



Master of Science in the field of

PHYSICS

*Incubating talent pool of well-versed
cadres in physics*

2027-28 (September 2027 intake)

IS THE PROGRAMME FOR YOU

Why this Programme

- An innovative and well-designed MSc programme that strengthens students' background to cope with ever-evolving challenges
- Stresses a balanced and flexible approach, with a strong focus on catering to the academic and career aspiration of students, developing their own speciality in subject knowledge and technical skills

World-class Rankings of HKU

Quacquarelli Symonds (QS) 

#11 World Rankings 2027

#1 Asia Rankings 2026

Times Higher Education (THE) 

#33 World Rankings 2027

#6 Asia Rankings 2026

Eminent Subject Ranking 

QS World University Rankings by Subject 2026:

#63 Physics & Astronomy

Top-notch Scientists in the Faculty

Clarivate Analytics' Essential Science Indicators

20.8% of our professoriate staff (average over the past decade) are classified Top 1% scholars

Provides a flexible yet solid education on theories, techniques and frontier developments in different subfields in physics, including the following fields of specialisation:

- ◇ astrophysics
- ◇ computational physics
- ◇ condensed matter physics
- ◇ device and nanophysics
- ◇ photonics and quantum information



Tuition fees

Composition fee: HK\$230,000* (subject to approval)
Students are required to pay Caution Money (HK\$350, refundable on graduation subject to no claims being made) and Graduation Fee (HK\$350). All full-time students will be charged a student activity fee of HK\$100 per annum to provide support for activities of student societies and campus-wide student events.



Programme duration

Full-time: 1 year



Study load

Credits: 60 credits
Learning hours: about 1,200 – 1,400 hours (including 180 hours for project and 310 – 360 contact hours)



Class schedule

Teaching could be on weekdays or weekday evenings, with occasional concentrated teaching during weekends



Medium of Instruction
English



Assessment

Mostly coursework and written examination

* The fee shall generally be payable in 2 instalments over 1 year

Where will this Programme Lead You

Transferable skills

- ◇ The problem-solving skills, particularly those involving quantitative and analytical techniques, serve all graduates with formal training in physics well.

Career development

- ◇ Master's degree holders in physics with advanced training in mathematics, laboratory skills and programming are highly valued by many employers and have multiple pathways into the job market.
- ◇ Prepares well-trained physicists for the high-tech workplace.

Host

Department of Physics

The Department of Physics conducts research at the cutting edge of fundamental and applied physics. The overarching research vision of the Department is to become locally pre-eminent, leading in Asia, and globally competitive in selected sub-fields of research. Our researchers engage in frontier research in the fields of astronomy and astrophysics; computational physics; theoretical and experimental condensed matter physics; materials sciences; nuclear and particle physics; photonics and quantum information. We also incorporate advanced research into our teaching and offer a number of postgraduate projects to nurture well-rounded individuals.

Who should Take this Programme



Students who intend to pursue another master's or doctoral degree in a wide range of science or engineering disciplines in the future



Students who would like to enhance their competitiveness in the high-tech industry

Hear from our graduates

"I came to HKU to broaden my training before pursuing doctoral study. The MSc in Physics allowed me to explore experimental, computational and condensed-matter approaches within the same year. Through my capstone project on electron transport in two-dimensional materials, I gained valuable hands-on experience in experimental research and device-fabrication procedures. This experience helped me discover a strong interest in condensed-matter and device physics, while also teaching me how research develops through repeated testing, problem-solving and adaptation. Beyond the formal curriculum, I actively sought additional opportunities in astronomy. During the founding year of the Hong Kong Institute for Astronomy and Astrophysics, I joined a separate computational project on gamma-ray-burst afterglows. I also had the rare opportunity to participate in the China–Chile Bilateral Conference and present my research at APRIM 2026. During the same year, I published my first sole-authored journal paper in Astronomy and Computing. Together, these experiences helped me recognise that my strongest interest lies in condensed matter, while my skills are particularly suited to computational research."



