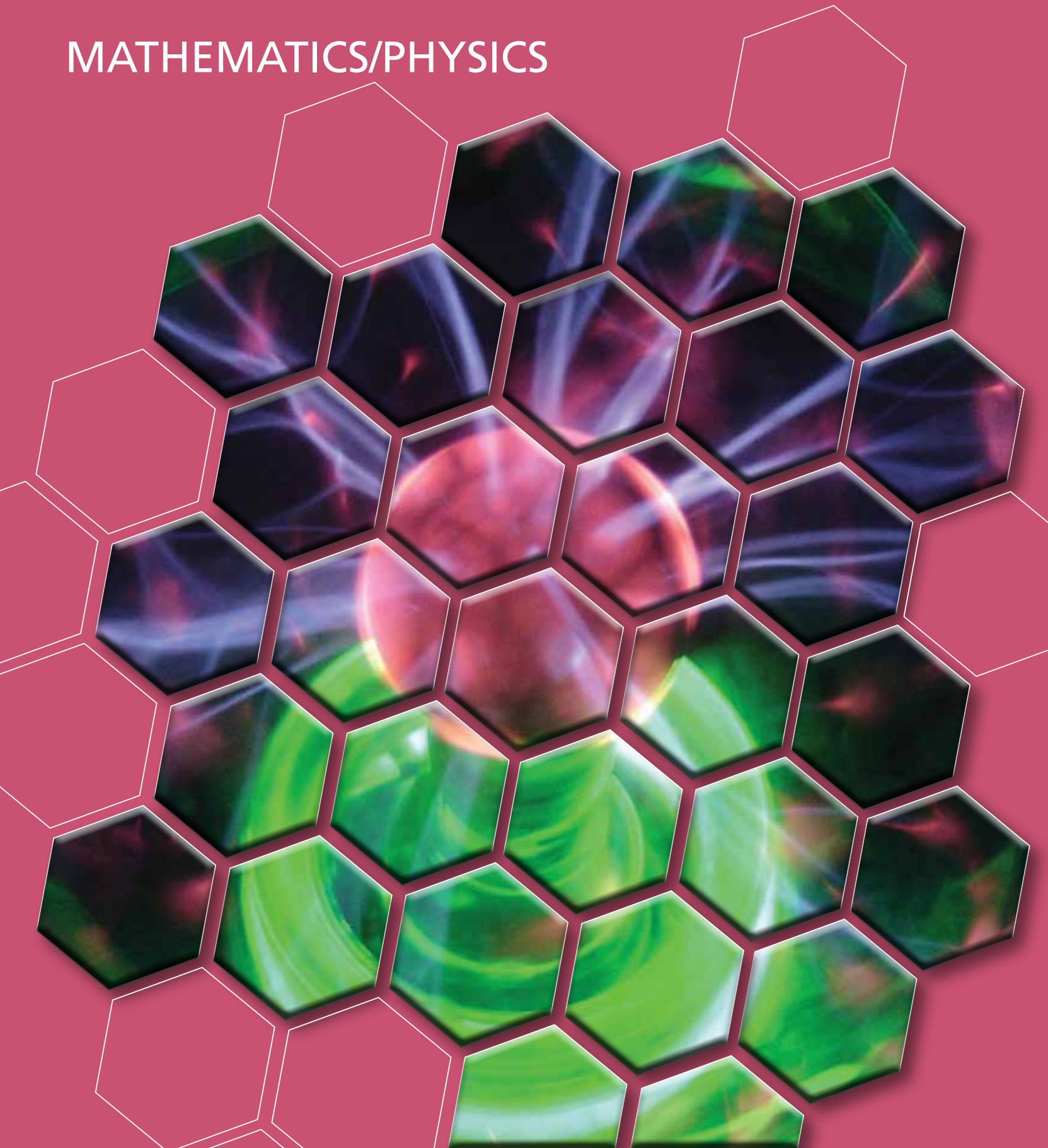


# MATHEMATICS/PHYSICS



**Anne Ghesquiere**  
**National Institute for Theoretical Physics**

**Mentor:** Prof F Petruccione

**Broad research area:** Quantum open systems

**Specific research field:** Entanglement in bipartite Gaussian state

**Purpose of study:**

The dynamics of the entanglement in an initially entangled two-particles Gaussian state are examined when the system is coupled to an environment.

