@unina.it) Module 2: Prof. P. Massarotti (paolo.massarotti2@unina.it)
Credits	6 CFU (3+3)
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	

Description	Module 1: The module introduces the phenomenology of the recently discovered Higgs boson at LHC. An introduction to the LHC experiments and physics of the Higgs boson in the Standard Model (Higgs boson production and decay modes) will be given. The Knowledge Discovery in Database (KDD) approach in Particle Physics will be applied. This method, largely used in Data Science, gives the basis of extracting useful information from large datasets and using it to make predictions or better decisionmaking. Moreover, the students will acquire the necessary background to learn about the main experimental methods used in the Higgs boson hunting as: statistical approach to search and discover a new particle; setting upper limits; how to measure the main properties of a new particle (mass, signal strength, spin-parity, couplings,...): classical approaches and most up-to-date Machine Learning techniques. Although Higgs discovery at the LHC completed the Standard Models puzzle, there are still many open questions. The LHC Beyond Standard Mode (BSM) Physics programme covers a wide range of theoretical models: Supersymmetry, Dark Matter and others. The course offers an introduction to the BSM phenomenology at the LHC, with an overview on most recent results. The course offers to students an overview on typical analysis strategies developed in these searches with the presentation of model dependent and independent results. Module 2: The aim of the module is to introduce flavor physics and to investigate the limits of the Standard Model (SM), searching for physics beyond the SM into virtual processes via precision studies within both light mesons and mesons. The main themes are treated from an experimental point of view, illustrating the most recent experimental results: from the measurements of the elements of the CKM matrix to measurements of oscillation of the K and B mesons, up to measurements of the rare and ultra-high decay ratios determined with extreme precision. At the end of the course the student will be able to understand the results of the main and most current flavor physics experiments.

Radiation effects on particle detectors and electronics

Lecturers	Lecturer 1: Dr. P. Casolaro (pierluigi.casolaro@unina.it) Lecturer 2: Dr. M. Campajola (marcello.campajola@unina.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students

Prerequisites	Basic knowledge of particle and nuclear physics
Description	The course focuses on radiation effects on particle detectors and electronics for applications spanning high energy physics, medical physics and space. After introducing the relevant radiation environments, the course illustrates the principles of interaction of radiation with matter and dosimetry. The mechanisms of radiation damage on particle detectors and electronics are examined, as well as mitigation strategies (radiation hardening). Simulation tools for dose evaluation are presented through dedicated hands-on activities with FLUKA (for Monte Carlo simulations in particle physics) and SPENVIS (for modelling space environments and radiation effects). Finally, the course provides an overview on experimental methodologies for radiation testing and radiation protection at facilities for radiation hardness assurance.

Nuclear Physics in stellar environment and measurements in lowbackground conditions

Lecturers	Module 1: Prof. G. Imbriani (gianluca.imbriani@unina.it) Module 2: Prof. A. Best (andreas.best@unina.it)
Credits	4 CFU (2+2)

Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of nuclear physics.
Description	The theories of nucleosynthesis have identified the most important sites of element formation in the stars and, also, the diverse nuclear processes involved in their production. The detailed understanding of the origin of the chemical elements combines astrophysics and nuclear physics, and forms what is called nuclear astrophysics. Nuclear fusion reactions are at the heart of nuclear astrophysics: they influence sensitively the nucleosynthesis of the elements in the earliest stages of the universe and in all the objects formed thereafter, and control the associated energy generation, neutrino luminosity, and evolution of stars. A good knowledge of the rates of these reactions is thus essential for understanding the broad picture The aim of this course is to determine such extremely low reaction rates at the relevant astrophysical energies. The course is divided in two parts: the first part will be dedicated to outline the nuclear physics in stellar environment; the second aims to give an overview of the challenges and specific characteristics of experimental nuclear physics in lowbackground conditions, in reference to nuclear astrophysics deep underground. We will discuss the main differences between “traditional” laboratories and underground ones; the motivations for wanting to measure in low-background environments; main sources of backgrounds and their rejection via passive and active methods; examples of currently active lowbackground laboratories; intrinsic backgrounds in common materials; methods to achieve similar or closely similar conditions on the surface. Module 1: 1.1 Nuclear reactions: a. Reaction Cross section; b. Theory of Resonances; c. Breit-Wigner formulas; 1.2 Stellar nucleosynthesis: a. Definitions and general characteristics of thermonuclear reaction rates b. Hydrogen burning c. Helium burning d. Advanced burnings e. r and s processes Module 2. 2.1 Measurement in low-background conditions: a. Background sources in nuclear physics, intrinsic and extrinsic b. Signal to noise in nuclear astrophysics 2.2 Backgrounds and suppression thereof: a. Deep-underground environments b. Passive shielding c. Active shielding, pulse shape discrimination 2.3 Real-world examples: a. Operational deep-underground laboratories
	b. Low-background measurements on the surface c. Possible site visit at INFN-LNGS (to be determined)

