M.SC. IN PHYSICAL SCIENCES

BIOMEDICAL PHYSICS

General link :
https://scienzefisiche.cdl.unipv.it/en
Link Biomedical Physics :
https://scienzefisiche.cdl.unipv.it/en
Presentation webinar :
https://thestudyabroadportal.com/open-day/biomedical-physics-at-the-university-of-pavia-exploring-the-life-phenomenon-through-the-principles-of-
physics/?utm_source=University/
More information :
https://apply.unipv.eu/en_GB/courses/course/172-masters-program-physical-sciencesbiomedical-physics-curriculum
https://fisica.cdl.unipv.it/en/node/185
https://scienzefisiche.cdl.unipv.it/it/informazioni-pratiche/guida-dello-studente/guida-dello-studente-laurea-scienze-fisiche-202425
Study plan :

https://scienzefisiche.cdl.unipv.it/en/practical-information/study-plan

BIOMEDICAL PHYSICS

IT IS A MULTIDISCIPLINARY FIELD THAT APPLIES PRINCIPLES AND TECHNIQUES OF PHYSICS TO THE STUDY OF MEDICINE, BIOLOGICAL SYSTEMS AND PHENOMENA



...to advance physics knowledge, technology, biomedical science and healthcare!

MEDICAL DIAGNOSTIC AND THERAPEUTIC TECHNIQUES ARE ADVANCING AT A HIGH RATE

WHEN RADIATION (IONIZING AND NOT) IS USED IN MEDICINE, PHYSICISTS PLAY A PIVOTAL ROLE

WHY PHYSICISTS IN THE BIOMEDICAL FIELD?

PHYSICISTS BRING CRUCIAL TECHNICAL AND THEORETICAL SKILLS, ENHANCING COLLABORATION WITH PROFESSIONALS SUCH AS PHYSICIANS, ENGINEERS, BIOLOGISTS, MATHEMATICIANS, CHEMISTS, STATISTICIANS, INFORMATICIANS AND OTHERS.

BIOMEDICAL PHYSICS PROGRAM

THE PROGRAM FOCUSES ON THE USE OF BASIC AND APPLIED RESEARCH IN :



PHYSICAL PRINCIPLES AND MODELS



EXAMPLES OF OUR RESEARCH LABS

Radiobiology Laboratory

(G Baiocco, I Guardamagna)

Cellular/Molecular biology, in vitro cells and ex-vivo (from patients). Measurements and models of the effects of ionizing radiation on biological structures (e.g.: DNA damage and repair, cell-to-cell communication, immune system response)

Ionizing Radiation Laboratory

(N Protti)

Use of scintillation detectors, solid-state detectors and instrumentation used in health/environmental physics.

NMR/MRI & SQUID Lab: MRI, nuclear hyperpolarization, nanoparticles for theranostics

(F Brero, P Carretta, M Filibian, A Lascialfari, M Mariani, G.Prando)

Hyperpolarization technique and use of magnetic nanoparticles to enhance MRI images contrast \rightarrow more effective and/or personalized diagnosis









EXAMPLES OF OUR RESEARCH ACTIVITIES (ONCOLOGIC THERAPY)

Simulations for Hadron Therapy

(F Ballarini, M Carante, R Ramos) Calculation of effectiveness in eliminating tumor cells (and the probability of damaging healthy cells) for ion beams used in hadron therapy (protons, C ions, and He ions)

Boron Neutron Capture Therapy

(S Bortolussi, N Protti, I Postuma, S Fatemi) Cell-selective radiotherapy via neutron capture on ¹⁰B



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Magnetic Fluid Hyperthermia

(F Brero, A Lascialfari, M Mariani, P Carretta) A technique that uses magnetic nanoparticles with therapeutic properties, thanks to the local release of heat that weakens tumor cells Risk of secondary tumors and complications and applications of microdosimetry in particle therapy (G Baiocco, I Guardamagna)

Plasmonic nanostructures for photothermal therapy and SERS imaging (M Patrini, P Gallinetto)

INTERNATIONAL GEANT4 SCHOOL

Free participation for LM students !! Educational event aimed at exploring the advancements of the Geant4 toolkit in the field of medical physics with special lectures dedicated to Geant4_DNA. https://agenda.infn.it/event/37741/

EXAMPLES OF OUR RESEARCH ACTIVITIES (DIAGNOSTICS)

Magnetic Resonance Imaging (MRI)

(F Brero, P Carretta, M Filibian, A Lascialfari, M Mariani) Research on new materials, software, and technology for MRI for diagnostic and

therapeutic purposes



Radioisotopes for theranostics

(A Fontana, M Carante) Study of cross sections for the identification of new radioisotopes suitable both as therapeutic agents and as diagnostic agents.

