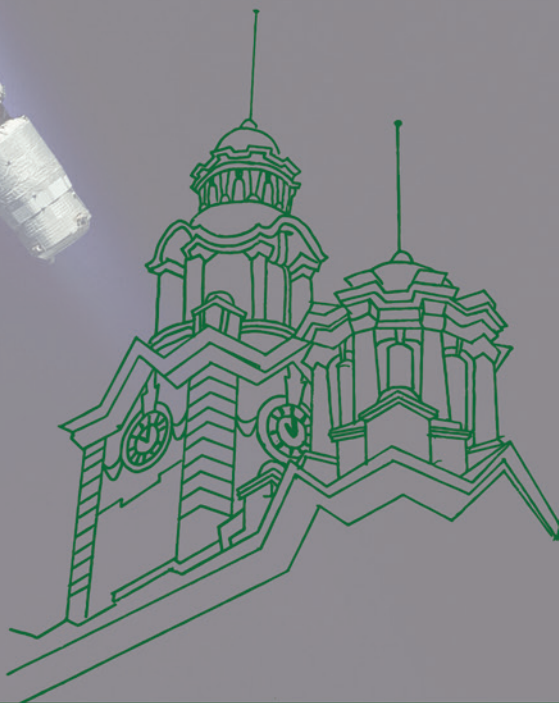
FACULTY OF SCIENCE
THE UNIVERSITY OF HONG KONG
香港大學理學院

Master of Science in the field of

SPACE SCIENCE

Establishing opportunities to pursue space exploration goals and employment

Apply now for entry in September 2022



SCIENCE CREATES KNOWLEDGE

IS THE PROGRAMME FOR YOU

Why this Programme

- 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

World-class Rankings of HKU

Quacquarelli Symonds (QS)

QS WORLD UNIVERSITY RANKINGS

#22 *World Rankings 2022*

#4 *Asia Rankings 2021*

Times Higher Education (THE)

THE WORLD UNIVERSITY RANKINGS

#30 *World Rankings 2022*

#4 *Asia Rankings 2021*

Eminent Subject Ranking

QS WORLD UNIVERSITY RANKINGS

QS World University Rankings by Subject 2021:

#66 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*

What the Programme Covers

- ◊ **Highly multi-disciplinary degree, covering broad areas of science, engineering, and data science related to space**
- ◊ **Strong focus on Chinese space science programme**
- ◊ **Talks by elite guest lecturers**

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

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

Where will this Programme Lead You

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

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

Who should Take this Programme

- ◊ 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.

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.

Hear from our students

Kees de KUIJPER
BSc Major in Astronomy, Leiden University

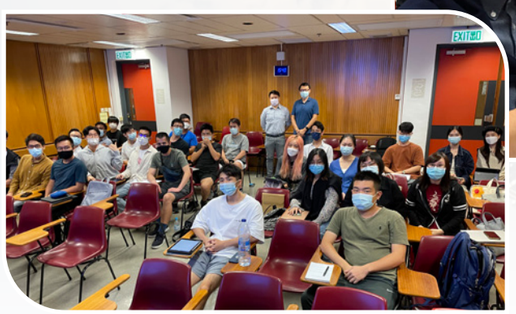
This MSc programme fits me naturally as I would like to pursue a career in the highly-exciting and fast-growing space industry. The many capstone projects offered provide unique experiences ranging from the fundamental scientific aspects to topics of practical applications to help students to get in touch with the space industry, which can even lead to internship positions.

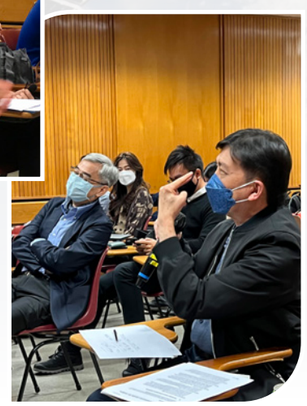
Xiang Feng FOO
BEng Major in Mechanical Engineering, City University of Hong Kong

I like how the MSc Space Science programme not only focuses on theoretical skills and hard skills, but also includes courses that enhance students' soft skills such as the Space Entrepreneurship. I believe such a diverse curriculum can prepare students well for their future development. With all the emerging resources and opportunities in the space industry, the learning journey will be more fun and exciting than ever!

Yingjie Alison YAO
BSc Major in Geographic Information Science, China University of Geoscience

Through this programme, I found space to be closely related to our life. We learnt the science behind the beautiful phenomena, along with the technical skills to process and analyse the data collected. The course on 'astropreneurship' really broadens my horizon and deepens my understanding of the commercial prospect of space. All in all, this programme is interesting, informative, and has helped me to gain an entirely fresh perspective of this exciting field.





WHAT YOU WILL LEARN

Programme structure

Design of curriculum	
Core courses (36 credits)	SPSC7002 Introduction to space weather *(6 credits)* SPSC7003 Remote sensing in space science *(6 credits)* SPSC7004 Radiation detection and measurement *(6 credits)* SPSC7005 Space science entrepreneurship *(6 credits)* SPSC7007 Data analysis in space science *(6 credits)* SPSC7015 Introduction to planetary science *(6 credits)*
Elective courses (18 credits)	SPSC7006 Small satellite design *(6 credits)* SPSC7011 Introduction to space plasma physics *(6 credits)* SPSC7014 Big data, AI and machine learning in space science *(6 credits)* ELEC6008 Pattern recognition and machine learning *(6 credits)* ELEC6026 Digital signal processing *(6 credits)* ELEC6065 Data compression *(6 credits)* ELEC6100 Digital communications *(6 credits)* STAT6016 Spatial data analysis *(6 credits)* STAT7102 Advanced statistical modelling *(6 credits)* PHYS8150 Computational physics and its contemporary applications *(6 credits)* PHYS8654 General relativity *(6 credits)*
Capstone project (6 credits)	SPSC7031 Space science final project *(6 credits)*

Remark: The 2022/23 programme structure will be reviewed from time to time and is subject to final approval.

