

The Department of Physics at the University of Malaya

RAYMOND OOI

DEPARTMENT OF PHYSICS, FACULTY OF SCIENCE, UNIVERSITY OF MALAYA



Fig. 1: Photos in the department of physics. The unique "sukun" tree symbolizing a " Ψ "

BACKGROUND AND HISTORY

The Department of Physics at the University of Malaya started in 1959 with the appointment of Thong Saw Pak as a professor of physics and the first head of the Department of Physics. The department was established to educate students who wish to study physics comprehensively, and to lead research in physics in Malaysia. The department offers Bachelor of Science, Master of Science and Doctor of Philosophy degrees. The development and success within the department has a long history. The department aims to provide quality education to all students and in particular, to equip our students with a strong foundation in physics, critical thinking and problem solving skills; by doing so, we do our best to ensure the marketability of our graduates.

STAFF

Currently there are 35 academic staff members (two of whom are foreign) with expertise in various fields such as low dimensional materials, photonics, quantum and laser science, theoretical physics, ionic materials, plasma technology, polymer physics, space physics, radio astronomy and particle physics. As a research university the entire department has active areas of research, all conducted at an internationally competitive level, annually producing an extensive number of publications in leading, high impact factor journals.

DEGREE PROGRAMS AND STUDENT ENROLLMENT

The Department of Physics offers Bachelor of Science (BS) degrees in physics and material science that are



Fig. 2: a)(middle) Prof. Syed Hussein Alatas VC of UM; b). (right) Prof. Abdus Salam (Nobel Laureate), Director, ICTP Trieste, Italy; c) Prof. Lee Sing, the head of the Department of Physics at UM at ICTP Trieste, signing the memorandum, 1989 forming the ICAC-UM (ICTP Affiliated Centre-Universiti Malaya) sited at the Department of Physics at UM (for the period 1989-1994). d) (left) Prof. Gallieno Denardo, head of the Office of External Activities, ICTP.

usually completed within 3.5 years with 126 and 128 credits, respectively. The programs have attracted bright students locally and from abroad to enroll in the Faculty of Science. In the 2016/2017 academic session, a total of 42 students have enrolled in the physics BS program and 12 students have enrolled in the material science BS program. There are presently 177 students undertaking bachelor degrees, and a similar number undergoing postgraduate studies. The undergraduate courses for the Bachelor of Science degree are conducted through the modes of lectures, tutorials, practical laboratory sessions and a final year project in which students participate in various areas of research under the supervision of the academics in the department. At the Master's degree level, students may choose to enroll for the Master's program in either a mixed mode (course work and research) or entirely by research. However, the PhD program is conducted only in the form of research, where students are attached with various research groups and centers of excellence in the department.

Research Strengths and Centers of Excellence (CoE)

(more information can be found in <https://fs.um.edu.my/department-institute/department-of-physics/research>)

Photonic Research Center (PRC)

<http://prc.um.edu.my/>

The PRC, a national center of excellence headed by the distinguished Professor Harith Ahmad, is developing fiber optics devices and sensors, and photonic materials. The group has had close collaborations with industries such as Telekom Malaysia, including the deployment of fiber optics for the backbone of national telecommunications, and more recently the roll-out of the High Speed Broadband Initiative (HSBB-Unifi). In addition, the group assisted in the development of many small and medium-sized enterprises (SMEs) in areas such as the fabrication of various optical components and technical consultation on network deployments and device development.