Cheuk Yin Jack YU
Class of 2025

"As a student in the MSc Physics programme with a focus on computational physics, this year has been an incredibly rewarding and transformative experience. The well-structured curriculum and hands-on projects have greatly enhanced both my theoretical understanding and computational skill set. I have had the opportunity to deepen my knowledge in areas such as numerical simulations and data analysis, while developing essential research skills that will be invaluable for my future career. I am truly grateful for the guidance and encouragement from the faculty, whose support has helped me grow as both a physicist and a problem-solver."



Qingchuan ZHAO
Class of 2026

What the Programme Covers

WHAT YOU WILL LEARN

Programme structure

Design of curriculum (60 credits)	
Compulsory course (3 credits)	
PHYS8970 Physics seminar (3 credits)	
Disciplinary elective courses (48 credits)	
Take at least 48 credits from Lists A and B with at least 18 credits must be chosen from List A:	
List A PHYS8150 Computational physics and its contemporary applications (6 credits) PHYS8351 Graduate quantum mechanics (6 credits) PHYS8450 Graduate electromagnetic field theory (6 credits) PHYS8550 Graduate statistical mechanics (6 credits) PHYS8701 Physics experimental techniques (6 credits)	List B PHYS8352 Quantum information (6 credits) PHYS8551 Topics in solid state physics (6 credits) PHYS8552 Condensed matter physics (6 credits) PHYS8654 General relativity (6 credits) PHYS8656 Topics in astrophysics (6 credits) PHYS8751 Device physics (6 credits) PHYS8850 Topics in particle physics (6 credits) PHYS8852 Photonics and metamaterials (6 credits) PHYS8152 Data analysis in physics, astronomy and space science (6 credits) PHYS8153 Big data, AI and machine learning in physics, astronomy and space science (6 credits)
Capstone requirement (9 credits)	
PHYS8971 Capstone project (9 credits)	

Remarks: The programme structure will be reviewed from time to time and is subject to change.

Compulsory Course

PHYS8970 Physics seminar

This course aims to initiate students into research culture and develop their capacity to communicate with audiences of varied backgrounds. Students learn professional presentation skills alongside research ethics, including the proper use of generative AI. By attending departmental colloquia and submitting brief corresponding written assignments, students gain exposure to contemporary physics research and observe presentation techniques from leading researchers. These activities prepare them for an end-of-semester oral presentation, normally on materials related to their Capstone Project. Satisfactory completion of the colloquia requirements, as specified by the course coordinator, is necessary to pass the course.

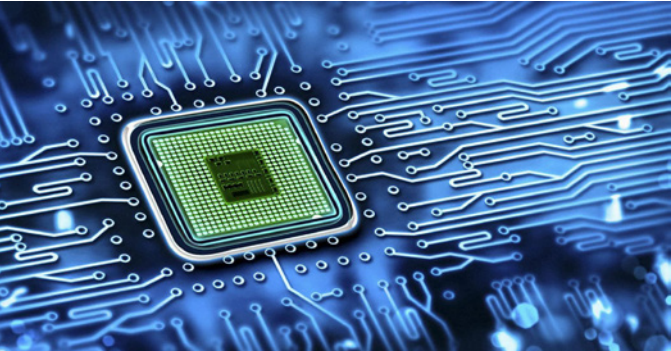
Disciplinary Elective Courses

PHYS8150 Computational physics and its contemporary applications

This course shows the power of computational approach to solving physics and related problems, which is complimentary to the traditional experimental and theoretical approaches. Students are expected to spend a significant proportion of time on actual programming. Topics include: Brief review of Python and an introduction to Google Colab; introduction to computational physics; ordinary differential equation for classical physics problems; partial differential equation for classical and quantum problems; matrix methods and exact diagonalisation for classical and quantum problems; Monte Carlo methods for statistical physics and quantum many-body physics; numerical methods for phase transitions and machine learning approaches to physics problems.

PHYS8351 Graduate quantum mechanics

This course introduces postgraduates to theory and advanced techniques in quantum mechanics, and their applications to selected topics in condensed matter physics. The course covers the following



topics: Dirac notation; quantum dynamics; the second quantisation; symmetry, group theory and conservation laws; permutation symmetry and identical particles; perturbation and scattering theory; introduction of relativistic quantum mechanics.

