University of Sussex

School of Mathematics & Physical Sciences

Research Strategy

Better Research for a Better World

Disclaimer: This is a School Research Strategy that applies across both Departments. However, Departments, Research Centres and Research Groups are encouraged to create their own strategies complementing the School Research Strategy. As strategies need to live, this document will be continuously updated in the coming years.

UNIVERSITY OF SUSSEX

Background

MPS, which consists of the departments of Mathematics and Physics & Astronomy, was formed in 2009 after a reorganisation of Sussex academic Schools. These two departments have thrived as a cohesive, multi-departmental unit since and enjoyed an intellectual footprint that goes back at least 3 decades. Together both departments pride themselves to be a highly collegial and inclusive environment for exceptional research. The School nurtures our research staff, especially our early career staff. Our main strategic priority has been to enhance the impact of our research with substantial investment in academics, professional staff and infrastructure. MPS is home to 61 academics (57.3 FTE) who belong to nine research groups as seen in Figure 1. We also have approx. 150 doctoral students within the two departments. Overall, the School has an excellent research reputation established by a unique group of creative and diverse scholars and enhanced by a dedicated Professional Services team. The School's research income as a percentage of full economic costing is one of the highest in the University, see Figure 2. The School's Research outcome has improved in REF2021 and the School prides itself on excellent public engagement.

Each Department has "primary" research groups to which every academic FTE has to be assigned, as well as more fluid "secondary" research groups, whose creation and participation can be reshaped in a more agile fashion, to reflect the ever-evolving and fast-changing nature of our research.

The Mathematics department has four primary research groups (Analysis and Partial Differential Equations, Numerical Analysis and Scientific Computing, Mathematics Applied to Biology and Probability and Statistics) but also leads an interdisciplinary research centre, the Dr Perry James (Jim) Browne Research Centre on Mathematics and its Applications. There are however no sharp boundaries between the Mathematics Research Groups and the centre with frequent collaborations between members of different groups and with many working at the interfaces of these disciplines. To this end, Mathematics established secondary research groups, namely Dynamics & Geometry, Mathematics of Machine Learning, and Mathematical Physics. The participation in the latter is joint with Physics and Astronomy.

The Department of Physics and Astronomy has a distinctive profile that specialises in particle physics, extragalactic astrophysics and cosmology, and novel quantum technologies. The department has five "primary" research groups (Astronomy Centre, Atomic Molecular and Optical Physics, Experimental Particle Physics, Materials Physics and Theoretical Particle Physics). Since 2023, the Sussex Centre for Quantum Technology (SCQT) and the Sussex Programmed for Quantum Research (SPQR) merged into the newly established Excellence Centre for Quantum Technologies. In addition to these, the department has a Space Research Group.

MPS, together with EngInf, leads the interdisciplinary Data Intensive Science Centre (DISCUS), which involves researchers across the whole University.

