Project title: Computer-assisted proofs in dynamical systems

Principal supervisor: Ben Mestel

Second supervisor: Robert Hasson

Discipline: Applied Mathematics

Research area/keywords: Computer-assisted proofs, functional equations, interval arithmetic/analysis

Suitable for: Full time applicants

Project background and description
Many of the functional equations that arise in the study of chaotic transitions are not easily amenable to standard analytic methods, but may be readily solved numerically. Interval analysis with error bounding may be used to develop rigorous numerical functional analysis, which may be applied to develop computer-assisted proofs of the existence and properties of the solutions of these functional equations.

The aim of the project is to develop rigorous numerical functional analysis within the context of a computer package such as Python or SAGE and to use it to solve outstanding problems in critical dynamical systems.

After a review of interval analysis and of computer-assisted proofs in this field, you will develop a suite of programs to implement rigorous numerical functional analysis on spaces of analytic functions, most likely building on existing interval arithmetics routines in Python and/or SAGE. This will provide a tool for other practitioners in this field. You will then use your programs to develop computer-assisted proofs of conjectures in dynamical systems and applied mathematics.

This research project would suit a student with good programming skills and with a familiarity with computer environments such as SAGE and/or Python.

Background reading/references