

# **Newton Gateway to Mathematics – Knowledge Exchange at the Isaac Newton Institute**

David Abrahams, Director  
21<sup>st</sup> January 2019



# Michael Atiyah 1929-2019

## Computer Vision

Organisers: A. Blake (Oxford), D. Mumford (Harvard), B.D. Ripley (Oxford).  
July to December 1993

Computer vision has its roots in practical engineering problems such as the visual navigation of mobile robots and vehicles and the automated analysis of medical images. A rapidly advancing interdisciplinary subject, it has reached out to mathematicians, statisticians and computer scientists for analytic tools and algorithms, and to psychologists and biologists for insight into natural vision systems. The programme will bring together specialists from these subjects to study aspects of computer vision such as ideas from mathematical analysis applied to image analysis, using stochastic representations to guide object recognition, and active vision, i.e. the continuous guidance of motion to optimize acquisition of visual information.

## Random Spatial Processes

Organisers: M.T. Barlow (Cambridge), R.T. Durrett (Cornell),  
G.R. Grimmett (Bristol), H. Kesten (Cornell).  
July to December 1993

Many physical processes may be modelled using random processes involving space and (possibly) time, e.g., the spread of disease and the structure of disordered media. Two of the principal targets of the theory of such random spatial processes are to understand the nature of phase transitions, and to describe the geometry of evolving processes. Recently the development of powerful and rigorous techniques has led to progress on some of the hardest problems. During this programme, probabilists and theoretical physicists will pursue such problems for interacting particle processes, percolation, random media, and models of population growth.

## Geometry and Gravity

Organisers: G.W. Gibbons (Cambridge), S.W. Hawking (Cambridge),  
N.J. Hitchin (Warwick), C.J. Isham (Imperial).  
January to June 1994

The past successes of Einstein's classical General Relativity have raised deep and difficult problems, involving global differential geometry and the theory of hyperbolic differential equations, whose solution would throw light on the evolution of black holes and nature of space-time singularities. The solution of many of these physical problems requires the development of a quantum theory of gravity. This would inevitably involve ideas from differential geometry and it would have implications for mathematics. The programme will bring together mathematicians and theoretical physicists working on both the classical and the quantum aspects of these problems to clarify the mathematical and physical questions that need addressing, and to contribute to their resolution.

## Cellular Automata, Aggregation and Growth

Organisers: B. Derrida (Saclay), A.J. McKane (Manchester).  
January

A huge increase in the sea of... be grown from simple p... (actal surface) is in marked... in these phenomena origi... in computer science t... s, such as scaling and unive... and this programme wil...

in contact the Deputy Director,  
dge, CB3 9EW, U.K.; tel. 0223 3

## Low-dimensional Topology and Quantum Field Theory

Organisers: E. Corrigan (Durham), M.B. Green (QMW, London), J.V.B. Imbrie (Cambridge).  
July to December 1993

This programme will focus on the spectacular developments that have occurred in recent years as a result of the increasing interaction between areas of the physics, mathematics and statistics. For example, the fusion of geometry and topology with the theory of gauge theory, the field theory used to describe the interactions of elementary particles. The programme will encourage further progress by bringing together mathematicians and physicists working in interrelated areas such as statistical physics, string theory, topology and quantum field theory.

## Dynamo Theory

Organisers: U. Frisch (Nice), H.K. Moffatt (Cambridge), A.M. Soward (Newcastle).  
July to December 1992

The programme will be concerned with the fundamental problem of the origin of magnetic fields in cosmic bodies, particularly stars and planets. Electromagnetic induction in a conducting fluid in motion can give rise to spontaneous growth of magnetic field, a phenomenon whose basic character is now well understood. A self-consistent theory incorporating the relevant fluid dynamics and thermodynamics has not yet been constructed, and this remains the outstanding challenge. Similar processes occur in thermonuclear fusion containment devices (e.g. JET - the Joint European Torus, at Culham). An understanding of these magneto-fluid dynamic processes is thus of central importance if energy from fusion (rather than fission) is ever to become a reality.

## L-functions and Arithmetic

Organisers: B. Birch (Oxford), D. Blasius (UCLA), S. Bloch (Chicago), J. Coates (Cambridge),  
J.-M. Fontaine (Orsay), R. Heath-Brown (Oxford), K. Kato (Tokyo).  
January to June 1993

Over the last thirty years, number theorists have come to realize that the mysterious connections between arithmetic problems and the properties of zeta and L-functions, initially discovered in the nineteenth century, are far more extensive than had been imagined earlier. A vast number of conjectures has now been formulated, stretching from the Riemann hypothesis and the Tamagawa numbers of motives. The programme will bring together mathematicians working in algebraic geometry, automorphic forms, and classical analytic number theory to discuss these conjectures.

## Epidemic Modelling

Organisers: B. Grenfell (Cambridge), V. I...  
January

The problems of understanding and... broad theoretical issues to specific... variety of mathematical extensions... close involvement in an... stimulated much... have become... program... in...

THE MASTER'S LODGE  
TRINITY COLLEGE  
CAMBRIDGE CB2 1TQ

22 January 1992

From SIR MICHAEL ATIYAH, P.R.S.

