

Mathematics for Humanity



A New Initiative of the International Centre for Mathematical Sciences

The International Centre for Mathematical Sciences (ICMS) will host a new project entitled 'Mathematics for Humanity', which will be devoted to education, research, and scholarly exchange having direct relevance to the ways in which mathematics can contribute to the betterment of humanity. The activities of the programme will revolve around three interrelated themes.

- A. **Integrating the global research community** (GRC)
- B. **Mathematical challenges for humanity** (MCH)
- C. **Global history of mathematics** (GHM)

Development of the three themes will facilitate the engagement of the international mathematical community with the challenges of accessible education, knowledge-driven activism, and transformative scholarship.

Within each of the three themes, researchers can apply for one of the following activities:

1. **Research-in-groups.** This is a proposal for a small group of 3 to 6 researchers to spend from 2 weeks to 3 months in Edinburgh on a reasonably well-defined research project. The researchers will be provided working space and funds for accommodation and subsistence.
2. **Research course or seminar.** A group of researchers can propose a course or a seminar on topics relevant to one of the three themes. These should be planned as hybrid events with regular meetings in Edinburgh that can also be accessed online. Proposals should come with a detailed plan for attracting interest and for the dissemination of ideas.
3. **Research workshops.** These are 5-day workshops in the standard ICMS format, of course with a focus on one of the three themes.
4. **Research school.** These are hybrid schools of two-weeks length on one of the themes. These should come with substantial planning, a coherent structure, and be aimed towards post-graduate students and early career researchers.

We expect that up to 30 researchers will be in residence in Edinburgh at any given time over a 9-month period, which might be divided into three terms, mid-September to mid-December, mid-January to mid-April, and mid-April to mid-July.

Every effort will be made to provide a unified facility for the activities of all groups working on all three themes, thereby encouraging a synergistic exchange of ideas and vision.

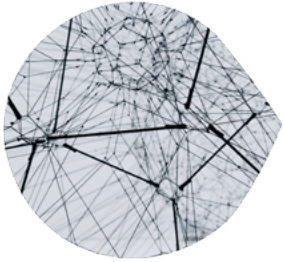
The proposals will be reviewed twice a year soon after the spring deadline of 15 April and the autumn deadline of 15 November. If you wish to apply for multiple activities, please submit a form for each separately. However, a single unified detailed proposal may be attached to each form.

On the following pages are brief explanations of the themes.

Theme 1: The global research community



The member nations of the International Mathematical Union are divided into five different groups according to an assessment of the mathematical resources available to the member and the ability to contribute to the international community. The main goal of this component of the project is to improve the connections and visibility of the lower group countries in the global mathematical research community. Building on and working with existing initiatives which improve mathematical training at undergraduate and MSc level, the ICMS will support training and research in countries belonging to groups 1 or 2 (or those working against even greater challenges) by providing opportunities for early career researchers from them to engage in synergistic research and interactive teaching in collaboration with researchers from group 4 and 5 countries. We aim thereby to provide benefits both to the researchers and to research students from low to middle income countries (LMIC).



Researchers should plan to gather at the ICMS to work on research projects and/or organise a series of hybrid or online research seminars and/or courses lasting from two-weeks to three-months. Proposals for courses or seminars must come with plans for collaboration with networks or institutions in LMICs that can help to organise the hybrid events as well as a strategy to reach a substantial number and range of researchers and students. The courses and seminars can be supplemented by workshops for early career researchers or schools for students that take place in Edinburgh, which must be applied for separately. The schools can be up to two weeks in length and the workshops will typically last one week. The schools should be interactive and designed to foster networking between students and lecturers. They should cover topics of current and broad interest in the mathematical sciences, including pure mathematics, mathematical physics or biology, finance, operations research, data science, logistics, statistics, and a wide range of mathematics applicable to industry.



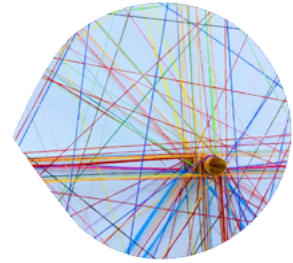
The project will also accept proposals for workshops or schools to bring together students and early career researchers from at least two different regions to learn an important mathematical topic of common interest. The proposers will be encouraged to select students from parts of the world that would significantly benefit from communication and interaction in a non-political setting in order to enhance mutual understanding via the process of striving for common intellectual goals.



In addition to the benefit to developing countries, these activities will enable the UK scientific community to maintain or establish influence and connections and to broker the exchange of ideas in parts of the world where links to Europe have been traditionally weak, such as South-East Asia or Central America. A key European institution with an outreach agenda is the International Centre for Theoretical Physics (ICTP) in Trieste, which is supported by the Italian government and UNESCO. They host training programmes for researchers from developing countries. The UK has historically had little involvement in its projects in spite of the fact that Abdus Salaam, the founder of ICTP, was also an initiator of the ideas that led to the founding of the ICMS. With the current weakening of programmatic ties to Europe, the time is right to establish independent connections that create long-term collaborative potential with emerging talents in developing regions of the world.