Neutrino physics

Lecturers	Lecturer 1: Prof. A. Di Crescenzo (antonia.dicrescenzo@unina.it) Lecturer 2: Prof. G. De Rosa (gianfranca.derosa@unina.it) Lecturer 3: Prof. G. Ricciardi (giulia.ricciardi2@unina.it)
Credits	6 CFU (3+3+3)
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	Programma • Introduzione storica (decadimento beta, scoperta del neutrino, esperimenti basilari) • La massa del neutrino o Massa di Dirac o Massa di Majorana o Il meccanismo seesaw • Mixing del neutrino o La matrice di mixing o Mixing tra due generazioni o Violazione di CP o Gerarchia e mixing semplificato tra tre generazioni o Determinazione sperimentale dei parametri della matrice PMNS o Oscillazioni di neutrini nella materia ed esperimenti connessi • Neutrini da sorgenti naturali (teoria ed esperimenti) o Il modello solare standard e neutrini solari o Neutrini da Supernova o Neutrini atmosferici e cosmici o neutrini ad alte energie o geoneutrini • Neutrini ai reattori e agli acceleratori dedicati • Neutrini a LHC • Sezione d'urto del neutrino (fasci di neutrini, produzione di neutrini, scattering neutrino-leptone, interazione neutrino-nucleo) • Prospettive teoriche e sperimentali o Determinazione della massa assoluta e della natura dei neutrini o Momento magnetico del neutrino o Neutrini sterili o Neutrini ai futuri colliders o Neutrini come portale della materia oscura o Cenni di bariogene

3. Astro-particle physics

Experimental Techniques for Astroparticle Physics	
Lecturers	Module 1: Prof. F. Garufi (fabio.garufi@unina.it) Module 2: Dr. V. Scotti (valentina.scotti@unina.it) Module 3: Dr. C. Aramo (carla.aramo@na.infn.it)
Credits	4 CFU (2+1+1)
Planned hours	36
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic Python/C/C++ & electronics knowledge
Description	Module 1 (2 CFU) : **<u>Generalities on detectors and data acquisition</u>** • **Sensors**: Operating principles, common characteristics of all sensors and transducers. Examples of sensors: Speed, Position, Pressure, Temperature, Radiation sensors, Light sensors, Photodiodes, CCD. • **Systems and Mathematical Models**: Basic concepts of automatic controls. • **Signal Conditioning**: Importance, operational amplifiers in various configurations, filters. • **Digitization of Information**: DAC, ADC, and their main characteristics; examples of conversion techniques. Sampling theorem, aliasing, effects of oversampling and decimation. • **Data Transmission**: Overview, various topologies, serial transmission, parallel transmission, synchronous/asynchronous communication. Networks and protocols (TCP/UDP IP). Characteristics of buses: data lines, address lines, control lines, arbitration. • *(Optional)* **Operating Systems and Real-Time OS**: Microcontrollers vs. microcomputers, analog and digital I/O lines. Module 2 (1 CFU): **<u>Space based detectors</u>** • Current research in astroparticle physics conducted from space • Methods and observing techniques for studying gamma rays and cosmic rays from space. Specific examples of space-based detectors • Trigger and data acquisition systems (data processing, decoding, and transmission) for space-based experiments • Space weather Module 3 (1 CFU) **<u>Imaging Atmospheric Cherenkov Telescopes and Single-photon Detectors</u>** • Operating Principles of Cherenkov Telescopes: Mirrors, Camera, Calibration • Signal Detection and Reconstruction Techniques • Detectors and Single-Photon SiPMs and Their Use in IACT Arrays

Data Analysis in Astroparticle Physics Experiments

Lecturers	Module 1: Dr. R. Colalillo (roberta.colalillo@unina.it) Module 2: Dr. B. Panico (beatrice.panico@unina.it)
Credits	4 CFU (2+2)
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic Python/C++ skills. A personal laptop is needed.

Description	Module 1 (2 CFU): **Use of Monte Carlo (MC) in Astroparticle Physics** • Codes in use: ◦ Corsika 7-8 ◦ Nusim (with references to Fluka, QGSJet/EPOS for describing low- and high-energy interactions) • GEANT4 for particle transport through matter. Module 2 (2 CFU): **Hands-On with Experimental Data** • Use of spectrometers and calorimeters, differences in data, and how to use them (Pamela/AMS/Limadou). • The Pierre Auger Observatory Open Data Analysis : -> energy calibration, mass composition, spectrum and anisotropies. -> Use of simulations for the interpretation of the data. -> Use of new detectors to discriminate between electromagnetic and hadronic showers (Auger overlap upgrade/multiPMT SWGO – with simulations).

New Experimental Frontiers in Underground/ Low Energy Astroparticle Physics

Lecturers	Module 1: Prof. E. Calloni (enrico.calloni@unina.it) Module 2: Dr. A. Allocca (annalisa.allocca@unina.it) Module 3: Prof. G. Fiorillo (giuliana.fiorillo@unina.it) Module 4: Dr. Y. Suvorov (yury.suvorov@unina.it)
Credits	4 CFU (1+1+1+1)
Planned hours	24

Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	The course aims to provide students with an experimental perspective on low-energy Astroparticle Physics, focusing particularly on themes that have seen significant development in the last five years and are considered very promising by the scientific community in the coming decades. It is divided into four modules. **Module 1:** Focuses on the direct search for ultralight dark matter. In recent years, experimental research methodologies for ultralight dark matter have undergone a shift. Until a few years ago, the limits on the existence of ultralight particles were determined using experiments on static violations of the equivalence principle or, similarly, the fifth force. The methodological shift, which actually began a few years ago, consists of a direct astrophysical search for dark matter, where a detector sensitive to a certain particle generates a signal due to direct interaction with the particle itself. This shift is due to the fact that astrophysical detectors have started to impose stricter limits compared to previous methods (under the assumption that the searched-for particle is a significant constituent of dark matter). This was the case for Virgo/LIGO, both for dark-photon types coupled with baryons and baryons-leptons, paving the way for extending research to additional particles and new projects, which will be discussed during the course. New experimental frontiers in the search for ultralight dark matter 1.1) Main candidates, mass ranges, and spin 1.2) The search for ultralight dark matter with Virgo/LIGO/KAGRA and force detectors 1.3) Prospects for the coming years **Module 2:** Examines the critical aspects of current gravitational wave observatories, highlighting the choices and challenges of immediate future developments. Then, focusing on third-generation detectors, it analyzes possible configurations, the motivations for the most significant choices, and illustrates the experimental steps undertaken by the scientific community toward final detectors. 2.1) Current limitations of Virgo/LIGO detectors, challenges, and key developments 2.2) The American and European approaches toward third-generation detectors 2.3) Experimental challenges and expected advancements toward the Einstein Telescope **Module 3:** Introduces Low Radioactivity Techniques and extends the search for rare events explored in previous modules. Specifically, it considers low-energy neutrinos, solar and from supernovae, searches for neutrinoless double beta decay (0νββ), dark matter, and axions. Finally, it provides a glimpse into dark matter in the laboratory: from Casimir energy to the weight of vacuum. Search for light particles: 3.1) Low-energy neutrinos, solar, and from supernovae 3.2) Neutrinoless double beta decay (0νββ), dark matter, axions 3.3) A glimpse at dark matter in the laboratory: from Casimir energy to the weight of vacuum **Module 4:** Completes the introduction to low-energy astroparticle detectors. It explores noble gas, solid-state, cryogenic, and directional detectors, haloscopes, helioscopes, and Light Shining Through Walls (LSW) techniques. Low-energy astroparticle detectors (light particles) 4.1) Noble gas detectors 4.2) Solid-state, cryogenic, and directional detectors 4.3) Haloscopes, helioscopes, and LSW techniques

4. Astrophysics

Fisica dell'atmosfera del Sole e delle stelle di tipo solare	
Lecturers	Lecturer 1: Dr. V. Andretta (vincenzo.andretta@inaf.it) Lecturer 2: Dr.ssa C. Sasso (clementina.sasso@inaf.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	

Description	Il corso introduce alla fenomenologia essenziale e ai concetti di base teorici della fisica delle atmosfere stellari, con enfasi sull'atmosfera del Sole e di stelle di tipo solare. Si illustreranno inoltre i principali effetti noti dell'attività dell'atmosfera del Sole e di stelle di tipo solare sul sistema planetario circostante. **Programma sintetico:**
	• Introduzione
	  ◦ (Cenni sulla struttura interna ed evoluzione del Sole.)
	  ◦ (Cenni sulle tecniche osservative da Terra e dallo spazio, dal radio ai raggi gamma, eliosismologia, misure dell'emissione particellare di una stella di tipo solare.)
	  ◦ L'atmosfera di una stella di tipo solare o di tipo tardo in dettaglio: fotosfera, cromosfera, corona.
	  ◦ L'atmosfera estesa di una stella: vento ed eliosfera.
	• Teoria delle atmosfere stellari.
	  ◦ Introduzione all'analisi spettroscopica quantitativa astrofisica in non equilibrio
	  ◦ (Elementi di fisica dei plasmi applicata alle atmosfere stellari.)
	• Processi dinamici a varie scale temporali e spaziali in un'atmosfera stellare, e loro effetti sui sistemi planetari
	  ◦ (Brillamenti, eruzioni di massa coronale).
	  ◦ Effetti a breve termine: metereologia spaziale
	  ◦ Effetti a lungo termine: clima e abitabilità

Observational and theoretical tools for the analysis of resolved stellar populations	
Lecturers	Lecturer 1: Prof. M. Marconi (marcella.marconi@unina.it) Lecturer 2: Dr. I. Musella (ilaria.musella@inaf.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	

Description	Since the first use of the term “stellar population” by Baade in 1944, this concept has evolved, was refined, and allowed us to go a long way in the study of the Milky Way and the Local Group of galaxies, but also of stellar astrophysics. Over half a century, accurate stellar photometry and spectroscopy, as invaluable investigation techniques, have allowed us to study stellar populations in great detail. More recently, the advent of large surveys and space missions facilitates a robust characterization of the collective properties of stellar populations, while also allowing the discovery of rare objects. The study of stellar populations represents a crucial topic also in the context of ongoing and futures facilities and surveys (see e.g. Gaia, JWST, Weave, Rubin-LSST, 4MOST). This course will provide the students with a comprehensive view of the properties of Galactic and extragalactic resolved stellar populations, including their variable star content, and a variety of currently adopted observational and theoretical tools for their analysis. This will allow the students to be able to interpret the main characteristics of the observed stellar populations in the context of the international projects they might be involved in, as well as to improve their knowledge of stellar physics and of the use of static and variable stars to constrain astronomical distances and galactic formation mechanisms. The course will include an introductory more theoretical part devoted to the properties of resolved stellar populations in different environments and of the associated pulsating stars and a second part devoted to the application of photometry and timeseries data analysis as well as of stellar evolution and pulsation models to infer the stellar properties and distances, fundamental to obtain the 3-D stellar distributions and the star formation history, and in turn constrain the cosmic distance scale and the galactic formation mechanisms. In conclusion, this course will provide fundamental knowledge on resolved stellar populations to students interested in both stellar and extragalactic topics. **Contents:** • CMD diagrams of resolved (simple and composite) stellar populations • Elements of Stellar Population Synthesis • Pulsating stars across the CMD as distance indicators and stellar population tracers • Elements of stellar photometry • Elements of stellar spectroscopy • Time-series data analysis and period determination • Methods to constrain the age and the chemistry of a stellar population • From stellar populations to galactic formation models • Individual and mean distance derivation • Calibration of the cosmic distance scale

