Department of Physics

RW James Building, University of Cape Town, Rondebosch, 7701
Tel: +27 (0) 21 650 3326
Fax: +27 (0) 21 650 3342
Internet: www.phy.uct.ac.za

Our mission

To create new knowledge and applications in Physics, and to educate students in Physics, within the context of UCT.

Our vision

UCT Physics will be unambiguously recognised both nationally and internationally as the leading Physics Department in Africa for its outstanding research and teaching.

Our strategic goals

- Produce research which has significant international impact, maximising our opportunities and resources.
- Deliver teaching programmes of exceptional quality, recognising the research themes within the Department.
- Provide a departmental environment within which both staff and students flourish.
- Sustain an effective public profile of the Department.

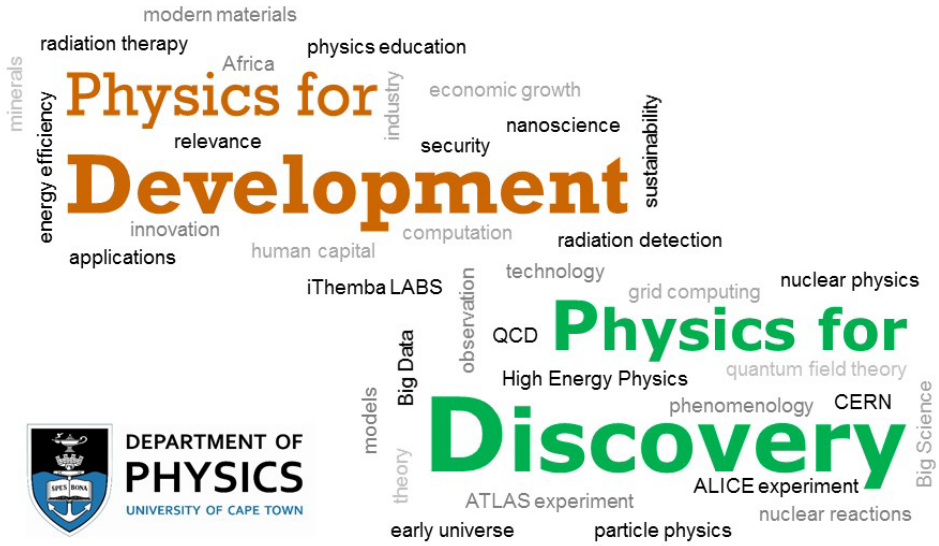
Historical legacy

Physics has been taught at UCT and its pre-cursor institutions since 1896. Experimental physics at UCT was initiated by Basil Schonland in the 1920s through his association with the Cavendish Laboratory at Cambridge. RW James arrived in Cape Town in 1937 from the University of Manchester where he had worked with Lawrence Bragg in the early days of x-ray crystallography at the Cavendish. James set as his goal the transformation of UCT from an institution which mainly focused on educating undergraduates for potential postgraduate study abroad, into a research-rich university. He built up physics research laboratories at UCT which offered post-graduate students opportunities to tackle international quality research projects. This attracted to the department students such as Aaron Klug and Allan Cormack, who both completed their substantive work at UCT which later lead to their Nobel prizes. Following on as HoD after James in 1957, Walter Schaffer continued to build the department by appointing Frank Brooks, Robin Cherry and John Juritz, all of whom grew to become leading experimentalists. In 1963 W.E. Frahn came to Cape Town to start a new theory group, which later received a significant boost from Jan Rafelski's time at UCT during the 1980s. Today the department builds on this strong tradition of supporting both experimental and theoretical physics, both of which rely more and more on computational techniques in the modern age.

Physics for Development : Physics for Discovery

Physics is truly an international and indeed universal science. The laws of Physics are the same in Cape Town, in London, at the North Pole, on the Moon, and in the farthest reaches of the galaxy, and beyond. Physics cannot fundamentally appeal to the advantages offered by the geographical location of Cape Town in the way that can be achieved by local zoologists, botanists, geologists, environmental scientists, and even astronomers. Therefore both international connectivity and local relevance become important ingredients to consider when positioning UCT Physics as a strong research department.

Our research landscape is thus framed as **Physics for Development: Physics for Discovery**.



Research themes

The research themes within the department span a wide range of physical dimensions but are neatly captured within 5 themes: **High energy physics, nuclear physics, nano-scale physics, industrial-scale physics and physics education.**

Within the theme of **high energy physics**, our experimentalists are members of two large collaborations at CERN: ATLAS (Sahal Yacoob) and ALICE (Tom Dietel). Our theorists (Andre Peshier, Heribert Weigert and Will Horowitz; and senior scholars Cesareo Dominguez and Jean Cleymans) are contributing to the leading envelope of modern high energy physics (particularly the applications of quantum chromodynamics, and statistical thermal models). There is also work relating to astrophysical problems, for example the behaviour of matter in the presence of strong magnetic fields, and the cosmology of the early universe. Two URC-accredited research centres operate within this theme. The UCT-CERN Research Centre (Director: Jean Cleymans) consolidates and links the CERN activities at UCT with the national funding programme SA-CERN. The Centre for Mathematical and Theoretical Physics (Director: Heribert Weigert) acts as a catalyst for cross-departmental interactions around the mathematical tools for physics. Funding through the SA-CERN programme is used mainly for academics and postgraduate students to travel to CERN, and operational expenses of the experiments. Tom Dietel is the regional coordinator for ALICE, and Andrew Hamilton presently chairs the SA-ATLAS group.