Theme 2: Mathematical challenges for humanity



This part of the programme will host collaborative projects, workshops, seminars, courses, and schools of varying lengths dealing directly with possibilities for contribution by mathematicians to the challenges facing humanity.

These could include:

- Epidemiology and medical statistics;
- Mathematical geoscience and the protection of the environment;
- Safeguarding artificial intelligence and data science;
- Mathematical models of circular economies;
- Sustainable and equitable finance;
- Networks, voting, and democracy;
- The mathematics of energy systems;
- Improving communication of risks and other statistical information;
- Tipping points and ‘tipping elements’ in the Earth’s climate system
- The creation of high-quality open-access climate simulation software



Proposals that address positive social change within the mathematical sciences and its interface with socio-political challenges will also be appropriate for this project. Obviously, the possibilities for proposals are not limited to the examples provided.

A basic model for the programme is ‘groups of groups’. That is, groups of 3-6 researchers should apply to the programme with a research project of at most three-months duration in mind, following the pattern of the research-in-groups programme. This could be supplemented by a programme for the dissemination of ideas, taking the form of research workshops, a course, a seminar series, or a school, most of which should be made available in a hybrid format to a wide public. A key point will be that several focussed research groups will be able to gather at the ICMS, who will be expected to interact and share ideas. The goal is to marshal energy and establish new connections by having several small groups working on different but related problems present during overlapping periods.





Theme 3: A global history of mathematics

The role of mathematics in human history has been crucial to humanity's self-understanding and to the coherent accounting of human development in many parts of the world. It is in the interest of mathematics and pedagogy for this history to be told accurately and seriously, conveying the genuine value of mathematics as a human heritage. In particular, research in the history of mathematics and its dissemination should be objective and free from political agenda to the extent possible. Meanwhile, it must be acknowledged that there is widespread misunderstanding about this history among mathematicians and educators, much of it propagated by scholars working in a climate that promoted the interests of specific regions subject to the influence of specific cultural currents. The narrative that was constructed thereby has contributed to alienating the majority of humanity from a sense of ownership of the mathematical tradition, thereby hindering education, scientific development, and international collaboration.



The purpose of researching a global history of mathematics that accounts for the rich interactions between regions and continuity of endeavour will be to:

1. Produce a more accurate understanding of historical processes and contributions;
2. Re-examine the foundations of the history of mathematics from a point of view that takes into account realistic interactions and inter-regional influence;
3. Thereby reclaim the status of mathematics in all its manifestations as a common heritage that can serve the needs of all of humanity.



The activities of the theme will include:

- Research fellowships for historians and mathematicians engaging in collaborative research on an accurate history of the way people have engaged with mathematical ideas in all parts of the world;
- Hybrid courses or seminar series organised by groups of visiting researchers for discussing new developments and exchanging ideas;
- Schools or workshops whose purpose is to disseminate the results of the research to the global community of research mathematicians, historians, educators, and students.



The research fellowships will follow the pattern of the research-in-groups programme of the ICMS with far more flexibility for longer stays of up to 3 months. A strong emphasis of this project will be to foster collaboration and communication between mathematicians, historians, and educators.

Administrative Structure and Governance of the Programme

The project will be managed by the current administration of the ICMS with support added in a manner appropriate to its mission and the increase in workload.

In particular:

- The activities will be overseen by the ICMS Advisory Board and given final approval by the Management Committee.
- A specialised Scientific Committee, a subcommittee of the ICMS Programme Committee, will be dedicated to the activities of the project and be responsible for overseeing the selection of all proposals.
- Two to four bespoke support staff dealing with the administration of the events will be appointed.

Supporting Infrastructure: The International Centre for Mathematical Sciences

Supported by two large grants from the Engineering and Physical Sciences Research Council of the government, the ICMS constitutes the mathematical infrastructure of the United Kingdom in collaboration with the Isaac Newton Institute in Cambridge. ICMS stimulates and promotes the mathematical sciences through diverse international research workshops and conferences in

the mathematical sciences. Its vibrant events programme attracts leading scientists from the UK and the world. Every year, the Centre hosts more than 20 week-long research workshops, numerous shorter strategic workshops, and a diverse range of events concerned with knowledge exchange, public engagement, and EDI (equality, diversity, and inclusion) initiatives. The ICMS is located in the Bayes Centre of the University of Edinburgh, where it occupies the top floor together with the Maxwell Institute for Mathematical Sciences. It also hosts a visiting collaborative research programme with offices on the top floor of the James Clerk Maxwell birth house.



ICMS was created in December 1989 by Edinburgh and Heriot-Watt Universities in response to a challenge laid down by Nobel Prize winner Abdus Salam in his Edinburgh Medal address of that year. It was supported early on by the International Centre for Theoretical Physics, the City of Edinburgh District Council, the Scottish Development Agency, Standard Life, Scottish Provident, the Scottish Higher Education Funding Council, Engineering and Physical Sciences Research Council, the London and Edinburgh Mathematical Societies, and the Royal Society of Edinburgh. The outstanding track-record of hosting a range of events touching on all aspects of the mathematical experience makes the ICMS an ideal organisation to host the initiative on Mathematics for Humanity.