Telephone (0223) 338400  
Direct Line (0223) 338412  
Fax (0223) 338500

Dear Colleague,

You will probably have heard that the Isaac Newton Institute for Mathematical Sciences will open next July. From the beginning, the Institute has been planned as a national one and we hope and expect it to make an important contribution to mathematics and the mathematical sciences in the UK. One of the Institute is illustrated by the enclosed Newsletter. I have written two years, described in the enclosed Newsletter. I hope that you might have further details of the Institute. We will be an important component of the problems because of the mathematical sciences found...



# INI - its Philosophy

- From inception, the Isaac Newton Institute (INI) has uniquely been devoted to the Mathematical Sciences in the broadest possible sense
- Range of sciences in which mathematics plays key role is enormous – no topic is excluded and scientific merit is the deciding factor
- INI overcomes usual barriers; very important to bring together of researchers with disparate backgrounds and expertise
- INI concerned with breakthroughs rather than consolidation
- Novelty, interdisciplinarity and adventure are important selection criteria, but these must be subject to the overriding criterion of quality
- INI contributes to the advancement of mathematical science world-wide, but must consider its activities in the context of UK
- Programming is balanced over years, but this is secondary to quality
- The Institute is leading on equality, diversity and inclusivity in science





# Activity and Scale



*Terry Tao: Fields medalist and participant on INI programmes in 2005, 2011 and 2015.*

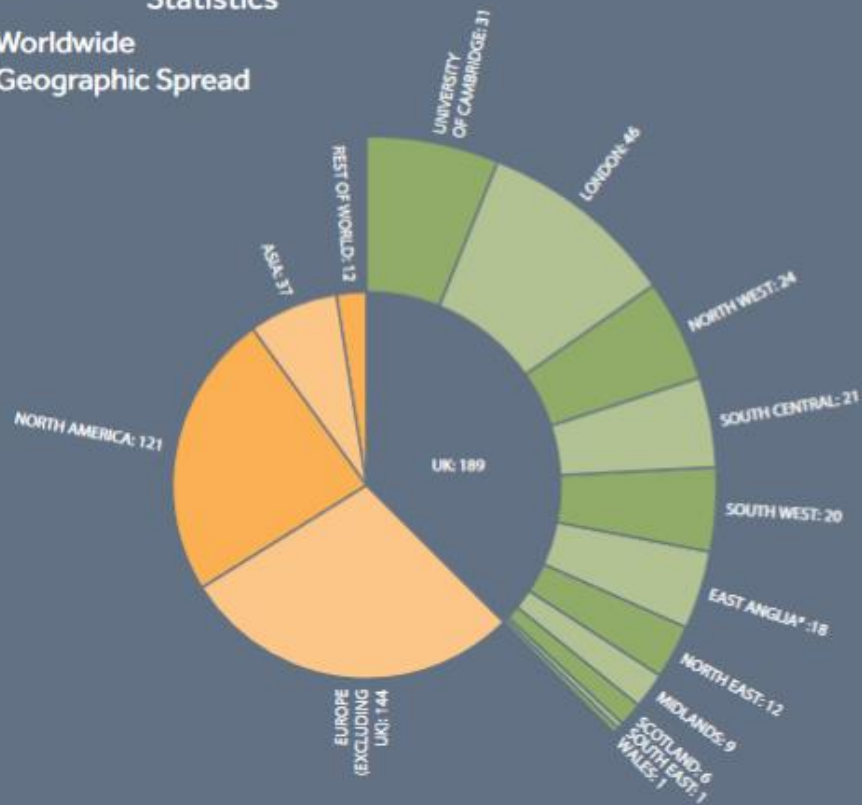


*Dijkstra Prize winner Cynthia Dwork who participated in 2016*

- Established in July 1992 as the UK's national mathematical sciences institute for long-term research programmes (6, 4 or 1 month) with ~30 participants in each at any time
- Two or three programmes run in parallel
- EPSRC grant recently renewed to 2024
- Some 150 research programmes to date
- Participants include 30 Fields Medalists, 13 Nobel Laureates, 12 Abel Prize winners, 25 Wolf Prize winners and over 50 Clay Senior Scholars
- > 2500 visitors through INI's doors each year
- Snapshot from 2017-18 Annual Report:

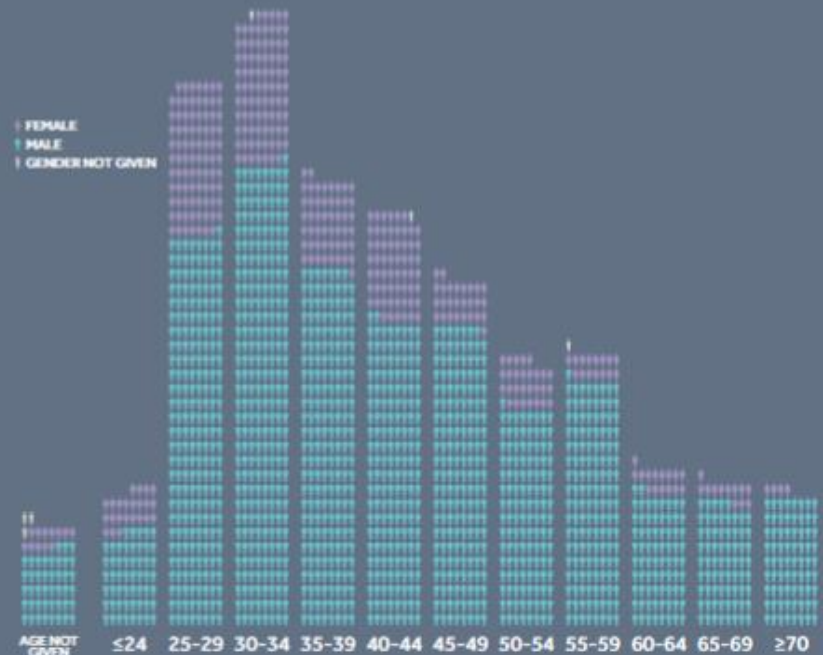
## Statistics

### Worldwide Geographic Spread



\*Excluding University of Cambridge

### Gender and Age



503

PROGRAMME  
PARTICIPANTS



16975

PROGRAMME  
PARTICIPANT DAYS



1499

WORKSHOP  
PARTICIPANTS



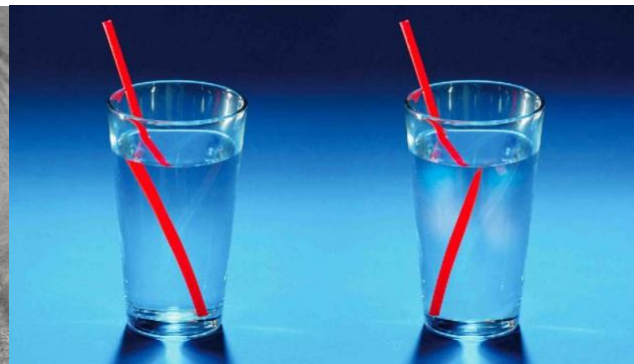
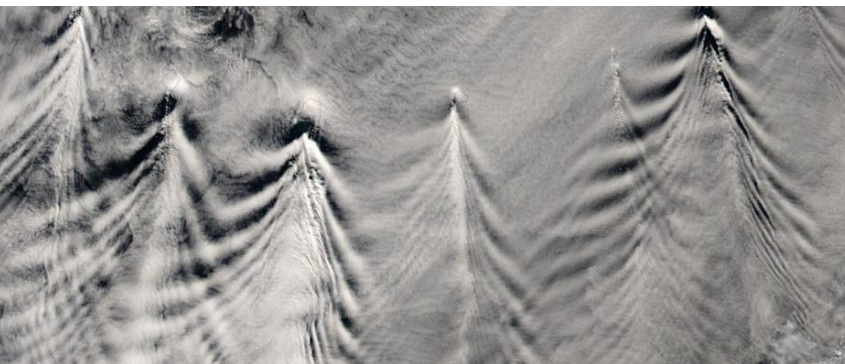
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WORKSHOP  
PARTICIPANT DAYS



# Industrial Mathematics & Statistics

- The UK has always had a rich and unique tradition for applying mathematics to better understand the world around us
- Some in our subject have been concerned that focusing on application/impact might diminish from the success of curiosity-led endeavour
- But increasingly academe needs to prove to Government and others that the funding it receives is justified (via REF, KEF etc)
- For the long-term future of mathematical sciences we must embrace the shift to *challenge-led* rather than discipline-specific funding
- David Wallace introduced Open for Business days within INI programmes to encourage knowledge transfer to limited numbers outside academe





- John Toland and Christie Marr created the *Turing Gateway to Mathematics* in 2013 as a stand-alone entity that supports knowledge exchange (KE) in the mathematical sciences
- Activity within and without INI programmes
- Thanks to the ability and dedication of its staff the TGM has become an international exemplar for mathematical sciences KE
- Offers a wide array of supporting mechanisms
- Very large number of close partnerships



- This launch event heralds a new phase in the Gateway's development
- It is a great deal more than a cosmetic change –
  - far closer link between INI's core activities and that of the Gateway
  - offers financial stability and sharing of resource
  - embeds KE within all our programmes whether small or large-scale
  - with partners (eg ICMS, KTN, ATI) will create opportunities and structures for the whole community to engage on grand societal challenges
  - increase mathematical sciences involvement in policy, legislation, regulation (evidence-based decision making)
- Provide broader suite of activities with greater horizon scanning and in-depth creation and sustenance of novel & distributed partnerships
- Help to realise some of the recommendations in the Bond Review



# The Future

- INI activity on all fronts has expanded significantly in recent years
- Newton Gateway will play a critical role in the Institute in coming years
- Present space inhibits future work – need to run events/programmes/w'shops in parallel
- Only 56 desk spaces for long-term visitors – need around 90, with extra meeting rooms
- Ambitious plans in train to expand its space – need to raise new funds for this
- We need your help to achieve this!