Galaxies & mass assembly in the Universe

Lecturers	Module 1: Prof. N. R. Napolitano (nicolarosario.napolitano@unina.it) Module 2: Dr. C. Tortora (crescenzo.tortora@inaf.it) Module 3: Dr. E. Iodice (enrichetta.iodice@inaf.it)

Credits	6 CFU (1+1.5+1.5)
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	Understanding the baryonic and dark matter content of galaxies—from their central regions to their outskirts—is a cornerstone of modern astrophysics. This topic is intimately linked to the physics governing gas accretion, star formation efficiency, and the broader cosmological framework, including hierarchical galaxy formation models. Photometric observations across various wavelengths, coupled with spectral energy distribution (SED) fitting, provide insights into the stellar mass and other properties of galaxies, such as star formation rates, ages, metallicities, and are connected with the initial mass function (IMF). Total galaxy masses, on the other hand, are derived through complementary techniques. Velocity dispersions can be analyzed using the Jeans equations, while gravitational lensing—a phenomenon predicted by general relativity—offers the most precise method to measure mass across all scales in the Universe, from stars to galaxy clusters. Gravitational lensing has broad applications, from constraining dark matter and dark energy to discovering exoplanets and faint, otherwise undetectable galaxies. Therefore, constraining galaxies' light and mass distribution in different environments provides stringent constraints on their formation within the ΛCDM paradigm. In this framework, clusters of galaxies are expected to grow over time by accreting smaller groups along filaments, driven by the effect of gravity generated by the total matter content. In the deep potential well at the cluster center, galaxies continue to undergo active mass assembly and, in this process, gravitational interactions and merging between systems of comparable mass and/or smaller objects play a fundamental role in defining the galaxies' structure and evolution, the build-up of the stellar halos and the intra-cluster light (ICL). Therefore, exploring the Universe down to the low-surface brightness (LSB) regime, where the highly diagnostic relics of the galaxy mass assembly across all environments reside, is the fundamental complimentary “tool” to constrain the ***physical processes at work during the mass assembly*** in the ΛCDM paradigm. In the last two decades, deep imaging and spectroscopic surveys have largely enhanced the study of mass assembly in different environments, by providing extensive analyses of the light and color distributions, kinematics, and stellar populations of galaxies, including discrete tracers as GCs and planetary nebulae (PNe), out to the regions of stellar halos and intragroup/intra-cluster space. From the theoretical side, semi-analytic models and hydrodynamical simulations give detailed predictions about the structure and stellar populations of stellar halos, the ICL formation, and the amount of substructures in various kinds of environments. Module 1-The Universe at all scales: overview on the structure of galaxies: Galaxy Photometry, Galaxy spectroscopy, Galaxy dynamics Module 2 -Total and Dark Matter in galaxies: Stellar populations and stellar mass,
	Gravitational lensing: an overview, Gravitational lensing and dynamics, Gravitational lensing application to surveys Module 3 - The Low-surface Brightness Universe: Theoretical predictions, Stellar halos & ICL part 1

Advanced Cosmology from an astrophysical perspective	
Lecturers	Module 1: Module 2:
Credits	4 CFU (2+2)

Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	Module 1 **Cosmological constant:** Einstein equations with the cosmological constant, History of the cosmological constant, The fine tuning problem, The coincidence problem, Cosmological constant and the anthropic principle, The decoupling of the cosmological constant from gravity, Dark energy as a modified form of matter I, Quintessence, Early dark energy, Quintessence potentials in particle physics, Reconstruction of quintessence from observations **Dark energy as modified form of matter:** k-essence, Phantoms, Coupled dark energy, Chameleon scalar fields, Dark energy models with scaling solutions **Cosmography: studying models without models:** Apparatus, Scale factor series, Redshift series, Analisys on Supernovae and Hubble factor: Data and Method, Cosmographic analysis with Chebyshev polynomials, Extended gravity cosmography, High-redshift cosmography: auxiliary variables versus Padé polynomials **Cosmology with emerging cosmological probes:** Cosmic chronometers, Quasars Gamma-ray bursts, Standard sirens Module 2 **Observational Cosmology: tests and probes for the accelerating universe:** Supernovae Type Ia, Baryon Acoustic Oscillations, Gravitational lensing: a unique probe of dark matter and dark energy, Perturbations in linear theory (in LCDM): perturbations in the metric and stress energy tensors, gauge choices. Sub and super-horizon evolution of perturbations. CMB physics and phenomenology of CMB anisotropies. Correlation functions and the power spectrum and bispectrum. Impact of beyond LCDM models on the cosmological observables (lets use an Einstein Boltzmann code to concretely see the impact)

5. Physics of Matter

First principles methods for applications in material science	
Lecturer	Dr. A. Pecoraro
Credits	2-3 CFU
Planned hours	12/18
Planned schedule	May-June
Prerequisites	Basic knowledge of general physics and quantum mechanics. One or two lectures (depending on the students' background) will be dedicated to recap the basics of solidstate physics.
Description	This course provides an overview of the theoretical and computational techniques used to calculate the electronic structure and the optical properties of periodic systems. It examines the limitations and shortcomings of current state-of-the-art methods. Additionally, the course explores various applications, paying particular attention to photovoltaics and emphasizing the key role of computer simulations in the advancement and development of solid-state materials. 1. Overview of the density functional theory (DFT) with description of the main approaches for treating exchange correlation. 2. Beyond DFT: many-body effects and the GW approximation for improved electronic structure calculations. 3. Basic principles of the emerging photovoltaic technologies, with a focus on the materials employed in current devices. 4. Computational modelling of materials: • Characterization of opto-electronic properties, including band structures, density of states, dielectric function. • Simulation of defects and doping effects on material performances. • Modelling of interfaces and charge transport phenomena.