Imaging data analysis, Artificial Intelligence, and Radiomics

(F Brero, S Bortolussi, S Fatemi, M Filibian, A Lascialfari, I Postuma) Physical/statistical analysis of diagnostic images to obtain quantitative information on disease progression



Production of radioisotopes for imaging

(LENA –Applied Nuclear Energy Laboratory) The LENA cyclotron produces F-18 daily, used for PET (Positron Emission Tomography) imaging



EXAMPLES OF OUR RESEARCH ACTIVITIES (RADIO-PROTECTION)

Radiation protection in industry

(E Giroletti)

Issues relating to the use of radiation in industry and the consequent radiation protection of workers are addressed



Radiation protection in space

(G Baiocco, I Guardamagna, F Ballarini, M Carante, R Ramos)

Dose calculations to astronauts in various space radiation exposure scenarios, with attention to the role of shielding



IMAGING

AN EXAMPLE OF RESEARCH TOPICS (SKILLS ACQUIRED)

RESEARCH IN ONCOLOGY





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AN IMPORTANT COLLABORATION WITH NATIONAL INSTITUTE FOR NUCLEAR PHYSICS



IMAGE ANALYSIS AND TREATMENT (AI) SENSORS FOR BIOMARKERS INNOVATIVE RADIATION TREATMENTS EFFECTS AT CELLULAR AND SUBCELLULAR LEVEL COMPUTATIONAL RADIOBIOLOGY & BIOPHYSICS



ENTIRELY IN ENGLISH

STUDY PLAN – 120 ECTS – 2 YEARS

1 ECTS credit = 1 CFU credit

48 CFU (of which : 6 CFU in FIS/02 or FIS/08, 1 class ; 12 CFU in FIS/04 or FIS/03, 2 classes ; 30 CFU in FIS/01 or FIS/07, 5 classes) **to be acquired by 8 classes from the following table:**

Nome insegnamento	Sector	CFU	Semester
Quantum electrodynamics *	FIS/02	6	1
Computational methods in Physics *	FIS/02	6	
Particle physics *	FIS/04	6	
Physics of ionizing radiations *	FIS/04	6	1
Laboratory of ionizing radiations *	FIS/04	6	1
Statistical methods in physics *	FIS/01	6	1
Artificial Intelligence for Experimental and Applied Physics *	FIS/01	6	I
Particle detectors *	FIS/01	6	11
Rheology and Diagnostic Techniques: Theory and Practice *	FIS/07	6	I
Physics of innovative oncological therapy techniques *	FIS/07	6	1
Simulations in experimental and applied physics *	FIS/07	6	
Physics of medical imaging *	FIS/07	6	1
Medical diagnostic techniques with ionizing radiations *	FIS/07	6	II
Introduction to ionizing radiation protection *	FIS/07	6	

12 CFU, 2 classes, from the following table :

Nome insegnamento	Settore	CFU	Semestre
General biology, anatomy and human physiology	BIO/06	6	1
Radiation biophysics and radiobiology	MED/36	6	II
Machine learning	ING-INF/05	6	П
MRI Physics for Neuroscience	M-PSI/02	6	Ш
Bioinformatics	ING-INF/06	6	I

12 CFU, 2 classes, to be acquired with electives.

For example one can choose transversal classes :

Agile Project Management	3 CFU - II semester
Entrepreneurship	3 CFU – I semester
Italian language for foreign students	3 CFU – II semester
Presentation making	3 CFU – II semester

3	B6 CFU	Thesis training
6	5 CFU	Other activities
e	5 CFU	Final exam

THESIS & INTERNSHIPS - COMPANIES AND HOSPITALS

STELAR SRL
LENA
FONDAZIONE CNAO
OTHER HOSPITALS

BRACCO SPA BRUKER SRL National/International networks of research groups (also within collaborations for Italian/European Projects)



INTERNSHIP AT CENTERS/COMPANIES Prof. Pietro Gallinetto - Coordinator (<u>pietro.gallinetto@unipv.it</u>)

EXAMPLES : BRACCO IMAGING - FONDAZIONE CNAO

AFTER THE MASTER'S DEGREE?

PhD

With possibility to stay abroad up to 1.5 years (<u>daniela.rebuzzi@unipv.it</u>) Double PhD with Universidad San Martin – Buenos Aires

RADIATION PROTECTION EXPERT

2° LEVEL MASTER DEGREE (asalvini@unipv.it, nicoletta.protti@unipv.it) to carry on tasks regarding radiation safety compliance https://lena.unipv.it/en/master-of-radiation-protection/



SPECIALIZATION SCHOOL IN MEDICAL PHYSICS

To work in hospital/health facilities

COMPANIES

developing medical technologies

FREELANCE & CONSULTING

SECONDARY AND HIGH SCHOOL TEACHING

...and more!

DO YOU WANT TO KNOW MORE ? ...FEEL FREE TO CONTACT US!

TEACHING STAFF

alessandro.bacchetta@unipv.it giorgio.baiocco@unipv.it francesca.ballarini@unipv.it silva.bortolussi@unipv.it alessandro.braghieri@pv.infn.it francesca.brero@unipv.it mariopietro.carante@unipv.it susanna.costanza@unipv.it alessandro.lascialfari@unipv.it giacomo.livan@unipv.it manuel.mariani@unipv.it paolo.pedroni@pv.infn.it fulvio.piccinini@pv.infn.it giacomo.polesello@pv.infn.it ian.postuma@pv.infn.it nicoletta.protti@unipv.it

THE END