PHYS8450 Graduate electromagnetic field theory

The aim of this course is to provide students with an advanced level of comprehension of the theory of classic electromagnetic field, enabling them to master key analytical tools for solving real physics problems. This course introduces and discusses the following topics: Boundary-value problems in electrostatics and Green’s Function method; electrostatics of media; magnetostatics; Maxwell’s equations and conservation laws; gauge transformations; electromagnetic waves and waveguides.

PHYS8550 Graduate statistical mechanics

This course covers advanced topics in equilibrium statistical physics. Topics include: Ensemble theory; theory of simple gases; ideal Bose systems; ideal Fermi systems; statistical mechanics of interacting systems; statistical field theory; some topics in the theory of phase transition may be selected.

PHYS8701 Physics experimental techniques

This course provides a detailed account of some common experimental techniques in physics research. It introduces the basic working principles, the operational know-how, and the strengths and limitations of the techniques. It will discuss and train students in the following techniques:

1. Brief review of the use of LabVIEW
2. Noise, data analysis, and computer grid
3. Photoluminescence & Raman spectroscopy
4. Temporal characterisation of laser pulses
5. Chirped pulse amplification: technique for amplification of laser pulses
6. Electrical characterisations

7. Cryogenics and low-noise electrical measurements
8. Transmission electron microscopy
9. Electron and X-ray diffraction
10. Scanning probe microscopy/spectroscopy
11. Photoemission spectroscopy
12. Photonic angle-resolved techniques
13. Nanofabrication techniques
14. Material synthesis techniques

PHYS8352 Quantum information

This course covers the theory of quantum information and computation, and its applications in physics and computer science. Topics include: Quantum computer; quantum algorithms; quantum error correction; quantum information processing; quantum entanglement and quantum cryptography.

PHYS8551 Topics in solid state physics

This course covers a broad introduction to the theory of solid state physics. Topics include: Crystal structures and symmetry; the reciprocal lattice and X-ray diffraction; Bloch theory and band structures; nearly free electrons and tight binding approximations; the Drude theory



WHAT YOU WILL LEARN

of metals; the Sommerfeld theory of metals; semi-classical model of electron dynamics; transport and optical properties of metals and semiconductors; lattice vibration and thermal properties.

PHYS8552 Condensed matter physics

This course introduces many-body physics in quantum matter. Systems consisting of many particles (bosons or fermions) display novel collective phenomena that individual particles do not have, for example, ferromagnetism and superfluidity. It aims to introduce students to the general principles behind these phenomena, such as elementary excitations, spontaneous symmetry breaking, adiabatic theorems, emergent topological phases of matter, etc. Theoretical languages useful in the interpretation of experiments, such as linear response theory and response functions, will be discussed. This course will focus on the phenomena of emergent many-body states that require not only the effect of quantum statistics but also that of inter-particle interaction. Examples include: Ferro-magnetism, Fermi liquid, superfluidity, superconductivity, and the quantum Hall states. Some general themes related to these quantum states, such as elementary excitation, Ginzburg-Landau description, spontaneous symmetry breaking, and topological phases of matter will be discussed. This course is

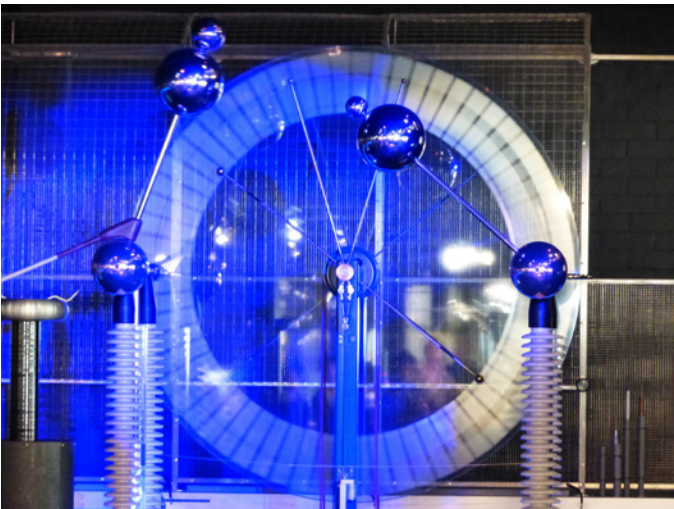
intended for both experimentalists and theorists. While there are no official prerequisites, students who would like to take this course are assumed to have sufficient knowledge of quantum mechanics and statistical mechanics.