Optimization Methods for Quantum Information

Lecturers	Lecturer 1: Dr. D. Farina donato.farina@unina.it Lecturer 2: Dr. G. Passarelli gianluca.passarelli@unina.it
Credits	4 CFU
Planned hours	24
Planned schedule	Second semester, precise schedule to be arranged with students
Prerequisites	Basics of quantum mechanics
Description	Optimization problems are ubiquitous in classical and quantum science. This course introduces selected state of the art optimization methods for quantum information and (closed and open) quantum many-body systems. The content is structured into two main areas: classical optimization methods for quantum information and many-body problems, and quantum optimization algorithms addressing classical optimization problems. While the focus will be on numerical methods, the course also offers a selection of problems that are optimally solved analytically. The general aim is to provide students with practical tools for their everyday research life. To this aim, theoretical lectures will be accompanied by live coding sessions. An outline of the program is the following, but it can be adapted to students' requests. 1. Semidefinite programming for quantum information science a. Basics of convex optimization and semidefinite programming b. Applications in quantum information science and many-body physics, such as certification of quantum state properties under partial information, distinguishability of quantum states and quantum channels (diamond distance), moment-matrix approaches for quantum many-body systems c. Live coding session 2. Optimal work extraction in quantum thermodynamics a. Maximum extractable work: Ergotropy b. Ergotropy in open quantum systems 3. Quantum optimization of classical problems a. Combinatorial optimization problems and Quantum Annealing (QA) b. Variational Quantum Eigensolvers (VQEs) and Quantum Approximate Optimization Algorithm (QAOA) c. Live coding session 4. Quantum optimal control a. Counterdiabatic driving b. Gradient-based and gradient free optimization

Fundamentals on applied superconductivity

Lecturers	Lecturer 1: Dr. Halima Giovanna Ahmad (halimagiovanna.ahmad@unina.it) Lecturer 2: Dr. Roberta Satariano (roberta.satariano@unina.it)
Credits	4 CFU
Planned hours	about 24-36 (12 – 2 hours each. Not excluded lessons of 4 hours in case of laboratory visits)
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of solid-state physics and quantum mechanics
Description	The aim of the course is to furnish competences on applied aspects related to superconducting quantum technologies, including: fundamentals on superconductivity, Josephson effect and circuit Quantum Electrodynamics (cQED), as well as an overview on current applications of Josephson devices in classical/quantum superconducting electronics. A brief overview of the program is the following: **The physics of superconductivity and Josephson effect**: fundamentals of superconductivity, Josephson effect and the role of temperature, magnetic field and microwaves also in unconventional devices. **Overview on *hot-topic* applications of superconducting electronics**: magnetic field sensors, single-photon detectors, optics/microwave conversion with superconducting circuits, cryogenic memories, digital electronics and quantum computing. Special focus on a specific case-study: the *transmon* qubit as building block for superconducting quantum processors for quantum computing. **Fabrication and experimental equipments**: thin film deposition techniques for superconducting quantum technologies and nano/micro-litography. Cryogenic systems and room temperature electronics. **Experimental measurements**: DC characterization of Josephson Junctions, protocols for characterization of transmon qubits, such as spectroscopy and time-domain measurements (Rabi oscillations, coherence times, fidelity benchmarking…), and hardware implementation of quantum algorithms on superconducting quantum processors Students will be asked to present a conference-like talk on a topic related to the above program.

A general overview of the Physics of Surfaces and Interfaces and related Advanced Spectroscopic Techniques

Lecturers	Module 1: Prof. R. Di Capua (roberto.dicapua@unina.it) Module 2: Prof. G. M. De Luca (gabriellamaria.deluca@unina.it)
Credits	4 CFU
Planned hours	24 hours (12 lectures (6 per module), 2 hours each)
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of classical general physics and fundamentals of quantum mechanics. One or two lectures (depending on the students' background) will be devoted to the few needed basic concepts of solid-state physics.
Description	The course aims to illustrate the foundation of physics of surfaces and interfaces and to provide an outline of the features of the most important advanced spectroscopic techniques. It is conceived to be of potential interest not only for Ph.D. students working in the physics of matter, but also for those involved in other fields of physics and of material sciences, due to the development of fundamental issues and methodologies of wide application. The main body of the course will be organized along the following two lines, corresponding to the partition into the two modules. **Module 1**: After a summary of the main concepts in the physics of materials and solids, the lectures will illustrate the basic phenomenological and theoretical aspects of the physics of surfaces, exploring the topics of surface electronic states, charge distribution at surfaces and interfaces, thermodynamic aspects of the equilibrium, role of collective excitations and related interactions. The arising of new functionalities and properties at interfaces between different materials will be explored, as well as related applications and perspectives for nanotechnology. Some microscopy and surface characterization technique will be described. **Module 2**: Some advanced spectroscopies, based on the study of the interaction of the matter with radiation will be described, being the most powerful experimental tools to investigate the electronic and magnetic properties of complex materials. The importance of high brilliance synchrotron sources will be highlighted, for the achievement of the highest momentum and energy resolution. The described techniques will include X-ray Absorption, Photoemissionbased techniques, Resonant Inelastic X-ray Scattering, and applications to the investigation of some functionalities of complex materials will be explored.

