

PROPOSAL FOR A NEPAD PROGRAMME IN MATHEMATICAL SCIENCES

1.1.1 Overview

Modern science increasingly rests upon the application of powerful mathematical methods for analysing data and for developing and testing theoretical models. From astronomy to biosciences to information technology, scientific progress is increasingly reliant on computational modelling and analysis, using a variety of analytical and statistical techniques. Huge databases are now being made available on the internet, in many fields. If African researchers are well taught and well connected, they can quickly become active members of the global scientific community. This proposal seeks to establish a linked network of African institutes with strong postgraduate teaching and research programs in the mathematical sciences, in the belief that such a network will have a powerful beneficial effect across all of the other science and technology initiatives now being proposed.

The African Institute for Mathematical Sciences (AIMS) opened in September 2003, in Cape Town, South Africa. Established as a flagship partnership project linking African and international universities, AIMS has quickly established itself as a centre of excellence preparing students for research and teaching careers in the quantitative sciences. AIMS recruits students from all over Africa for an intensive nine-month course taught by outstanding lecturers recruited worldwide. In its first year, AIMS graduated 30 students from 11 African countries. In June 2005, AIMS held its second graduation ceremony, for 41 students from 16 African countries, including 13 women.

AIMS graduates have an outstanding record of proceeding to high quality Masters and PhD programs, in Africa, across all scientific disciplines and especially those with relevance to African development: epidemiology and biomathematics, information technology including bandwidth management, telecommunications, financial mathematics, statistics for planning and demographics, computer science, laser physics and many other fields. AIMS already has strong links with mathematical sciences departments in many African universities and is ready to expand its role in developing well-trained, well-connected faculty members. In July 2005, AIMS hosted a Free Software course attended by 40 African researchers including several heads of department. AIMS graduates have an excellent training in free software and Linux and are already spreading these skills across African universities.

Based upon its experience and proven track record, AIMS is now in a position to expand its efforts.

In partnership with the African Mathematics Millennium Science Initiative (AMMSI), and other mathematical institutes across Africa, AIMS has proposed a network of mathematical sciences institutes, the African Mathematical Institutes Network (AMI-Net). AMI-Net would, under the aegis of NEPAD, identify promising centres across Africa for upgrading into AMI-Net nodes, building at a rate of three new nodes per year for five years. Nodes would be selected on the basis of quality, development potential and geographical distribution, by a governing council consisting of representatives of NEPAD, senior African and international scientists, and the AMI-Net director. By the end of 2010 there would be a network of fifteen

partner institutes spread right across Africa, each functioning in a similar manner to AIMS. Such a network would produce a minimum of 300 well-trained postgraduate mathematical scientists per year, and would we believe have a great impact in stimulating science and technology across Africa.

AIMS is willing to act as a hub for AMI-Net, running training courses, providing software support and administration for the network. In parallel with the development of AMI-Net, we believe an expansion of the existing AIMS activities is also called for. The high number of quality applications being currently received justifies an expansion of the AIMS course to at least 70 students. This will require an extension of the existing accommodation and teaching facilities, and two additional staff members. We would also like to establish two new high-tech, low-cost teaching labs, one to expose students to high technology fabrication of devices, and one focused on biotechnology. Both labs would interface well with the existing computer network at AIMS, giving the students real experience in simulation, modeling and data analysis. These labs would also serve as prototypes for similar small-scale labs which might subsequently be established at other AMI-Net sites.

1.1.2 Programme Objectives

This programme aims to strengthen Africa's capacity in the quantitative sciences. It focuses on those aspects of mathematical science of greatest relevance to African development, in the broadest sense. Its specific objectives are:

1.1.2.1 To help build a new generation of African scientists and technologists, with excellent quantitative problem-solving skills.

1.1.2.2 To prepare students for research across a wide range of scientific disciplines, through promoting core skills required across all scientific fields.

1.1.2.3 To build a critical mass of mathematical scientists, connected via the internet and working in collaboration across Africa, supporting experimental programmes and engaging in interdisciplinary research on a wide range of topics.

1.1.2.4 To spread the use of free mathematical software for scientific research.

1.1.3 Indicative Projects and Activities

The above goals will be achieved through the following two principal initiatives, which we believe can lead to AMI-Net and AIMS becoming a flagship programme for NEPAD.

Project 1: Building an African Mathematical Institutes Network (AMI-Net)

We envisage the following milestones in building AMI-Net:

1. A small project assessment team will conduct site visits and cost assessments for a number of candidate nodes spread across Africa, within a six month period. Funding at a level of approximately \$100,000 will be required for this initial assessment process.
2. The team will report its findings to a governing body established under the aegis of NEPAD.
3. The governing body will set the terms for an annual grant round which will select new AMI-Net nodes on the basis of a transparent, competitive process.
4. Administrative and software support will be established at the AIMS hub to coordinate the establishment of the network.
5. Three new AMI-Net nodes will be established each year, for five years.
6. Each new node will receive a grant to support the development of infrastructure (computers, internet connection, library, administrative and other support), in accordance with the specific needs and opportunities at that site. Technical assistance will be provided, as needed, from the AIMS hub.

7. All AMI-Net nodes will be linked via the internet allowing email and regular videoconferencing on research topics of common interest. This will do much to overcome isolation and bring visibility to small research groups, helping to build a critical mass of researchers in Africa, in many fields.
8. Currently, AIMS is over-subscribed by offers from international lecturers wanting to come and teach courses. Many of the lecturers who teach at AIMS can be encouraged to visit AMI-Net nodes and teach courses there. In this way, AIMS will continue to act as a catalyst for the development of the network.

Project 2: Expanding the African Institute for Mathematical Sciences (AIMS)

AIMS has been highly successful in recruiting bright young African scientists and developing their research skills in an environment where collaboration and initiative is encouraged. Within the pan-African environment at AIMS, relationships and collaborations are established which will help to build networking in science and technology across the continent, for many years in the future. Expansion of AIMS will strongly contribute to other NEPAD Science and Technology initiatives by providing a steady stream of well-prepared, well-connected postgraduate students ready to participate in advanced research projects.

We believe a modest expansion of the AIMS course to 70 students is now merited on the basis of the large number of high quality applications currently being received (AIMS currently receives over 4 applications for each place on the course). These students will, in time, contribute to the development of future AMI-Net nodes. Many of them will become lecturers who can help develop excellent teaching programmes at the new nodes. With the global connections they build through contact with international lecturers at AIMS, they will be in a good position to build international scientific collaborations and partnerships.

The AIMS facility needs to be expanded to accommodate the additional students, to include a larger lecture theatre, as well as accommodation for visiting researchers. Building plans and a detailed budget for this expansion are available.

AIMS would like to install two new teaching labs, which will interface well with the excellent computing facilities at AIMS. The Centre for Bits and Atoms at MIT is keen to install a small device fabrication laboratory at AIMS, and local biotechnologists are interested in installing a small teaching lab geared towards proteomics and genomics, funded by the Cape Biotechnology Trust. These labs will expose students to cutting-edge technologies, encouraging innovative thinking and a greater awareness of practical, development-oriented science.