PHYS8654 General relativity

This course serves as a graduate-level introduction to general relativity. It provides conceptual skills and analytical tools necessary for astrophysical and cosmological applications of the theory. Topics include: the principle of equivalence; inertial observers in a curved space-time; vectors and tensors; parallel transport and covariant differentiation; the Riemann tensor; the stress-energy tensor; the Einstein gravitational field equations; the Schwarzschild solution; black holes; gravitational waves detected by LIGO and the Friedmann equation.

PHYS8656 Topics in astrophysics

This course covers high-energy processes, the basic theory of stellar structure and evolution and an introduction to compact objects. It follows a rigorous mathematical treatment that stresses the underlying physical processes. Topics include: Radiation mechanisms; stellar structure equations; polytropic model; elementary stellar radiation processes; simple stellar nuclear processes; stellar formation; late stage



of stellar evolution; supernova explosion; compact stars; cosmic rays; numerical solution of stellar structure equation; introduction to astrophysical data analysis. If time permits, additional selected topics will be covered.

PHYS8751 Device physics

The growth of the modern electronics industry over the past 70 years has had a great impact on society and everyday life; with its foundation resting upon the semiconductor physics and devices. This course aims at presenting a comprehensive introductory account of the physics and operational principles of some selected and yet classic semiconductor devices, microelectronic and optoelectronic. Students are assumed to have

acquired some basic knowledge of quantum mechanics, statistical mechanics, and solid-state physics, though a review of the physics of semiconductors will be given at the beginning of the course. The course begins by giving a review of solid-state physics, particularly the physics of semiconductors, followed by discussions of the fundamentals and practical aspects of PN-junctions and rectifying diodes, amplifying and switching devices like bipolar and field-effect transistors (e.g. MOSFET), light-emitting and detection devices such as LEDs, laser diodes, and photodetectors. If time allows, a brief discussion of some special devices will be presented.

PHYS8850 Topics in particle physics

This course covers selected topics in both theoretical and experimental aspects of particle physics. Topics include: Fundamental particles; symmetry and conservation law; Feynman diagrams; electromagnetic interaction; weak interaction; strong interaction; particle accelerator and detector.

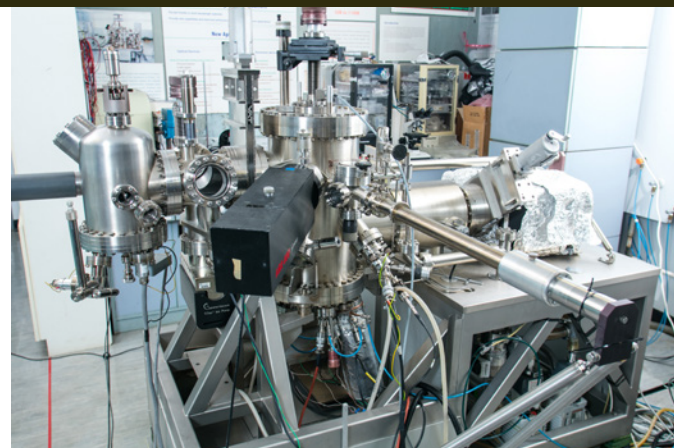
PHYS8852 Photonics and metamaterials

Over the last two decades, tremendous progress has been made in the manipulation of light propagation using structured photonic media — metamaterials, with negative refraction, super-imaging and invisibility cloaking as the most well-known examples. These new