Plasma Technology Research Centre (PTRC)

The center is one of the active research groups. Plasma research started in the early 1960s under the leadership of the late Professor Thong Saw Pak. In 1978, the first physics PhD thesis was awarded to the late Dr Chen You Hor. University of Malaya (UM) plasma research center went international in the 1980s under the distinguished leadership of Emeritus Professor Lee Sing with programs

such as the “Tropical College on Applied Physics” and the “United Nations University (UNU) Training Program on Plasma and Laser Technology”, culminating in the formation of the Asian African Association for Plasma Training (AAAPT) in 1988 promoting scientific collaboration programs among countries in the South-South. In the early days, the scope of study started with oscillations in electrical discharges, and progressed to developing pulsed high power sources such as the dense plasma focus for fusion consideration, pulsed capillary discharge and vacuum sparks as radiation sources; more recently, the areas of study are industrial plasmas (RF plasma, dielectric barrier discharge, atmospheric pressure plasma). This led to the re-naming of the center to the “Plasma Technology Research Centre”, which was initiated by Professor Wong Chiow San in 2010 with the aim of developing cutting-edge, cost effective plasma technologies. Current works and new initiatives include plasma medicine, plasma remediation of pollutant gases, and plasma treatment of materials in addition to other fundamental plasma physics such as complex plasma and astrophysical plasma.

National Centre for Particle Physics (NCP)

<http://ncpp.um.edu.my/>

NCP was first established in 2013 through the initiative of the Academy Science of Malaysia (ASM) together with the University of Malaya (UM), and is aimed at developing high energy physics research in Malaysia. NCP deals with the following main research areas: experimental and theoretical particle physics; high energy physics; general theory of relativity and gravitation detector physics; particle data analysis; high performance computing and finally, some metaphysics discussions. NCP has been in active collaboration with CERN (CMS), KEK (Belle and Belle-ii), DESY (ZEUS) and COMET. In terms of financial support, NCP is fully funded by the University of Malaya research fund and ASM is providing two research officers to help with the management and administration of the centre. At the moment, NCP has been cited in 130 papers published by CMS and ZEUS as well as in individual publications from local students.

Radiation and Nuclear Physics

Nuclear physics activities have been predominantly in theoretical areas concerning the low-energy nucleon structure regime, presently with links in astrophysics, while the radiation physics research has been largely experimentally-based, including work in photon scattering and radiation detection, as well as in education, with

Master’s degrees that grew out of the various groups. The earliest works of the group include neutron physics studies, supported by the ability to carry out neutron activation analysis using a radionuclide-based neutron source possessed by the department. Track detection of charged particles and neutrons also began in the late 1970s, with work engendered by Prof. David Bradley and Prof. Ng Kwan Hoong. The former has a truly longstanding relationship with UM that first began with a junior lectureship from 1978 to 1981, while Prof. Ng has had immense success in Medical Physics within the Medical Faculty of UM. In his role as an academic icon to a high impact research project on the use of optical fibers as monitors of radiation, Prof. Bradley has worked with Prof. Yusoff Amin (UM Physics) and Prof. Jamil Maah (UM Chemistry), involving collaboration between seven universities – six from Malaysia along with Nuclear Malaysia and the University of Surrey. Professor Bradley commented, “It’s a great honor and privilege to be invited as an Academic Icon in the University of Malaya’s High Impact Research program, and I have also welcomed the opportunity to re-engage with the University where I first started out my career as a lecturer.” He has over 35 years’ experience in the field of radiation and medical physics, during which he has published more than 350 papers. His research interests include the fundamentals and applications of photon scattering, and radiological risks associated with naturally occurring radioactive material (NORM). Prof. Bradley has also been the secretary of the International Radiation Physics Society (IRPS) and editor-in-chief of the Elsevier journals ‘*Applied Radiation and Isotopes*’ and ‘*Radiation Physics and Chemistry*’. Recently he has been Editor-in-Chief (Scientific) of the *British Journal of Radiology*, the longest-standing journal of its type in the world.

