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The purpose of this review is to benchmark UK research activity in mathematical sciences against the rest of the world, and it will be used to help inform future strategy and funding policy. It is *not* a review of individual institutions or researchers. Please therefore ensure that your comments address and illuminate for the panel the UK-level issues flagged in the attached evidence framework (see Annex A).

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UK Research activity in the mathematical sciences was rated very highly in RAE2008, with 49% or more of research activity<sup>1</sup> in each of the three relevant subject areas being rated as (3\*) or (4\*). Eminent international mathematical scientists were members of each of the three mathematical science sub-panels. Two additional features are worthy of note in the table below:

- Performance is very similar across all three disciplines.
- Excellence is widespread throughout the research community, not being concentrated only in a small number of large submissions.

	%4*	%3*	%2*	%1*
Pure: all submissions	14	39	39	6
Pure: biggest 4 submissions	30	43	26	1
Pure: biggest 8 submissions	22	39	30	6
Applied: all submissions	12	37	38	13
Applied: biggest 4	26	45	29	0
Applied: biggest 8	24	43	31	2



Of course, it is far from the case that the benefits of this support all flow in one direction. For example, The LMS supports and manages a programme for Africa in conjunction with the

and to mentor young African mathematical researchers, teaming them with active mathematical researchers from institutions from established countries around the world, including the UK. The programme is sponsored by the Nuffield Foundation and the Leverhulme Trust.

A huge amount of foreign interaction with UK mathematical sciences also arises under the auspices of the

research in the mathematical sciences.





benefited greatly from the influx of foreign talent to permanent academic posts over the past 20 years, but this is not a pattern that can or should continue indefinitely. To maintain a steady state in UK mathematical science departments while at the same time providing a good supply of PhD mathematical scientists to the wider economy, we calculate that there should be around 500 UK PhDs in the mathematical sciences each year. The next stage in the pathway to academic positions is critical – simply to maintain current numbers of academics, about 100 postdoctoral positions in mathematical science are needed each year. The Postdoctoral Fellowship Scheme supported by EPSRC is very successful, but yields only about 12 positions each year. The number of EPSRC “responsive mode” awards in the mathematical sciences including a research assistant will be at most 20 in 2010-11 (given the budgeted responsive mode funds of £7M). There are of course a number of Research Fellowships and Research Assistantships funded through directed calls from EPSRC, through other Research Councils and through College endowments and the like – but the grand total is still a long way short of 100.

Please use this space to provide any additional information which you believe would be useful for the Review Panel

The key points we wish to emphasise are these:

- The UK’s research performance in mathematical science has been excellent in the period since the last International review in 2004. The quality of research produced has been maintained, and there has been some increase in volume.
- This excellent performance is under severe threat. There have already been very large cuts in Research Council support for research in the mathematical sciences. Not only will this result in reductions in the quality and quantity of the research produced in the UK, but it will also (as discussed in H) seriously damage the already inadequate pathways to academic careers in the UK. However, a further threat lie beyond these: given the current and impending pressures on university finances, we face the prospect in this era of Full Economic Costing that university administrations will invest only in fields



- Is the UK internationally leading in Mathematical Sciences research? In which areas? What contributes to the UK strength and what are the recommendations for continued strength?
- What are the opportunities/threats for the future?
- Where are the gaps in the UK research base?
- In which areas is the UK weak and what are the recommendations for improvement?
- What are the trends in terms of the standing of UK research and the profile of UK researchers?

- What are the key technological/societal challenges on which Mathematical Sciences research has a bearing? To what extent is the UK Mathematical Sciences research community contributing to these? Are there fields where UK research activity does not match the potential significance of the area? Are there areas where the UK has particular strengths?
  - Are there any areas which are under-supported in relation to the situation overseas? If so, what are the reasons underlying this situation and how can it be remedied?
  - Does the structure of the UK's mathematical science research community hamper its ability to address current and emerging technological/societal challenges? If so, what improvements could be implemented?
  - Are there a sufficient number of research leaders of international stature in the Mathematical Sciences in the UK? If not, which areas are currently deficient?
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- Is there sufficient research connecting mathematical scientists with investigators from a broad range of disciplines including life sciences, materials, the physical sciences, finance and engineering? What is the evidence?
  - Where does the leadership of multidisciplinary research involving mathematical sciences originate? In which other disciplines are the mathematical sciences contributing to major advances?
  - Are there appropriate levels of knowledge exchange between the Mathematical Sciences community and other disciplines? What are the main barriers to effective knowledge and information flow, and how can they be overcome?
  - Have funding programmes been effective in encouraging multidisciplinary research? What is the evidence?
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- What is the flow of trained people between industry and the research base and vice versa? Is this sufficient and how does it compare with international norms?
  - How robust are the relationships between UK academia and industry both nationally and internationally, and how can these be improved?
  - To what extent does the Mathematical Sciences community take advantage of opportunities, including research council schemes, to foster and support this knowledge exchange? Is there more that could be done to encourage knowledge transfer?
  - Nationally and internationally what is the scale of Mathematical Sciences R&D undertaken directly by users? What are the trends? Are there implications for the UK Mathematical Sciences research community, and how well positioned is it to respond? Is there any way that its position could be improved?

- What are the current and emerging major advances in the Mathematical Sciences area which are benefiting the UK? Which of these include a significant contribution from UK research?
- How successful has the UK Mathematical Sciences community (academic and user-based) been at wealth creation (e.g. spin-out companies, licences etc.)? Does the community make the most of opportunities for new commercial activity? What are the barriers to successful innovation based on advances in the Mathematical Sciences in the UK, and how can these be overcome?

- Are the numbers of graduates (at first and higher degree level) sufficient to maintain the UK Mathematical Sciences research base? Is there sufficient demand from undergraduates to become engaged in Mathematical Sciences research? How does this compare with the experience in other countries?
- Is the UK producing a steady-stream of researchers in the required areas or are there areas of weakness in which the number of researchers should be actively managed to reflect the research climate. What adjustments should be made?
- How effective are UK funding mechanisms at providing resources to support the development and retention of talented individuals in the mathematical sciences?
- How does the career structure for researchers in the Mathematical Sciences in the UK compare internationally?
- Is the UK able to attract international researchers in the Mathematical Sciences to