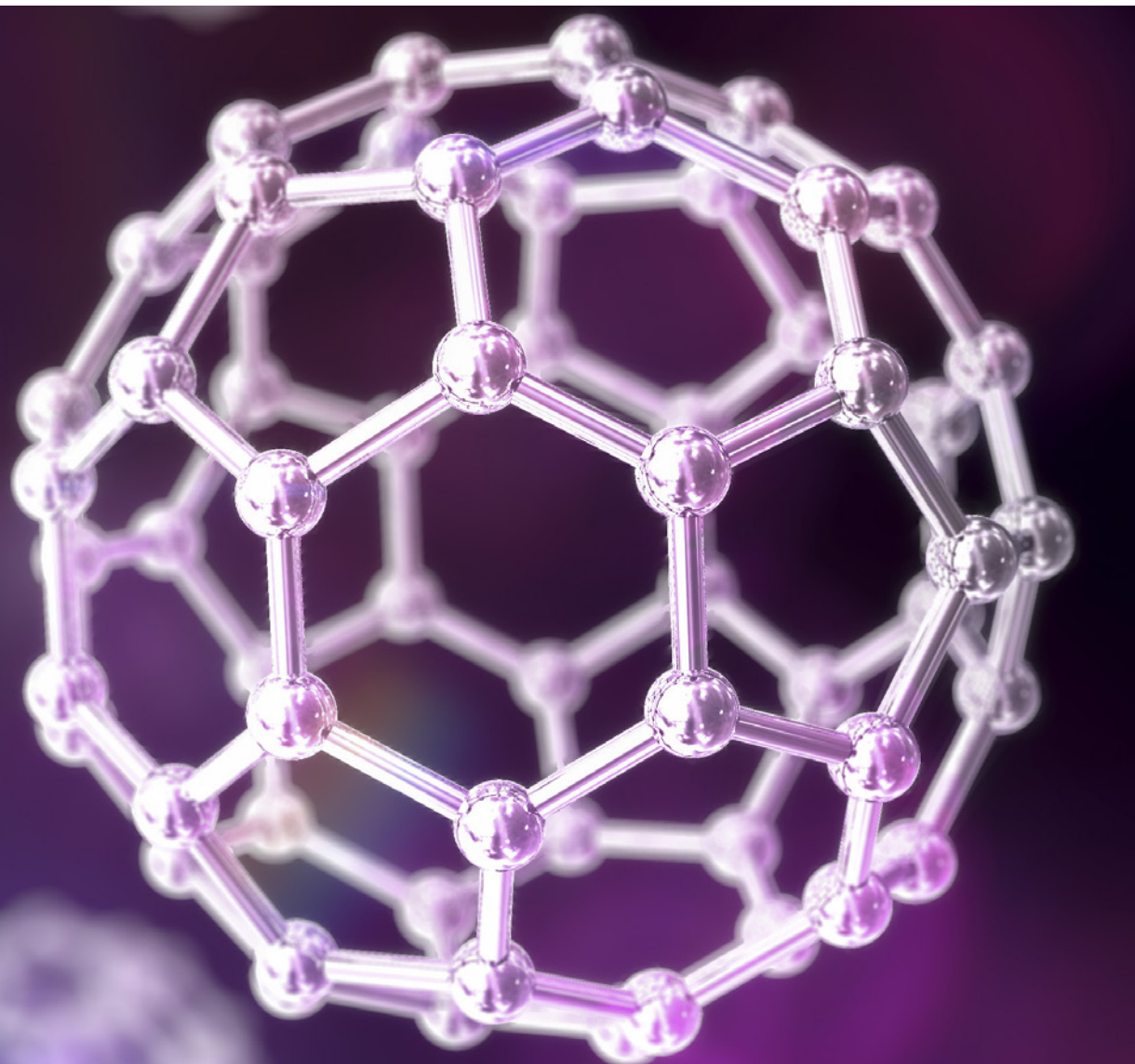


WHAT YOU WILL LEARN

discoveries are paving the way towards many potential applications of photonic structures, including imaging, display, holography and information processing. This course aims at providing a fundamental understanding of the interaction of light with structured media whose unit cells are much smaller than the wavelength of light, as well as the design and functionalities of various metamaterial-based photonic devices. The course requires some knowledge of electromagnetism and optics. It includes some most recent results in the field of metamaterials and nanophotonics, topics include: Modelling of the interaction of light with periodic structures, gratings and photonic crystals; coupled mode theory; interaction of light with metals, covering both propagating and localised surface plasmon polaritons; effective-medium description of the unconventional electromagnetic properties of metamaterials, such as negative permeability and negative refraction, zero refraction index, hyperbolic metamaterials, chirality and bi-anisotropy; design of the unit cells



of the metamaterials based on plasmonic structures for achieving various electromagnetic properties and functionalities; transformation optics and invisibility cloaks; metamaterial devices, including super-imaging lenses, meta-lenses, metasurface holography, etc.; nonlinear optical properties of metamaterials and metasurfaces; photonic systems with Parity-time symmetry; metamaterial approach for designing the topological properties for light.



