



Research Projects

Below is a list of possible projects students can consider doing in the physics department. Most projects can be adapted to be taken at various levels from 3rd year level physics project (PHY 363 or PHY 363), Honours, Masters or Doctoral, unless indicated specifically. This is only a guideline, so details need to be discussed with the relevant contact person.

Experimental Physics

Electronic Materials & Thin Films

Contact person: **Prof. FD Auret**

Using solgels to form semiconductor thin films. Studying the effect of processing (chemical, annealing, doping) on the microstructural (SEM, AFM) and electrical properties of these films, either on their own or part of a larger structure (**Dr J Nel**)

Fabrication and characterization of ohmic and Schottky contacts to Si, Ge, GaAs, GaN, SiC, AlGaN, CdTe, semiconductors.

Electrical characterization of above mentioned semiconductors.

UV photoresponse characterization of wide bandgap materials.

Modification of semiconductor properties by particle irradiation.

Defect characterization in semiconductors by deep level transient spectroscopy (DLTS and high resolution Laplace-DLTS).

Physics Education Research Group

Contact Person: **Dr C Moji**

Comparing performance of students from mainstream Physics 1 and extended program Physics 1 as they study together in final semester.

Lightning and Thunder: Indigenous outlook against scientific perspective.

Electromagnetic Induction: Fields in "empty spaces". How freshmen understand the concept.

Optical Characterization Research

Contact Person: **Dr L Prinsloo**

Fundamental studies on bisphosphonates used in bone cancer treatment.

Raman characterization of SiC irradiated with neutrons and irradiated with neutrons.

Distinguishing between fake and authentic gemstones.

Studying San rock art, glass trade beads, ostrich egg shells and organic residues in archaeological context.

The investigation of Ta, Nb, Zr and Hf oxides, fluorides and oxyfluoride.

Identification of corrosion products on historical metal objects (Archaeology).

Determining the effect of anti-cancer extracts on single blood cells through their Raman spectra (Plant Science).

Characterizing carbonaceous materials through their Raman spectra (Carbon group).

Determination of the distribution of insecticides on painted surfaces using Raman and FTIR spectroscopy (Institute of Material Science).

Theoretical Physics

Theoretical aspects of complex systems

Contact person: **Prof. P Selyshchev**

Peculiarities of creep temperature dependence in irradiated materials.

Formation of track structure by swift heavy ion irradiation.

Condensation of drops in irradiated steam.

Creep of irradiated metals.

Radiation-induced growth of second phase in binary alloy.

Delayed damage of polymer, organic and other complex molecules

under and after irradiation.

Modality of stationary states of irradiated materials.

Self-organization point defects under irradiation.

Stochastic effects in crystal under irradiation

Mathematical Physics

Contact person: [Dr. R Duvenhage](#)

Noncommutative ergodic theory and quantum statistical mechanics.

Quantum groups and their actions. Field theory and string theory on quantum spaces.

Quantum few-body theory

Contact person: [Prof. S.A. Ratikianski](#)

Dependence of the parameters of quantum resonances on the masses of the particles (BSc).

Mutual transformation of the bound and resonant spectral points (Hon).

Lambda-nucleus effective-range expansion (Hon).

Power-series expansion in the complex plane of the angular momentum (MSc).

Lambda-nucleus resonances (MSc).

K-meson nucleus resonances (MSc).

Low-energy scattering of the J/Ψ ; particle from light nuclei (MSc).

Shift of the charge-carrier resonances in one-dimensional nano-structures due to the space-charge accumulation (PhD).

Driven Schrödinger equation for two- and three-body problems (PhD).

Jost function for two-dimensional problems (PhD).

Stark-effect in one-dimensional semiconductor nano-structures (PhD).

Nuclear fusion inside molecules (PhD).

Theoretical and Computational Solid State Physics

Contact person: [Prof. N. Chetty](#)

Quantum Mechanical
Modeling of Solids

Computational Physics
Research

Electronic Materials Modellings

Contact person: [Dr. WE Meyer](#)

Ab initio modeling of
defects in semiconductors
using VASP software.