Master of Science in the field of
SPACE SCIENCE

Establishing opportunities to pursue space exploration goals and employment

Apply now for entry in September 2021
Modern Space Science is a highly multi-disciplinary field that encompasses a broad range of sub-disciplines, from astrophysics, to aerospace engineering, electronics, remote sensing, and space exploration.

According to a Morgan Stanley Report published in 2017, the revenue generated by the global space industry is estimated to increase to US$1.4 trillion in 2040, up from US$350 billion in 2016.

China has recently been investing heavily in Space Science, launching 39 satellites in 2018 alone, over twice as many as in 2017 and more than any other country in the world.

Given its status as a global metropolis, its strong international links, and its location in the Greater Bay Area, Hong Kong is ideally placed to capitalise on the growth of China in Space Science.

Key partners in Mainland China (Zhejiang University, Nanjing University, Chinese Academy of Sciences) and Europe (Padova-CISAS, Italy)

This taught postgraduate programme, offered by Department of Physics, with contributions from Departments of Earth Sciences, Statistics & Actuarial Science and Electrical & Electronic Engineering, taps into our strengths in high-energy astrophysics, planetary sciences, statistics, and engineering, while leveraging our connections with elite mainland and global partners.

World-class Rankings of HKU

Times Higher Education (THE) - #35 World Rankings 2020

Quacquarelli Symonds (QS) - #22 World Rankings 2021

Eminent Subject Ranking - #66 World University Rankings by Subject 2021: Physics & Astronomy

Top-notch Scientists in the Faculty - Clarivate Analytics' Essential Science Indicators 2020: 16.5% of our professoriate staff are the world’s Top 1% scholars

Transferable skills

- Equip students with knowledge in space science
- Focus on integrating the latest developments and practical applications in this interdisciplinary field
- Help students with skills necessary for space science research and work in the space industry

Internships

- We have negotiated internship opportunities with some of our key partners
- These internships can be tailored to individual circumstances and may take place between semesters, or during the summer (after the second semester)
- Local internship partners include positions at HKU and through the Orion Astropreneur Space Academy (Hong Kong) platform
- Likely international internship partners include Beijing Institute of Space Mechanics and Electricity (BISME), the Shanghai Academy of Space Flight Technology (SAST), the Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences (CSU, CAS), Nanjing University, Zhejiang University, and Padova-CISAS (Italy).

Career development

- Our MSc will provide a solid foundation to enter this exciting field, covering the essence of the frontiers in hardware, software and data analysis
- Promising employment opportunities in the public and private sectors, in China and worldwide

Scholarships*

- A limited number of scholarships available for candidates with outstanding academic record and financial hardship.

*Subject to approval

Host

Department of Physics

This taught postgraduate programme, offered by Department of Physics, with contributions from Departments of Earth Sciences, Statistics & Actuarial Science and Electrical & Electronic Engineering, taps into our strengths in high-energy astrophysics, planetary sciences, statistics, and engineering, while leveraging our connections with elite mainland and global partners.

- Space lovers who would like to pursue a career related to space science.
- Researchers who would like to establish links with Mainland China and international space research institutes and participate in large-scale space research projects.
- Professionals who would like to build links with the growing space ecosystem in Mainland China and Internationally.
- Entrepreneurs who would like to tap into the tremendous opportunities arising from the growing space economy.

Tuition fees

Composition fee: HK$210,000*

Students are required to pay Caution Money (HK$350, refundable on graduation subject to no claims being made) and Graduation Fee (HK$350)

Programme duration

Full-time: 1 year

Part-time: 2 years

Study load

Credits: 60 credits

Learning hours: 1,300 - 1,500 hours (including 150 hours for project and 300 - 360 contact hours)

Class schedule

Teaching takes place mainly on weekday evenings and Saturdays

Medium of Instruction

English

Assessment

- Mainly written coursework and/or examination
- Capstone project on a topic of the student’s interest

*The fee shall generally be payable in 2 instalments over 1 year for full-time and 4 instalments over 2 years for part-time
**MSc in Space Science (60 credits)**

**WHAT YOU WILL LEARN**

**SPSC7004 Radiation detection and measurement**

- Understand the fundamental interaction and properties of different radiation detectors, including some of the most commonly used ones in contemporary science missions.
- Be able to design and evaluate the performance of radiation detectors.
- Learn about the various spectral signatures in different parts of the electromagnetic spectrum.
- Develop skills in understanding and quantifying the performance of radiation detectors.