Quantum and Laser Science (QLS)

<http://sites.google.com/site/qtmphoton/>

The QLS group was initiated by Prof Dr Raymond Ooi in 2011 to develop theoretical, computational and experimental capabilities to study the physics of: a) generation, b) propagation and c) interaction of novel light sources with photonic structures and quantum systems. The group conducts a broad range of research topics in quantum optics (quantum coherence, quantum information); nonlinear optics (laser spectroscopy, ultrafast and intense laser physics); plasmonics; photonic crystals and metamaterials; atomic and molecular spectroscopy; laser cooling and trapping; ultracold quantum gases and Bose-Einstein condensates. The research was funded by the Ministry of Higher Education in 2011-2016, which led to

the creation of the High Impact Research (HIR) building. The funding has led to active research and a large number of high impact Tier 1 journal papers. The experimental labs in the HIR house state-of-the-art equipments like a high intensity femtosecond laser (Coherent), a supercontinuum laser, a lock-in amplifier, a triple monochromator, an ICCD, an inverted microscope, and optics with optical tables.

Center of Ionics UM (CIUM)

CIUM is led by Prof. Abdul Karien Arof, whose research has been focused on using ionic and polymer electrolytes (such as those from chitosan) to make efficient batteries, supercapacitors, dye-sensitized solar cells, fuel cells, electrode materials for coatings against corrosion ionic glasses and carbon-based materials. Members of the center have won top prizes at the International Invention, Innovation and Technology Exhibition (ITEX) for their research products in conducting polymers.

Low Dimensional Research Center (LDMRC)

The center has had notable accomplishments in the study and synthesis of nanomaterials like thin films and various nanostructures. The group was started by the late Prof. Dato' Dr. Muhammad Rasat Muhammad. The center house houses much of the central equipment. Fabrication involves chemical vapor deposited in silicon and carbon based thin films and nanostructures, metal-oxide nanostructures, organic electronics and solar photovoltaic, bio-nanoelectronics.

One of the projects recently established is the collaboration with Nobel Laureate Prof. Shuji Nakamura on blue LEDs, namely Gallium-Nitride epitaxy and optoelectronics nanofabrication.

The research also involves the use of advanced analytical equipment through collaborations with institutions such as with the Synchrotron Light Research Institute, Nakhon Ratchasima 30000 (Thailand), the University of Cambridge and the University of Santa Barbara. The research on materials here is also on efficient energy storage and harvest, focusing on the physics of renewable energy.

FUNDING

The Department of Physics has been funded locally by the Ministry of Higher Education (MoHE) and the Ministry of Education (MoE) Malaysia, as they both support



Fig. 3: Group photo during the visit of Nobel laureate Prof Dr Toshihide Masakawa and the Nagoya University delegation on 31 July 2017.

fundamental physics research. Collaborative Research in Engineering, Science (CREST) has supported industry-academia research collaborations. A few staff members, like Newton-Ungku Omar, have secured international funding. In 2017, the department successfully secured a substantial amount of funding from the Education, Audiovisual and Culture Agency, working on the program "Erasmus Capacity Building in Higher Education," in disseminating the research output into teaching-based education.

ENDOWMENT FUND

Working with Alumni, the department is trying to establish an endowment fund from former graduates. A successful former student is Tan Sri Lim We Chai (Chairman, Top Glove Corporation Berhad), who graduated with a Bachelor of Science Degree (Hon.) in Physics (1982).

FACILITIES

The department has modern and sophisticated equipment in the central facility for teaching and research, such as FESEM, HRTEM, MicroRaman spectrometer, XRD, AFM, MOCVD, FTIR, Clean Room, Mask Aligner, Surface Profiler, GammaCell 220, HPGe, TLD Reader, and X-ray machines. The astronomy group owns a radio astronomical telescope station.

ALUMNI

Students who graduate with the Bachelor of Science degree from the Department of Physics have the capability to hold various positions both in government and in the

private sector, as well as to pursue their studies to higher degree levels in their field of physics or other related fields. The Department of Physics aims to provide the best education in physics and to produce graduates who have had real-world experiences through working in various industries, such as the world's largest glove manufacturer, Top Glove, by alumni Tan Sri Lim Wee Chai. At the same time, the Department of Physics also emphasizes on research activities in order to continuously excel in academic rankings.