Core Courses

SPSC7002 Introduction to space weather

Our modern lifestyles rely on satellite technology which can be severely affected by the Earth's local particle environment. Much of this is due to the influence of the Sun, which emits large quantities of radiation and charged particles that interact with the Earth's magnetic field. This course covers the fundamentals of space weather, from its origins, to its effects, and forecasting.

SPSC7003 Remote sensing in space science

This course introduces the theory behind, and the many practical applications of remote sensing, focusing on applications of satellite-based detectors to monitor the Earth's environment. The course covers the physical principles of remote sensing, including the various spectral signatures in the different parts of the electromagnetic spectrum. Students will learn about the different sensor technologies, and how to characterise and quantify their performance.

SPSC7004 Radiation detection and measurement

This course provides an overview of various ways we detect radiation to make physical measurements in space science. It covers the fundamentals of radiation interactions and properties of radiation detectors, including some of the most commonly used ones in contemporary science missions.

SPSC7005 Space science entrepreneurship

No longer driven entirely by governmental institutions, developments in frontier space science in modern times also receive boosts from academia, corporations and entrepreneurs alike. Businesses like SpaceX, Blue Origin, or Virgin Galactic are not only capturing people's imagination, but also proving that space provides big business opportunities. This course will cover the basics of designing, launching, and running a business, with a special emphasis on how ventures can be started for the burgeoning space industry.

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.

WHAT YOU WILL LEARN

Course Description

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.

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. This course covers the practical aspects of designing a small satellite, based on the principle of purchasing "off-the-shelf" components, and benefitting from "open source" solutions to many of the technical challenges. Topics include: science instruments and payloads, satellite subsystems, ground networks, space science data and software, ground networks, launchers, and operations.

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 in 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. Examples in all areas will be drawn from fields such as astrophysics, particle physics and complex systems, including rare source identification from vast data, training sets, smart classification, time series, imaging and spectral analyses.

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. Pre-requisite: A good background in linear algebra, programming experience. Mutually exclusive with: COMP7504 Pattern recognition and applications.

Course Description

ELEC6026 Digital signal processing

This course provides an introduction to the fundamental concepts of digital signal processing (DSP) 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 course will cover the modulation and

Course Description

demodulation. Then, performance analyses under additive white Gaussian noise channel and fading channel are examined. This is followed by topics on spatial diversity and channel equalisation. Mutually exclusive with: ELEC6014 and ELEC6045.

STAT6016 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) Model selection and regularisation; (iv) Kernel and local polynomial regression; selection of smoothing parameters; (v) Generalised additive models; (vi) Hidden Markov models and Bayesian networks.

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 fraction of time in actual programming. Topics include: Introduction to computational physics; ordinary differential equation for classical physical problems; partial differential equation for classical and quantum problems; matrix method and exactly 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.

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 Freidmann equation.

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/tpg/SpaceScience

"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 *Roch;* MA, PhD *Harv*

Other Academic Staff

The University of Hong Kong (HKU)

Professor S C CHAN (EE)	BSc (Eng), PhD *HK;* MIEEE
Dr Stephen W K CHEUNG (PHYS)	BS *Wisconsin;* MS, PhD *U Virginia*
Dr Simon K C CHEUNG (SAAS)	BSc *HK;* MSc *ANU;* PhD *CUHK*
Dr Y K CHUNG (SAAS)	BSc, Phil *CUHK;* PhD *HK*
Dr Alex Po LEUNG (PHYS)	BSc *CityU;* MPhil *HKU;* PhD *Queen Mary London*
Dr Gregg LI (PHYS)	BA, MBA, MA, Dr Eng, FHKIOD; CISA
Dr Stephen NG (PHYS)	BS, MPhil *HK;* PhD *Stanford*
Dr Pablo Saz PARKINSON (PHYS)	BS *Columbia*; MS, PhD *Stanford*
Dr Ken K T TSANG (PHYS)	BSc *CUHK*; MS *Stony Brook*; PhD *Princeton*
Dr Y C WU (EE)	BEng, MPhil *HK;* PhD *Texas A&M*
Dr David H F YU (SCIENCE)	BSc, MPhil *HK*; PhD *MPI for Extraterrestrial Physics*
Dr Binzheng ZHANG (DES)	BE, MS *ZJU;* PhD *Dartmouth*

Zhejiang University (ZJU)

Professor Huiquan WANG	BE, Dr Eng *ZJU*

Nanjing University (NJU)

Dr Zhiyuan LI	BS, MS *NJU;* PhD *UMass*
Dr Chuan LI	PhD *NJU*

Others

Professor Denis BASTIERI (Padova/Guangzhou)	MSc, PhD *Padua*
Dr Marcos LOPEZ-CANIEGO (Aurora Technology for ESA)	BS, MS *Autonoma Madrid;* PhD *Cantabria*
Dr Massimiliano RAZZANO (Pisa)	BS, MS, PhD *Pisa*

Admissions

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 **January, 2022**
Deadline for local applicants: **12:00 noon, June 30, 2022 (GMT +8)**
Deadline for non-local applicants: **12:00 noon, June 17, 2022 (GMT +8) (extended)**

Online application

admissions.hku.hk/tpg

Further Information

Programme details

bit.ly/2YIozXG

Enquiries

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

Faculty of Science

(852) 3917 5287
scitpg@hku.hk
www.scifac.hku.hk/
science.hku
@hku_science
@hku_science
/hkufacultyofscience