

The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*CUSA1035 Mysteries in the Atomic World*  
*原子世界的奧秘*

**Introduction:**

This course will bring students to retrace the thinking paths of physicists in the early 20th century to unravel the mysteries of atoms. The course includes lectures, experiments, and a visit. Students will glimpse through the basic concepts of quantum physics, such as wave particle duality, quantization, wave function and its probabilistic interpretation, spin, and their applications to understand some atomic and nuclear phenomena, including energy levels in atoms, atomic spectra, formation of molecules, as well as a more advanced topic on magnetic resonance imaging (MRI), which is now widely applied to medical imaging.

Students will gain hands-on experience in using modern laboratory equipment to measure atomic spectra, and determine the charge mass ratio of electron. A visit to a company in Hong Kong Science and Technology Park will also be included to let students gain hands-on experience on the operation of a medical MRI machine.

本課程帶領學生重溫二十世紀初物理學家探索原子奧秘的過程。課程包括講座、實驗，和參觀三部分。學生將瞥見量子物理的基本概念，包括波粒二象性、量子化、波函數及其或然率詮釋，自旋；這些概念如何應用於了解原子和核子的現象，包括原子的能階、光譜、分子的形成，以及一個較深入、目前廣泛應用於醫療造影的現象：磁力共振。

學生也會學習如何利用現代科學儀器測量原子的光譜，以及電子的電荷質量比。課程也包括到香港科學技術園參觀一間儀器公司，以體驗實際操作醫學磁力共振儀器。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Department of Physics, Faculty of Science, CUHK

**Teacher:**

Dr. TONG Shiu Sing

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**Course Content:**

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| <p>25 August 2022<br/>(Thursday)</p> <p>9:00 am – 12:30 pm<br/>2:00 pm – 5:30 pm</p> | <p><b><u>Lecture and demos:</u></b><br/>Discovery of subatomic particles, atomic spectra, wave particle duality, relationship between classical wave phenomena and quantization, atomic models and quantization of atomic energy, and the emergence of quantum physics</p> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Study of atomic spectra, and charge to mass ratio of electron</li> </ul>  |
| <p>26 August 2022<br/>(Friday)</p> <p>9:00 am – 12:30 pm<br/>2:00 pm – 5:30 pm</p>   | <p><b><u>Lecture and demos:</u></b><br/>Basic concepts of quantum physics, conceptual understanding of Schrodinger equation, wave function and probabilistic interpretation. Electron microscope, quantum phenomena such as quantum tunnelling and our existence.</p> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Visiting the modern physics laboratory at the Department of Physics, CUHK. Experiments with a scanning electron microscope and a transmission electron microscope, seeing microscopic objects, atoms, and electron diffraction patterns</li> </ul> |
| <p>27 August 2022<br/>(Saturday)</p> <p>9:00 am – 12:30 pm<br/>2:00 pm – 5:30 pm</p> | <p><b><u>Visit:</u></b><br/>Visiting a Magnetic Resonance Imaging (MRI) company at Hong Kong Science Park. Experience the operation of a MRI machine and acquisition of MRI images.</p> <p><b><u>Lecture and demos:</u></b><br/>Introduction to the concepts of spin, Pauli Exclusion Principle and atomic orbitals, and their applications to understand some atomic and nuclear phenomena including MRI.</p> <p><b><u>Discussion:</u></b></p> <ul style="list-style-type: none"> <li>• Summary of essential ideas and findings, assessment</li> </ul>   |
| <p>29 August 2022*<br/>(Monday)</p> <p>9:00 am – 12:30 pm<br/>2:00 pm – 5:30 pm</p>  | <p>Make up Class</p>  |

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|----------------------------------|---|
| <b>Duration</b>                  | 3 whole day sessions (total 21 contact hours)   |
| <b>Date</b>                      | 25, 26, 27 August 2022<br>29 August 2022 *  |
| <b>Time</b>                      | 9:00 am – 12:30 pm; 2:00 pm – 5:30 pm   |
| <b>Teaching Mode<sup>#</sup></b> | Face to Face (The Chinese University of Hong Kong)  |
| <b>Enrollment</b>                | 30  |
| <b>Expected Applicants</b>       | Students who are promoting to or studying S4-S6 who have basic knowledge on mechanics and waves                           |
| <b>Tuition Fee</b>               | HKD 3,560.00 (including materials for experiments)  |
| <b>Credit</b>                    | 1.5 Academy Unit<br>Certificates or letters of completion will be awarded to students who attain at least 75% attendance. |

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode only. It may be cancelled in accordance with the pandemic development and the policy of the university.