Department of Mathematics

9 October 2009

Prof. Devang Khakhar
Director

Subject: Proposal for establishment of a National Centre for Mathematics (NCM) at IIT Bombay

Dear Prof. Khakhar:

I am submitting a proposal for establishment of a *National Center for Mathematics* at IIT Bombay as a joint centre of TIFR and IITB. This has been approved recently by the TIFR Council.

It is well-known that there is a real crisis in the supply of trained manpower in mathematics although there is a huge pool of talented young people in the country. Unless some bold corrective steps are taken, it will severly affect development of sciences and technology in India. The demand for trained manpower in mathematics has increased manifold due to establishment of a large number of new universities and institutes and many major projects recently undertaken by DRDO, ISRO, DAE etc.

Establishment of NCM as a joint centre of TIFR and IITB is eagerly awaited by the mathematical community in India. The community desires two such centres in the country as per the document released by a group of 60 mathematicians after serious deliberations in a workshop held at the National Institute of Advanced Studies (NIAS), Bangalore in 2006.

TIFR and IIT Bombay are uniquely positioned to establish this centre which has a huge potential to work as a catalyst in progress of Mathematics in India.

With best regards,

J. K. Verma
Head of Department

A Proposal to Establish
National Center for Mathematics

A joint center of IIT Bombay and TIFR

1. Introduction

On 25-26 October 2006, a two day workshop was convened at the National Institute of Advanced Studies, Bangalore, by Professors C. S. Seshadri, Director, Chennai Mathematical Institute and M. S. Raghunathan, TIFR, Mumbai. The workshop was inaugurated by Prof. C. N. R. Rao. About sixty mathematicians and scientists participated in this workshop. The agenda for discussion was:

(1) Research and Development in pure mathematics
(2) Applied mathematics (Research, Training and Applications)
(3) Higher Education in Mathematics
(4) Computer Science and Mathematics
(5) Requirements of user agencies.

A report of the discussions and recommendations was prepared. In particular, it proposed setting up of the following institutes and centers:

(1) An institute similar to INRIA (National Institute for Computing and Information Sciences) in France.
(2) An institute for training mathematicians in the areas of particular requirement by the strategic departments like DAE, ISRO, DRDL, and also for Departments of Meteorology, Communications, IT etc.
(3) A center to be set up on Computational Mathematics: dealing with cryptography, coding theory, computational number theory, fluid dynamics, mathematical finance, mathematical biology and economics.
(4) An institute like International Center for Theoretical Physics (ICTP) at Trieste which encourages interaction between mathematicians, physicists and scientists and engineers from various disciplines.
(5) One or two Inter University Centers in Mathematics on the lines of IUCAA and Nuclear Science Center for training of teachers and researchers for a period of 2 years.
(6) Two conference centers with all the infrastructure facilities on the lines of Mathematical Research Institute in Oberwolfach (MFO) in Germany, where national and international conferences, seminars and workshops could be held round the year.

In this proposal, we will discuss setting up a center at IIT Bombay which is similar in spirit to MFO. The Oberwolfach Mathematics Research Institute (MFO), Germany started in 1944 and still remains, a highly successful model. In the post second world war Germany, MFO played an important role to reestablish the image of Germany as a leading nation in mathematics. There are about 50 week-long international workshops and conferences per year at Oberwolfach. Similar centers have been set up in many countries:

(1) **1963:** Research Institute in Mathematics, Kyoto (Japan)
(2) **1982:** Mathematical Sciences Research Institute, Berkeley (USA)
(3) **1982:** International Center for Mathematical Meetings, Luminy (France)
(4) **1996:** Morningside Center of Mathematics, Beijing (China)
(5) **2002:** Center of Mathematical Sciences, Hang Zhou (China)
(6) **2003:** Banffœlnternational Research Station, Banff (Canada)

2. **The need for setting up the NCM**

India has several research groups in mathematics. They are at varying stages of development. They organize instructional schools, workshops, national and international conferences from time to time mostly with government support. This happens in a completely unplanned manner. The organizers of these programmes spend a considerable amount of time in getting government support and getting good speakers from India and abroad. Very often the facilities available for these programmes are very poor.

To overcome these difficulties, the National Board for Higher Mathematics (NBHM) initiated in 2004, a unique programme called Advanced Training in Mathematics Schools (ATM Schools). At present, about 15 ATM schools are organized every year with an approximate budget of one crore per year. These schools are organized in some of the best institutes and universities which have good facilities. These schools have been welcomed by students and researchers from all over India. There is a clear need to enhance this programme so that many more students in all major areas of mathematics may be trained. A center like NCM can play an important role in developing these programmes further.