Electrical properties of Low dimensional Materials

Lecturer	Prof. A. Cassinese (antonio.cassinese@unina.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	Introductory course to organic compounds with different functionalities (like semiconductors, conductors, ferroelectrics, superconductors) of interest for electronic and optoelectronic application. Both fundamental aspects and practical application will be described
Description	- Organic semiconductors, working principles and applications: - Injection and Electrical conductivity in organic semiconductors and I/O hybrids. P-type and n-type semiconductors - Organic compounds with different functionalities (conductors, ferroelectric, electrical bistable and superconductors - Organic Field effect transistor (OFET) and electrochemical transistor (OECT) : basic issues and practical application - DC, AC and microwave electrical characterization techniques. SCLC model, ballistic and UDR model. - Quantum capacitance and conductance. Lithographic techniques, soft lithography and nanolithography, Notes on Quantum Devices and other emerging applications. Electrical Device measurements (OFET or OECT) and data analysis

Electrodynamic properties of novel materials and devices	
Lecturer	Prof. A. Andreone
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	- Electrodynamics of metals, superconductors and dielectric media: basic principles - A short introduction to artificial materials: metamaterials and photonic band gap crystals and quasicrystals - Transformation optics: a new approach to defining the light geometry using metamaterials - Cutting edge THz technology - Plasmonics and plasmonic structures - Some exemplary applications of “natural” and “artificial” materials: from microwave systems to optical devices and sensors, cloaking, solar cells

6. Biomedical physics

Advanced topics in environmental radioactivity and radiation protection	
Lecturers	Module 1: Dr. F. Ambrosino (fabrizio.ambrosino@unina.it) Module 2: Prof. M. Pugliese (mariagabriella.pugliese@unina.it)
Credits	4 CFU (2+2)
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	basic principles of radiation physics
Description	Module 1: Advanced topics in environmental radioactivity The lectures introduce some basic aspects and concept on new frontiers about environmental radioactivity. Physical methodologies, both theoretical and experimental, will be treated for a correct use of the instrumentation involved in radiation detection. In this course, the students will have the opportunity to perform radiation measurements. Module 2: Advanced topics in radiation protection The lectures introduce some basic aspects and concept on new frontiers about radiation protection. Radiation protection topics that have been included in the new legislation in force will also be covered. In this course, the students will acquire skills on the radiation protection for humans and the environment, and will have the opportunity to perform dosimetry measurements.

Monte Carlo and AI basis in Medical Physics	
Lecturer	Prof. G. Mettivier (giovanni.mettivier@unina.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	Medical Physics background, Programming skills (C, python, Matlab)
Description	The lectures introduce to some basic aspects and concepts of the use of Monte Carlo simulations procedures and Artificial Imaging tools for their application in the Medical Physics field. The use of simulation code, like Geant4, allows to students to implement and study dosimetric and radiation-matter interaction problems related to medical apparatus or medical procedure (Virtual Clinical Trials). The study of AI algorithms (Machine Learning and Deep Learning) and autonomy models are the basis for understand the basic of automatic learning and reasoning. In this course, the students will have opportunity to design and develop such systems as part practical lessons.

Biosensors	
Lecturer	Dr. B. Della Ventura (bartolomeo.dellaventura@unina.it)
Credits	2 CFU
Planned hours	12
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	The course aims at providing the student with the most widespread techniques currently used in realizing biosensors. Lectures will include the discussion of the physical mechanisms underlying the transduction processes and laboratory demonstrations of some devices. The following biosensors will be described. • Piezoelectric biosensors: quartz-crystal microbalances. • Electrochemical biosensors: volt-amperometric and impedance spectroscopy techniques. • Plasmonic-based biosensors: colorimetric and fluorescence-based biosensors.

7. Geophysics

Computational seismology	
Lecturer	Dr. A. Scala (antonio.scala@unina.it)
Credits	4 CFU
Planned hours	24
Planned schedule	First year - To be arranged in discussion with students
Prerequisites	

Description	This course introduces the key features of several commonly used techniques for the numerical modeling of fault rupture and seismic wave propagation, with an emphasis on their applicability across various seismological contexts. By the end of the course, students will have a solid understanding of the fundamental principles of these techniques and will be able to assess which approach to apply and how to implement it in different scenarios. Syllabus: • Seismic wave propagation ○ The elastodynamic problem and the momentum balance equation ○ The elastic constitutive equation ○ Numerical modelling • Rupture dynamics ○ Coulomb theory ○ Constituive friction conditions ○ Numerical modelling of spontaneous rupture • Finite Difference Methods (FDM) ○ Time-space discretization and the staggered grids ○ Fault modelling in FDM ○ Convergence and stability • Finite Element Method (FEM) and Spectal Element Method (SEM) ○ The variational formulation ○ Space discretization and convergence ○ High-order time scheme ○ Free surface and fault modelling as boundary conditions