PHYS8152 Data analysis in physics, astronomy and space science

This course introduces concepts of data analysis in physics, astronomy and space science. Techniques ranging from traditional statistical methods to more recent machine learning methods will be introduced. Applications of these techniques in physics, astronomy and space science will be the focus of this course, enabling students to understand how they are deployed in solving actual problems.

PHYS8153 Big data, AI and machine learning in physics, astronomy and space science

Artificial Intelligence (AI), Machine Learning and Big Data analytics have found widespread applications in all branches of science and technology. The objective of this course is to introduce concepts of AI and big data analytics, with focus on their applications in physics, astronomy and space science. Selected advanced examples on how big data science and deep learning can be applied in physics, astronomy and space science will be introduced to provide students a flavour of the contemporary research in the field.

Capstone Requirement

PHYS8971 Capstone project

Prerequisite: Pass or already enrolled in PHYS8970.

This capstone course provides students with the opportunity to study a specific research-type problem by themselves, either theoretical, experimental or numerical, under the supervision of an academic staff using the knowledge that the student gained in their entire MSc study. For theoretical and numerical projects: Students will receive training in research literature reading and reviewing, and make investigation which is close to research work in nature. Students may need to perform some original calculations, to fill in mathematical gaps of some sophisticated derivations, or a combination of both. For numerical projects, students also need to use computers to find numerical or simulation results. For experimental projects: Students will carry out experiments in research labs and receive a comprehensive training in advanced experimental techniques, including preparation of samples, determination of physical properties, measurement of

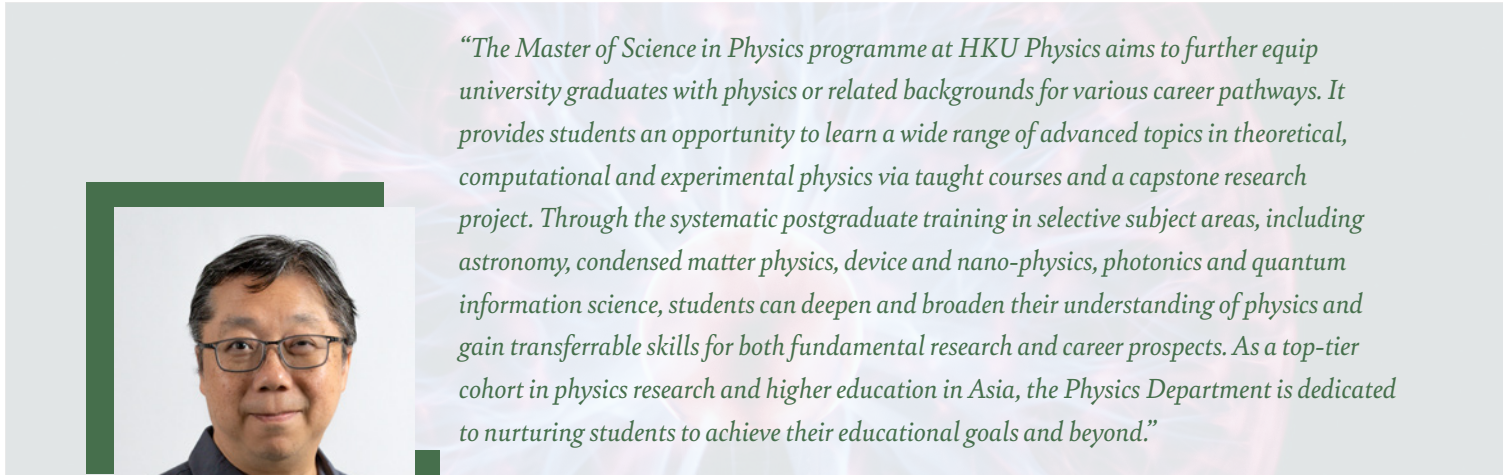


small signals obscured by noise, laser, high-vacuum and low-temperature techniques and so on. Wide reading of the relevant scientific literature and originality in experimental design are expected. It is expected that most of the projects will involve teamwork.