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**Shreyas Pitale**  
**University of the Free State**

**Mentor:** Prof HC Swart

**Broad research area:** Material science, surface science

**Specific research field:** Low voltage cathodoluminescence and surface chemical behaviour of oxide-based nanophosphors

**Purpose of study:**

Host compounds are selected on the basis of their inherent structural stability and chemical inertness. Synthesis of oxide-based nanocrystalline phosphors using single step, easy and cost-effective combustion route is undertaken. The examples of such phosphors include Zinc Aluminate doped with Manganese ion as a green cathodoluminescent material and Lithium aluminate doped with terbium ion as a bluish-white cathodoluminescent material; Lithium strontium borate doped with samarium ion as a orange-red cathodoluminescent material; Zinc Tantalum oxide doped with Praseodymium ion as a red cathodoluminescent material. Following investigations for above mentioned compounds are conducted:

- Structural investigations using X-ray diffractometry.
- Scanning electron microscopy and transmission electron microscopy etc. Investigations on optical properties of these phosphors using absorption spectroscopy, cathodoluminescence spectroscopy etc.
- Surface chemical stability study of such phosphors using surface sensitive techniques such as Auger electron spectroscopy, X-ray photoelectron spectroscopy etc.

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**Iyabo Usman**  
**iThemba LABS**

**Mentor:** Dr R Neveling

**Broad research area:** Nuclear physics

**Specific research field:** Nuclear structure studies at intermediate energies using the K600

**Purpose of study:**

High-energy resolution experiments on nuclei in the region of giant resonances present a unique way to extract information about the dominant processes of the decay. Fine structure has been established in recent work to appear as a global phenomenon in medium-mass to heavy nuclei for the Isoscalar Giant Quadrupole Resonance (ISGQR). This holds not only for electric modes like the ISGQR or the isovector giant dipole resonance (IVGDR) but also for magnetic quadrupole (M2) or spin-flip modes like the Gamow-Teller (GT) resonance. Data for medium-mass to heavy nuclei have been presented, with an extension of the systematics towards lighter nuclei in the experiments done at iThemba LABS. The Isoscalar Giant Quadrupole Resonance (ISGQR) in low-mass nuclei has been investigated in high energy-resolution experiments using protons inelastic scattering at 200 MeV. The measurements extend and complete the investigation already undertaken for medium and heavy-mass nuclei using the K600 magnetic spectrometer and a proton beam from the K200 Separated Sector Cyclotron (SSC) facility of iThemba LABS. The nuclei  $^{12}\text{C}$ ,  $^{27}\text{Al}$ ,  $^{28}\text{Si}$  and  $^{40}\text{Ca}$  were studied by measuring excitation energy spectra in the region of the ISGQR for scattering angles below, at and above the maximum of the ISGQR. Recently, it was proposed to continue the investigation by conducting a survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance (IVGDR) over a wide mass range using inelastic proton scattering at 200 MeV and the newly commissioned Zero-degree Facility of the K600 magnetic spectrometer. An important further step is to test the role of level densities in transition from spherical to deformed nuclei. This can most easily be accomplished in a systematic way by measuring across the neodymium isotope chain  $^{142,146,148,150}\text{Nd}$ . A variety of methods have been proposed to extract information on characteristic scales of the fine structure including an entropy index method and a multifractal analysis of the fluctuating strength function. Recently, an analysis based on continuous wavelet transform has been shown to be most promising. A critical comparison of the different methods is discussed. Furthermore, level densities of  $J\pi = 1^-$  states can be extracted in a rather model-independent way, which serve as an important test of level density models applied in astrophysics, claims of a parity dependence and possible fluctuations with excitation energy.

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