ACTIVITIES

The Physics Colloquium is annual activity where final year students present their research works. There is also the "Physics Night", an activity organized by students' Physics Society to provide the opportunity for students to mingle with lecturers in a friendly and informal environment as well as to provide a sort of thanksgiving regarding the service of the lecturers.

VISITORS

Many notable figures have visited UM during the golden years of the plasma physics group, headed by Prof. Lee Sing. HRH Prince Philip of Great Britain visited the UM Department of Physics 1965, in conjunction with the gift of a large capacitor bank to start the Plasma Physics Laboratory under the Colombo Plan. HE Ambassador Dr. Ritter of West Germany visited UM in 1977 on the occasion of the presentation of a million-dollar plasma facility to UM as a follow-up grant to the Alexander von Humboldt Fellowship of Dr. Lee Sing. Nobel Laureate Abdus Salam visited the UNU Training Programme on Plasma and Laser Technology at UM in January 1986.

Some of the notable physicists who have visited the department are Nobel Laureates: Prof. Alfred Fert, Prof. Shuji Nakamura, and Prof. Toshihide Maskawa.

We also have academic icons who have visited: Prof. Steven Tingay (International Centre for Radio Astronomy Research, Perth), and Prof. Hwang Chorng-Yuan (National Central University of Taiwan), who regularly visits. Other regularly visiting professors who are also academic icons are Prof. David Bradley from the University of Surrey, UK and Prof. Mitsumasa Iwamoto from Tokyo Institute of Technology, Japan

ACCOMPLISHMENTS

The staff in the department has won several notable Awards. The ITEX award and some international awards were won by Prof. Ramesh. Prof. Ramesh Subramanian and Dr. Ramesh Kasi have won several invention awards such as PECIPTA 2013 (Gold medal and was the "BEST OF THE BEST" (Electrical and Electronic Theme)) and in 2015 (silver medal) in a KLCC organized by the Ministry of Education. At the Malaysia Technology Expo (MTE) 2014, one gold and one silver medal were awarded, and in 2016 there were two golds awarded.

Organized Conferences – The department is hosting international conferences together with the Institute of Physics. The International Meeting on the Frontiers of Physics (IMFP) is organized every 3-4 years and we will be organizing the Asia-Pacific Physics Conference (APPC) in 2019. The department is proud to be organizing the International conference on Quantum and Nonlinear Optics 2018 (<https://sites.google.com/view/qno18>) for the first time.



Prof. Dr. **C. H. Raymond Ooi** obtained a BSc from University of Science Malaysia (USM), a Master of Engineering from Nanyang Technological University in photonics and Dr.rer.nat (PhD) from Universität Konstanz, Germany in 2003 on quantum optics and laser cooling of molecules. At Texas A&M University he worked with Prof Marlan Scully as a research associate on nonlinear optics, quantum coherence and laser interaction techniques. During this time, he was also a visiting scientist at Princeton University and the Max-Planck Institute of Quantum Optics. He then joined KAIST as a research professor and Korea University as an assistant professor where he worked on intense laser matter interactions. He became an associate professor at the University of Malaya and started the "Quantum and Laser Science" group, the first of its kind in Malaysia. His research has produced more than 100 ISI papers (mostly in Q1 journals), with three in *Nature Scientific Reports*, and two in *Physical Review Letters*, and with more than 830 citations covering various aspects of quantum optics, nonlinear optics and spectroscopy, photonic structures and Bose-Einstein condensates. He served as the chief editor for the *Jurnal Fizik Malaysia*, and is an editorial member for the *Central European Journal of Physics* and the *Academy of Sciences Malaysia (ASM) Science Journal*. In 2013, he received the Malaysian Toray Science Foundation Science & Technology award. He was elected as a fellow of the Academy of Sciences Malaysia in 2015.