More course information at:

<https://www.scifac.hku.hk/prospective/tpg/Physics>





“The Master of Science in Physics programme at HKU Physics aims to further equip university graduates with physics or related backgrounds for various career pathways. It provides students an opportunity to learn a wide range of advanced topics in theoretical, computational and experimental physics via taught courses and a capstone research project. Through the systematic postgraduate training in selective subject areas, including astronomy, condensed matter physics, device and nano-physics, photonics and quantum information science, students can deepen and broaden their understanding of physics and gain transferrable skills for both fundamental research and career prospects. As a top-tier cohort in physics research and higher education in Asia, the Physics Department is dedicated to nurturing students to achieve their educational goals and beyond.”

Programme Director
Professor Francis Chi Chung LING

BSc, MPhil, PhD HKU; CPhys; M IEEE; F Inst P

Other Programme Committee Members

Dr Kai Ming LEE (Co-Programme Director)	BSc HKU; PhD Caltech
Professor Hoi Fung CHAU	BSc, PhD HKU; M IEEE; F Inst P
Professor Chenjie WANG	BSc USTC; PhD Brown

Other Academic Staff

Professor Xiaodong CUI	BSc USTC; PhD Ariz State
Professor Jane Lixin DAI	BSc HKUST; MSc, PhD Stanford
Professor Dong-Keun KI	BSc, PhD POSTECH
Professor Jenny Hiu Ching LEE	BSc CUHK; MS, PhD Michigan State
Dr Alex Po LEUNG	BSc CityU; MPhil HKU; PhD Queen Mary London
Professor Jeremy Jin Leong LIM	BSc, PhD Macquarie
Professor Tran Trung LUU	BSc VNU; MSc KAIST; PhD LMU
Professor Zi Yang MENG	BSc USTC; PhD Uni Stuttgart
Professor Stephen Chi Yung NG	BSc, MPhil HKU; MS, PhD Stanford
Dr Jason Chun Shing PUN	BA, BS Roch; MA, PhD Harvard
Professor Shunqing SHEN	BSc, MSc, PhD Fudan
Professor Yanjun TU	BSc USTC; PhD U Penn
Professor Zhong WAN	BS Jilin; PhD Purdue
Professor Yihan WANG	BS USTC; MA, PhD SBU
Professor Mao Hai XIE	BEng Tianjin; MSc Chinese Acad of Sc; PhD Lond; DIC
Professor Yi YANG	BSc Peking; MSc Peking; PhD MIT
Professor Wang YAO	BSc Peking; PhD UCSD
Professor Bing ZHANG	BS, PhD Peking
Professor Shizhong ZHANG	BS Tsinghua; PhD UIUC
Professor Shuang ZHANG	BS Jilin; MS Northeastern; PhD UNM
Professor Zhendong ZHANG	BS HUST; PhD UChicago

Admissions

Requirements

- ◇ A Bachelor’s degree or above (equivalent qualification) in a relevant science subject (e.g. physics, astronomy, earth sciences, mathematics) or an engineering discipline
- ◇ Prior knowledge in university-level electromagnetism, quantum mechanics and thermodynamics, university-level linear algebra and multi-variable calculus, basic statistics, and some computer programming experience (e.g. coding in C++, Mathematica, Matlab or Python)
- ◇ Shall pass a qualifying examination if deemed necessary
- ◇ Fulfil the University Entrance Requirements

How to apply

Application deadlines:
Non-local applicants: **12:00 noon (GMT +8), April 30, 2027**
Local applicants: **12:00 noon (GMT +8), June 30, 2027**

Online application:
admissions.hku.hk/tpg



Expected degree conferment will take place in

November/December 2028 (Winter Congregation)

Further Information

Programme details
t.ly/Ho36F



Enquiries

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Faculty of Science

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🏠 www.scifac.hku.hk/