UCT CERN

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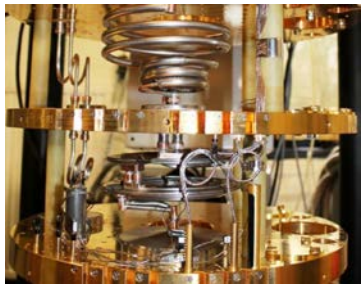
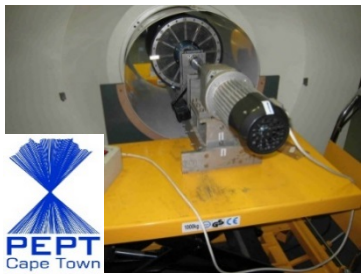
CTMP
Centre for Theoretical and Mathematical Physics

Nuclear physics research in the department benefits from the facilities of iThemba LABS (national laboratory) which is located 30 km from UCT and where there is located a range of accelerator-based activities, mainly centred on the 200 MeV cyclotron which provides beams for fundamental, applied and medical research. For example, the AFRODITE array of high purity germanium gamma ray detectors is used to study the structure of nuclei in high spin states. The neutron beam facility will soon receive ISO accreditation as an international metrology standard for fast neutron beams, an initiative supported by the National Metrology Institute of South Africa. In recent times the focus of the research activities of the "nuclear physics" academics has consolidated into activities which features fewer fundamental studies in favour of applications, mainly in the areas of radiation detector development (Andy Buffler and Tom Leadbeater) and particle radiation therapy (Steve Peterson). New nuclear physics labs have recently been established in the RW James Building, including a bunker housing a D-T 14 MeV fast neutron source.

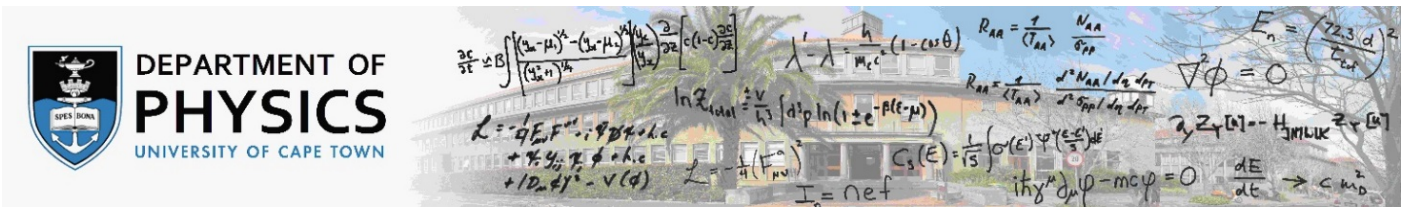
Nano-scale physics research has up to now mainly taken place within the Nanoelectronics Research Laboratory (Mark Blumenthal) which features an ultracold (8 mK) closed-loop liquid helium refrigerator. This facility provides many opportunities for world-class nano-scale research and materials applications. The materials science department at iThemba LABS operates a Van der Graaff accelerator, and a number of other facilities, useful for solid state physics research. There are strong links with UCT Chemical Engineering (and Hydrogen South Africa) focusing on the use of nanowires to improve the efficiency of hydrogen production. Trish Salagaram has research interests in using compuataional methods to study the properties of materials.



The main focus in **industrial-scale physics** is around the development of models of flow within systems which are important in industry, particularly the minerals sector, with data derived mainly via positron emission particle tracking (PEPT). PEPT Cape Town is a dedicated PEPT laboratory operated by the Department of Physics (Andy Buffler, Tom Leadbeater and Katie Cole) and sited at iThemba LABS where two PET scanners have been adapted for PEPT, with a new PEPT lab recently established in the RW James Building.



Physics education research in the department focuses on physics education at university-level, and has a historical link to early Academic Development Programme activities within the department (Dale Taylor and Saalih Allie). A particular focus has been on the role of measurement in physics laboratory teaching and learning, but also now includes the school-university interface, student epistemologies, modelling and visualization, and computational physics education (Spencer Wheaton and Trisha Salagaram). The department believes strongly in being research-led in its teaching, by allowing courses to be improved by influence from research into teaching and learning (Gregor Leigh *et al*.).



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