Advanced Earthquake Seismology

Lecturer	Prof. G. Festa (gaetano.festa@unina.it)
Credits	2 CFU
Planned hours	12

Planned schedule	First year - To be arranged in discussion with students
Prerequisites	
Description	This course offers an in-depth exploration of earthquake seismology, focusing on state-of-the-art techniques for earthquake characterization from both observational and modeling perspectives. Students will gain proficiency with modern observational tools, such as DAS technology and seismic arrays, as well as advanced methods for analyzing data related to microseismicity and the characterization of large-scale seismic events. Syllabus • New instrumentation for earthquake monitoring ◦ Seismic Arrays ◦ DAS technology ◦ Geodetic measurements • Earthquake source ◦ Introduction to earthquake source ◦ Earthquake dynamics ◦ Point source vs finite source approximation • Microseismicity analysis ◦ Event detection and catalogue enhancement based on Machine Learning and Template Matching ◦ Source parameter estimation • Finite source models ◦ Full-waveform inverse techniques ◦ Back-projection

Earthquake Early Warning

Lecturers	Lecturer 1 Dr. S. Colombelli (simona.colombelli@unina.it) Lecturer 2 Prof. A. Zollo (aldo.zollo@unina.it)
Credits	4 CFU (2+2)
Planned hours	24
Planned schedule	Second year - To be arranged in discussion with students
Prerequisites	
Description	This course will overview the state-of-the-art in EEWS conception, design and worldwide developments. It will illustrate the different phases in the analysis/decision chain including the real-time seismic waveform acquisition, the fast and automated signal processing, the source parameter estimation, the prediction of the potential earthquake damage and finally the broadcast of alert messages, to pilot safety actions during the earthquake emergency. Syllabus: Earthquake Early Warning Systems (EEWS): Concepts, approaches & technologies • The basic principles and possible uses of EEWS • Worldwide developments • Technological requirements • The example of ISNET in south Italy • Real-Time data acquisition and signal processing • Observed parameters and output of an EEWS Current and next-generation EEWS: methodologies for network-based and on-site systems • Components of a regional EEWS • Automatic picking and event detection • Real-time eqk location and magnitude determination • Peak motion prediction and alert notification • The EW system PRESTo • Onsite EEW • Impact-Based EEWS: Early estimation of the potential damage zone • EW for high-speed railways The Physical Grounds of Earthquake Early Warning • The conceptual issue of real-time magnitude estimate • The open debate on earthquake determinism • The pre-slip model and the cascade model • The earthquake rupture nucleation: hints from geological observations, seismological data and laboratory fracture experiments • Strategies for the real-time magnitude estimate: the slope method

AI for Geophysics

Lecturer	Prof. M. Palo (mauro.palo@unina.it)

Credits	2 CFU
Planned hours	12
Planned schedule	Second year - To be arranged in discussion with students
Prerequisites	
Description	The lectures will quantitatively describe the main characteristics of the MachineLearning algorithms currently applied to geophysical data for detection, classification, data reduction, clustering of the phenomena. In the course, the mathematical formalism of the neural networks (NNs) will be first introduced, then specific NNs will be described together with the geophysical scientific issues they aim to tackle. Special attention will be devoted to experimental data from volcanoes and earthquakes. Syllabus: - Short introduction to Neural Networks and Machine Learning - Neural Networks for pattern recognition - applications to: o Classification of the nature of the volcanic signals o Identification of low-energy seismic radiation o Determination of earthquake first motion polarity - Unsupervised machine learning – grouping and data reduction of geophysical observations by: o Clustering techniques o Principal Component Analysis o Independent Component Analysis o Self-Organized Maps

8. Interdisciplinary topics

Physics of the climate change	
Lecturer	Dr. A. Sannino (alessia.sannino@unina.it)
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of classical physics (mechanics, thermodynamic and electromagnetism)
Description	The course provides the basis of physics applied to the global warming and the ongoing climate change, paying particular attention to the main atmospheric and biosphere constituents, their sources, interactions and processes. During the course, the Earth's radiative balance and the different factors that play in this balance will be studied in detail, such as trace gases, atmospheric aerosols and their compounds. The main terrestrial cycles (water cycle and carbon cycle) will be studied and their role in the ecosystem and the possible consequences of their disturbance will be examined. Finally, the current state of knowledge of these phenomena will be analysed, trough the experimental basics of the climatological models used, the possible scenarios to which they lead and the research centres involved. The program will include: 1) Introduction to climate system (3h) 2) Thermal radiation and terrestrial radiative balance (3h) 3) Climatological models (2h) 4) Earth cycles (4h) 5) Climate Change sources (4h) 6) The limit of 3°C (2h) 7) Current situation, observations and possible scenarios (6h)

Statistical Methods for Data Analysis	
Lecturer	Prof. A.O. M. Iorio (albertoorsomaria.iorio@unina.it)
Credits	3 CFU
Planned hours	18
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of the concept of probability. Examples and exercises will be done in C++, so basic knowledge of computer programming is recommended.
Description	Statistical methods for data analysis: • Statistics and probability distributions • Parameter estimates and maximum likelihood (ML) and extended ML methods • The Bayes theorem: frequentistic and Bayesian approaches • Computation of upper limits • Combining measurements • Monte Carlo techniques • Fit quality with Toy Monte Carlo • Multivariate discrimination methods • Artificial Neural Networks Introduction to statistics application frameworks based on ROOT toolkit: • RooFit • TMVA