**SPSC7005 Space science entrepreneurship**

- No longer driven entirely by governmental institutions, developments in frontier space science are increasingly dependent on collaboration with commercial entities. This course will provide students with the skills to design and launch small satellites, including understanding the practical aspects of designing and launching a small satellite.

**SPSC7007 Data analysis in space science**

- This course introduces concepts of data analysis in space science. Techniques ranging from traditional statistical methods to recent machine learning algorithms will be introduced. Applications of these techniques in space science will be the focus in this course for students to understand how they are actually deployed in solving practical problems in space science.

**Programme structure**

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<th>Design of curriculum</th>
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<td><strong>SPSC7003 Remote sensing in space science</strong> (6 credits)</td>
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<td><strong>SPSC7005 Space science entrepreneurship</strong> (6 credits)</td>
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<td><strong>Elective courses (18 credits)</strong></td>
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<td><strong>SPSC7006 Small satellite design</strong> (6 credits)</td>
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<td><strong>SPSC7014 Big data, AI and machine learning in space science</strong> (6 credits)</td>
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<td><strong>SPSC7015 Introduction to planetary science</strong> (6 credits)</td>
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**Capstone project (6 credits)**

- **SPSC7031 Advanced statistical modelling** (6 credits)
- **STAT7002 Space science final project** (6 credits)

**Elective Courses**

- **SPSC7006 Small satellite design**
  - Small satellites (sometimes referred to as microsatellites, CubeSats, etc.) are becoming increasingly popular. Once proposed mainly for educational purposes, due to their low cost and shorter development time scales, these days many such satellites are being proposed and launched with a range of cutting-edge scientific goals. Microsatellites make full use of the latest achievements in basic technologies such as modern microelectronics, micro mechanics, and advanced materials.

- **SPSC7011 Introduction to space plasma physics**
  - Most of space is filled with plasma, the fourth state of matter where freely moving charges from ionised gas interact with (and generate) electric and magnetic fields. Leading to a complicated set of phenomena. This course provides an introduction to the field, covering such topics as plasma characteristics, electromagnetic waves, cold plasmas, collision theory, magnetohydrodynamics (MHD), force-free magnetic-field configurations, stochastic processes, and interaction of particles and waves. It emphasises some of the applications of plasma physics in the fields of geophysics and astrophysics.

- **SPSC7014 Big data, AI and machine learning in space science**
  - Artificial Intelligence (AI), Machine Learning and Big Data analytics are interdependent disciplines that are increasingly influential in the real world under the broad umbrella of data science. They have found widespread applications in all branches of science and technology and have direct application in space and satellite technologies. This course introduces the basics of all these areas. Data analytics is the science of analysing raw data to make conclusions, a particular challenge in the Big data era, while Machine Learning (ML) is a technique enabling computers to learn without being explicitly programmed and is part of the broader concept of Artificial Intelligence. Key concepts across these fields will be explored including practical processes, techniques and algorithms. There will be a focus on real-world examples with specific emphasis on applications in space and planetary sciences. The course will also cover some ML software packages in Python and R.

- **SPSC7015 Introduction to planetary science**
  - We live in a golden age of planetary science, with new missions being proposed at an unprecedented rate by all the major space agencies. This course provides a modern understanding of the properties of our Solar System and planetary systems around other stars and of the physical, chemical, and geological processes that govern their motion and properties. Special attention will be paid to how our knowledge has been enriched by recent discoveries from space missions such as Cassini and Kepler.

**Remark:** The programme structure will be reviewed from time to time and is subject to change.
WHAT YOU WILL LEARN

ELEC6008 Pattern recognition and machine learning
This course aims at providing fundamental knowledge on the principles and techniques of pattern recognition and machine learning. Specifically, the course covers the following topics: Bayes decision theory; parametric and non-parametric methods; linear discriminant functions; unsupervised learning and clustering; feature extraction; neural networks; context-dependent classification; case studies.

ELEC6026 Digital signal processing
This course provides an introduction to the fundamental concepts of digital signal processing including a wide variety of topics such as discrete–time linear time invariant systems, sampling theorem, z-transform, discrete-time/discrete Fourier transform, and digital filter design. Furthermore, the course will also discuss in detail about other advanced topics in digital signal processing such as multidimensional signals and systems, random processes and applications, and adaptive signal processing.

ELEC6065 Data compression
This course provides an introduction to the state-of-the-art compression techniques for typical media including files, digital images, videos and audios. Specifically, the course will discuss in detail about the coding and quantisation techniques commonly used for images, videos and audios. Finally, the course will cover basic concept and terminologies of common image, video and audio standards.