3. **NCM as a joint Center of TIFR and IIT Bombay**

(1) There are about 100 active mathematicians in Mumbai. There are about 60 students pursuing Ph. D. in mathematics in TIFR, IIT Bombay and Mumbai university. This is one of the largest concentrations of mathematicians in India.
(2) IIT Bombay and TIFR are in a unique position to establish NCM. They have well developed mathematics departments which enjoy world-wide reputation.
(3) The faculty members in these two departments and many engineering departments have well developed research groups who will help in organization of various programmes of the Centre throughout the year.
(4) IIT Bombay will be developing about 100 acres of land beyond the pipeline. This area is in beautiful surroundings of Vihar lake and adjoining hills which will provide a perfect setting for NCM.

4. **Programmes for the Centre**

There will programmes at the Center in all broad research areas in mathematics listed below. There are groups of mathematicans in all these areas in India, although they are at different levels

of development. The NCM will play a vital role in gathering researchers in all these areas for collaboration and training at national and international level.

Algebraic geometry	Harmonic Analysis	Algebra
Differential equations	Discrete mathematics	Lie groups
Mechanics	Number theory	Scientific computing
Topology	Statistics	Probability Theory
Functional analysis	Differential geometry	Complex analysis
Financial mathematics	Mathematical biology	Coding and cryptography
Control Theory	Operations research	History of Mathematics
Mathematical Economics	Theoretical Computer science	Mathematical Physics

The following is a partial list of programmes to be conducted by NCM.

(1) **Annual Foundation Schools:** To bring beginning Ph. D. students to some respectable common level by training them in the core areas of mathematics. Basic training of students entering mathematics research is very poor at present due to poor state of mathematics education in most universities. These schools will prepare students for further training in the Advanced Instructional Schools.

(2) **Advanced Instructional Summer Schools:** in six research areas will be conducted each year by some of the best teachers and researchers in the country to train Ph. D. students. The level of training that research scholars receive in Indian universities in mathematics is either poor or non-existent. These schools will impart this training so that the level of research among Ph. D. students improves.

(3) **Research Level Workshops:** The Centre will organize six national and six international weeklong workshops each year to inform researchers about the latest developments by inviting leading researchers from India and abroad.

(4) **National and International Conferences:** The Centre will host six national and six international weeklong conferences each year.

(5) **Instructional Schools for Young Teachers:** To train young teachers at B. Sc. and M. Sc. level in a systematic way so that transition to modern syllabi becomes smooth.

(6) **Research in groups:** This is a very popular programme at MFO. Researchers from around the world visit MFO for collaboration. They submit proposals for research to be carried out at the Centre. Mathematicians in India are scattered and lack even basic facilities for research. The Centre will enable them to conduct collaborative research by supporting extended periods of stay at the Centre in a rich atmosphere.

(7) **Year Long Programmes:** The Center will invite a few research groups each year to organize year long programmes (YLP). Each group will organize two workshops and an international conference. The workshops will prepare students so that they may be able to understand the talks in the international conference. During an year long programme, many collaborators will be invited to the Center under research in groups programme.

5. **The Governance structure**

(1) The Apex Committee in charge of the Center will have 7 members, out of which 3 will be nominees of IIT Bombay (including the Head of the Center : see below), 3 nominees of TIFR, and an eminent mathematician from outside these two institutions as the Chair. The Directors of IIT Bombay and the TIFR will together appoint the Apex Committee. The term of the Apex Committee will be 3 years.

(2) The Center will have a full-time Head who should be a distinguished mathematician. The Head will be appointed by a 3 member committee consisting of the Director of IIT Bombay, the Director of TIFR, and the Chairman of the Apex Committee, for a 5-year term. The chosen Head will first be appointed a regular faculty member in the Department of Mathematics at IIT Bombay and will be counted among the 3 nominees of IIT on the Apex Committee.

(3) The Apex Committee will decide on all the programmes to be run by the Center, and will decide on important policy matters.

(4) The Head will run all the programmes of the Center under the guidance of the Apex Committee, and will look after the day-to-day running of the Center.

6. **Infrastructure needed in short term**

(1) IIT Bombay may set up an office for NCM in Mathematics Department.

(2) The office will help in putting together funding proposals, make arrangements in guest houses in and around IIT Bombay for the stay of visitors to the Center.

(3) The Development Office of IIT Bombay will approach alumni for funding.

(4) The offices in the basement of Mathematics Department may be adequate to start the programes. These may be given to the Center when vacated by the faculty members of the CSE department.

(5) The immediate manpower requirement will be two technical assistants and a systems administrator.

7. **Infrastructure needed in long term**

(1) A multipurpose building with a 100 seat auditorium.

(2) Twenty offices for the visitors.

(3) A computer lab with 50 terminals for training sessions.

(4) Four 40 seater seminar halls.

(5) A 50 room guest house and a cafeteria.

(6) A reading hall for 40 students with modular furniture and computer terminals.