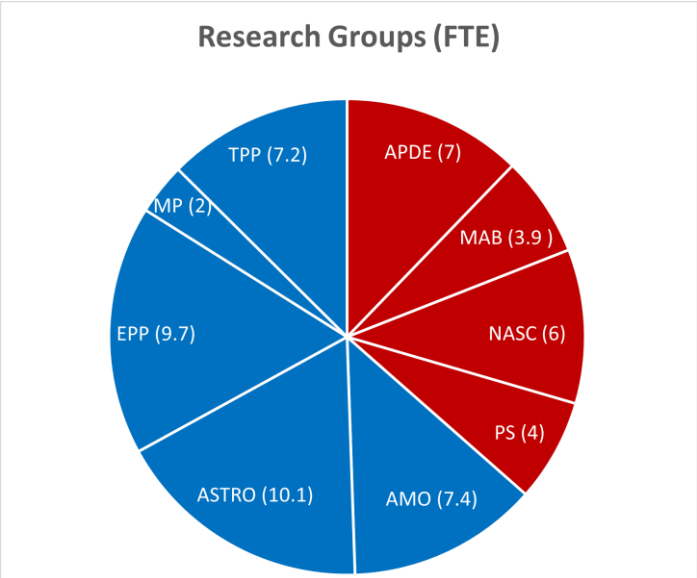

Figure 1

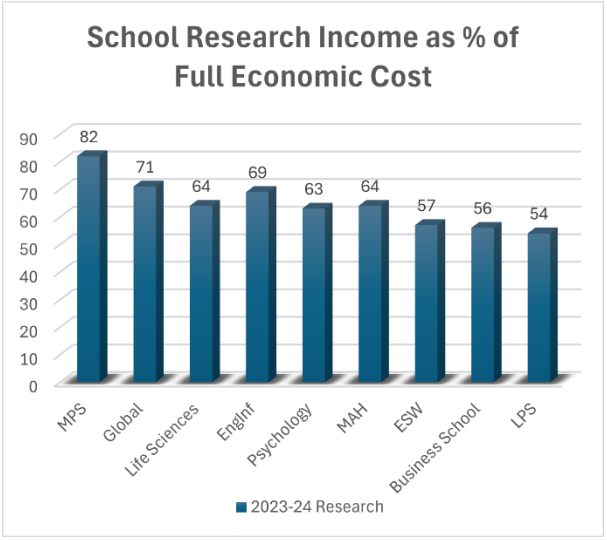

Figure 2

This Research Strategy is based on an internal SWOT analysis (see Appendix A) and several school workshops with feedback loops between DRaKE, HoS, HoDs, research group leads/coordinators and research support staff (see Appendix B).

RESEARCH VISION, UNDERSTANDING & OBJECTIVES

We are a research-intensive School aiming to be consistently recognised as truly world-leading in key areas of our science. MPS is committed to the University's vision and strategy.

Research is a key priority and fundamental to the **identity** of both Departments. We are **bold** and aspire to exploit our expertise to tackle research problems of globally recognised significance. We are **imaginative**, harnessing the rich and varied talents within our School and the University and nurturing strong partnerships outside. We are **focused** on achieving high academic and socio-economic impact. We are **coherent and collegial,** recognising and making the best use of the skills of all our staff.

The University and our School have a long tradition of challenging conventional thinking and working at the interface of different research areas, be they intra- or interdisciplinary. We continuously build on this strength to create new synergies and partnerships across the HE sector and external partners. This will facilitate and enhance the translation of our research in order to provide solutions to some of the grand challenges the world faces (see the School's work on Drought modelling in Africa), as well as impact our local communities (see COVID-19 modelling). The Schoolwide expertise in data science will be a key factor in fostering new interdisciplinary and impactful activities.

The School will continue to pursue flexibility and agility in responding to new challenges and emerging areas and will aim to secure strategic support for larger top-down and smaller bottom-up initiatives thus promoting a healthy research ecosystem.

Our research objectives are:

a. Maintaining or enhancing a strong international reputation that makes a significant contribution to the University's position in international league tables
b. Enhancing the quality of our research outputs, environment and impact such that we would be indistinguishable (within measurement errors) from all but the Top 5 in any UK REF exercise
c. Obtaining sufficient financial resources (contribution income and FEC recovery) from diverse sources to ensure our research activities are sustainable
d. Making a significant and growing impact on skills and economy of the region and nationally to address the `Place' and KEF agenda
e. Obtaining grant income per FTE that is high by UK standards to perform favourably in league tables (Top 20 UK position and rising)

	Description	Comments
A	Maintaining (or enhancing) field-weighted citation	Research Metrics SciVal and Altmetrics.
B	(i) : number of accepted publications with ERA grade of 4* (10-12 on our 12-point scale) per year to aggregate to 0.22 (i.e. 1.5 (average number of papers per FTE)/(~ 7 Years till next REF)) 4* papers per FTE and per Year, leading to 50% of papers for the next REF submission being 4* (ii) : To increase the number of 4* Impact Case Studies within each Department (2 out of 3 for UoA10 (Mathematics) and 2 out of 4 for UoA9 (Physics and Astronomy), and (iii) : Enhance our environment so that it allows individuals and groups to excel in their research activities and careers (e.g. maintain at least one PhD per FTE at any time point, maintain/raise completion rates and placement after graduation)	Rolling forecasts, ERA scores. Annual data via Personal Research Plans, working closely with RQI, and maintaining a live list of Impact Case Studies with their readiness status and projected scores. Research dashboard, rolling forecasts and continuous improvement of research culture based on appraisals and staff survey
C		Rolling forecast and research dashboards
D	(i) : Maintain and improve contribution income (10% aspirational increase) and (ii) : Maintain FEC recovery rates >80%	Rolling forecast and research dashboards.
E	Maintain and enhance our outward-facing work to contribute towards improving the University-level KEF results (e.g. improve the success rate for Innovate UK applications, strategically use HEIF money to initiate contact and carry out feasibility studies with local councils, businesses and third-party organisations to contribute to local growth and regeneration, attract investment from business partners, spin-out companies)	Rolling forecast and research dashboards.
	Work towards aspirational total research income targets of £180k/FTE for Physics and Astronomy and £25k/FTE for Mathematics.	
	Raising the profile of the Research in our School through public engagement, open lectures, teacher days, and masterclasses. Advertise the Sussex brand together with the science we present.	Use the existing internal system to monitor outreach events, the number of students reached etc.