Introduction to Labview Programming	
Lecturer	Dr. D. Rapagnani (david.rapagnani@unina.it)
Credits	2 CFU
Planned hours	12
Planned schedule	To be arranged in discussion with students
Prerequisites	
Description	This course aim to give a LabVIEW basic programming knowledge, with some hands-on activities. The LabVIEW environment will be presented with a particular emphasis on the language peculiarities and strengths. Standard programming strategies (e. g. sequential and state programming) will be described for proper applications design. Also communication with hardware devices will be illustrated to make students able to operate their own devices. More advanced programming features will also illustrate for the implementation of complex and multi-level applications. A few examples will be proposed to illustrate how to implement LabVIEW for automation and data acquisition. The final test consisting in the realization (design, development and test) of a controlling software will be agreed together with the students. **Course Outline** Introduction to LabVEW: The LabVIEW Environment, Data Flow, Data Type and Data Structure Building simple Vis: Loops, Error Handling, Decision-Making, Structures, Programming Strategies Measure: Acquiring data with Hardware, Accessing Files Advanced VI: Design Patterns, Controlling UI

Data Driven Science	
Lecturer	Module 1: prof. Massimo Brescia (massimo.brescia@unina.it) Module 2: dr. Fabio Ragosta (fabio.ragosta@unina.it) Module 3: dr. Antonio Ferragamo (antonio.ferragamo@unina.it
Credits	4 CFU
Planned hours	24
Planned schedule	To be arranged with PhD students
Prerequisites	
Description	*Module 1 (2 CFU, Brescia):* The scientific investigation based on data driven approach Machine/deep learning paradigms Parameter Space exploration and XAI principles Genetic Algorithms Swarm Intelligence *Module 2 (1 CFU, Ragosta):* Data driven time series analysis MCMC (Monte Carlo Markov Chain) and Gaussian processes Non-parametric measures and time series statistics Use cases in Astronomy: Rubin LSST, VST *Module 3 (1 CFU, Ferragamo):* Cosmological Simulations Numerical technics n-body, zoomed simulations Physical Interpretation and simulations development

Fundamentals of NMR and its applications for the diagnosis of infective diseases	
Lecturers	Dr. S. Potenti (simone.potenti@unina.it)
Credits	3 CFU
Planned hours	18
Planned schedule	To be arranged in discussion with students
Prerequisites	Basic knowledge of physics and chemistry
Description	**Syllabus** 1. Introduction to NMR Spectroscopy • Physical principles • Overview of NMR instrumentation: state of the art, limitations, and innovations 2. NMR Techniques and Methodologies • Qualitative and quantitative analysis • From spectra to structure: 1D and 2D spectroscopy • Variable-temperature and solid-state NMR • Time-resolved techniques • Overview of common NMR-active nuclides 3. Structural and Chemical Applications • Determination of molecular structures and reaction mechanisms • Supramolecular interactions and an introduction to docking 4. Advanced Diagnostic Applications • Metabolomics for pathogen recognition • Identification of molecular biomarkers for infectious disease diagnostics • Use of diagnostic nanomaterials 5. Innovative Approaches • Integration of NMR spectroscopy with machine learning Future potential of NMR in diagnostic

9. SOFT SKILLS

Scientific writing	
Lecturer	Prof. Paolo Russo (paolo.russo@unina.it)
Credits (planned)	3
Planned hours	18 (2 hrs per lecture, 2 lectures per week)
Planned schedule	To be arranged in discussion with students
Prerequisites	none
Description	The course provides basic intro to the professional task of scientific publication in international journals, with reference to motivations for publishing, scientific journal selection, writing style, ethical issues, manuscript editing, revision and proofs reading, manuscript correspondence. Moreover, the following aspects will be covered: description of the basic aspects of the Editorial structure of a scientific Journal (Editor, associate editors, editorial board members, publisher, journal manager); basic aspects of the manuscript review process; methods for manuscript review; understanding and evaluation of bibliometrical indices. The course evaluation will be based on exercises assigned to attendees on selected aspects of the course material.

How to boost your PhD	
Lecturer	Dr. Antigone Marino (CNR–ISASI, antigone.marino@unina.it)
Credits (planned)	3
Planned hours	18
Planned schedule	To be arranged in discussion with students
Prerequisites	none

Description	Nowadays, the scientific researcher profession requires a plurality of skills, on which we rarely stop to think about. Which ones are they? Above all, how to acquire them to turbo boost your PhD? The course is focused on this aspect of the scientific carriers. • Soft Skills - The technical skills of a person are the first ingredients for a successful career, but often the competition with others is played on other skills, which are more related to the character of the person. This does not mean owning them or not. A good training action will widen the spectrum of these skills as well as technical ones. • Scientific Communication – A large amount of researcher's work is now devoted to communication. Mostly through posters, slides, papers and reports. We will see what are the channels of communication and how to treat them properly. • Digital Reputation - Once upon a time, there was a file in every scientist’s computer called curriculum dot something. Nowadays, this file is not enough to promote your career. Society is collecting all the information in the biggest database we have ever had, internet. The care of our digital records can be a fundamental key for our work. The digital reputation of a scientist is defined by his/her behaviour in the online environment and by the content he/she posts about him/her self and others. Tips to analyse and control your digital presence will be given. • Outreach - Political institutions are now asking us to bring our work to the attention of journalists, citizens and stakeholders. That is why outreach is playing an important role in scientific careers. Organizing a good outreach event needs a little bit of experience and a welldefined project. We will see which the conditions that make the outreach event effective are.