ELEC6100 Digital communications
This course aims at enabling the fundamental understanding of the digital communication systems. After an overview on basic probability and random processes, the module will cover different modulations and fading channel. Then, performance analyses under additive white Gaussian noise channel are examined. This is followed by a topic of interest, participate in any existing projects and take an appropriate project. Students may either propose an oral presentation is required and a written report must be submitted.

ELEC6016 Spatial data analysis
This course covers statistical concepts and tools involved in modelling data which are correlated in space. Applications can be found in many fields including epidemiology and public health, environmental sciences and ecology, economics and others. Covered topics include: (1) Outline of three types of spatial data: point-level (geostatistical), areal (lattice), and spatial point process. (2) Model-based geostatistics: covariance functions and the variogram; spatial trends and directional effects; intrinsic models; estimation by curve fitting or by maximum likelihood; spatial prediction by least squares, by simple and ordinary kriging, by trans-Gaussian kriging. (3) Areal data models: introduction to Markov random fields; conditional, intrinsic, and simultaneous autoregressive (CAR, IAR, and SAR) models. (4) Hierarchical modelling for univariate spatial response data, including Bayesian kriging and lattice modelling. (5) Introduction to simple spatial point processes and spatio-temporal models. Real data analysis examples will be provided with dedicated R packages such as geoR.

STAT7102 Advanced statistical modelling
This course introduces modern methods for constructing and evaluating statistical models and their implementation using popular computing software, such as R or Python. It will cover both the underlying principles of each modelling approach and the model estimation procedures. Topics from: (i) Linear regression models; (ii) Generalised linear models; (iii) Mixed models; (iv) Kernel and local polynomial regression; (v) Generalised additive models: (vi) Hidden Markov models and Bayesian networks.

Capstone Requirement
SPSC7031 Space science final project
Students must carry out a research project in any aspect of space science under the guidance of a faculty member from the MSc in Space Science programme. Students are encouraged to approach faculty members in their areas of interest as soon as possible, in order to choose an appropriate project. Students may either propose a topic of interest, participate in any existing projects of the faculty member, or else they will be assigned a project after consultation with the course coordinator. An oral presentation is required and a written report must be submitted.

More course information at: https://www.scifac.hku.hk/prospective/tpa/SpaceScience

YOUR PROGRAMME EXPERTS

Our MSc programme will provide a solid foundation to enter this exciting field, with promising employment opportunities both in the public and private sectors, in China and worldwide.

Programme Director
Dr Jason PUN
BA, BSc Rochester; MA, PhD Stanford

Co-Programme Director
Dr Pablo Saz PARKINSON
BS Columbia; MS, PhD Stanford

Other Academic Staff

The University of Hong Kong (HKU)
Professor S C CHAN (EE)
BSc (Eng), PhD HK; MIEEE
Professor Kwong Lam CHAN (PHYS)
BA Berkeley; PhD Princeton
Dr Stephen W K CHING (PHYS)
BS Wisconsin; MS, PhD U Virginia
Dr Simon K C CHEUNG (NSAS)
BSc HK; MSc ANU; PhD CUHK
Dr Y K CHUNG (NSAS)
BSc, Phi CUHK; PhD HK
Dr Alex Po LEUNG (PHYS)
BSc CityU; MPhil HKU; PhD Queen Mary London
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Zhejiang University (ZJU)
Professor Huiquan WANG
BE, Dr Eng ZJU
Nanjing University (NJU)
Dr Zhiyuan LI
BE, MS NJU; PhD UMass
Dr Chuan LI
PhD NJU
Others
Professor Denis BASTIERI
MSc, PhD Padua
Dr Marcos LOPEZ-CANIEGO
BS, MS Autonoma Madrid; PhD Cantabria
Dr Massimiliano RAZZANO
BS, MS, PhD Pisa
Requirements

A bachelor’s degree in a relevant Science subject (e.g. Physics, Astronomy, Earth Sciences) or an Engineering discipline (e.g. Aerospace, Electrical, Mechanical).

How to apply

Application opens in **March, 2021**

Deadline for local applicants:
**Full-time & Part-time, 12:00 noon, June 30, 2021 (GMT +8)**

Deadline for non-local applicants:
**Full-time & Part-time, 12:00 noon, May 17, 2021 (GMT +8)**

Enquiries

Department of Physics
Tel: (852) 2859 2361 Email: mspace@hku.hk

**Further Information**

Programme details

Online application

[Link](aal.hku.hk/tpg)

[Link](bit.ly/2YIoZG)