Strategic Plan

Key to achieving our research targets is the creation of an open, supportive and diverse research culture that fosters excellence and facilitates impact in every part of the School. We are in a unique position to reach out and build bridges both in an intra and interdisciplinary way which allows us to leverage talent and funding in pursuit of solving fundamental science problems as well as carrying out impactful research by working on some of the grand challenges that the world faces.

We focus on a multi-level strategy that follows the full life-cycle of research from problem definition (including stakeholder engagement), attracting research support/funds, carrying out the research, communicating research results, external engagement, knowledge exchange and impact for stakeholders. This approach will enable us to clearly signal our research strengths –which inform and enhance our taught portfolio and enable us to attract and retain high-calibre international scholars.

The vision and strategic plan at the School level inform the development of Departmental research strategies while aiming to constantly adopt best practices and maximise our efficiency where activities can be coordinated and carried out at the School level, in particular KEF, Business, Outreach and Research communication activities.

The strategic plan is consistent with the strategic plan of the University of Sussex (Sussex 2025): to obtain excellence through support and development of its researchers. Through recognising external drivers and the strengths of individuals and groups, our strategy is developed and refined both top-down and bottom-up and it is built upon the following **7 pillars**.

1. **Establish a vibrant, exciting, collaborative research environment and culture.** Environment and culture are key to our plans.

2. **Recruit and retain the best researchers at all career stages.** This includes establishing a recruitment process aiming at research excellence; ongoing support and mentoring of all existing staff; a predictable and transparent promotion process; defining clear career pathways for researchers at all levels.

TASKS:

- MPS is fully committed to implementing the **Concordat** to **support the career development** of Researchers and to provide a productive and supportive working environment for researchers. The School has an Early-Career Development Lead whose task is to support early career Research Staff in their career development and to continue to represent their interests at the School and University levels.

- MPS and the University will continue to use the successful **Researcher Development Framework** to plan personal and career development for research students and researchers. This ensures the fulfilment of all requirements of the **Concordat** to Support the Career Development of Researchers, the **QAA code of practice** for research programs and the Roberts recommendations for postgraduate researchers and research staff.

- MPS will **enhance its research capacity** and facilitate ongoing strength and succession planning through **strategic recruitment**, and subsequent development of, exceptional early career researchers.

- **Continue the recruitment** of high-calibre research leaders who either are or have the potential to become **international leaders** in their research area and who demonstrate a clear fit with the vision of the School and the strategic aims of the relevant departments/research groups.

- Provide **clear and reliable development pathways** for all career levels in line with promotion committee expectations. Faculty develop and update yearly their own Personal Research Plans. These in turn inform and are aligned with Departmental, School and Institutional-level strategies. They also provide input to the personal Annual Development Review (ADR).

- Provide **fair and equal career opportunities for all** in hiring and promotion practices, supporting all researchers in achieving their full potential.

- **Stimulate researchers** by providing opportunities to join new research teams and **engage in networking** and intellectual exchange (research days, themed meetings, hackathons), with opportunities for interdisciplinary and agenda-setting research within MPS and across the University. DISCUS provides an example of how this can be achieved in practice.

- **Facilitate targeted opportunities for collaboration** within critical mass-sized research groups and support all researchers in engaging with collaborators and internal and external stakeholders. This could be achieved via appropriate stimuli to individual devolved budgets or strategic redirection of HEIF money.

- **Ringfence 40% of research workload capacity** for research activities and monitor compliance based on academic time surveys and ADR. Continue to employ a transparent workload model that is regularly revised. If possible, support holders of research grants with partial or full relief from other duties depending on the nature of the grant.

- Allow **adequate time for researchers** to concentrate on research work (e.g. by allocating teaching in one term wherever possible and requested) as well as advocate for the provision of high-quality resources (including technology and office space as well as Professional Services support).

- Provide the opportunity for **study leave/sabbaticals for research work**. Faculty can apply for a six-month sabbatical leave every nine semesters.

3. Strengthen and support our research activities. This includes providing exceptional service from research management staff, creating research incentives as well as cultivating a supportive and collaborative environment.

TASKS:

- Recruit staff with specific skills that are essential to our **research and impact strategy** and enhanced professional support. Skills gaps will be filled primarily through **professional business development** staff. If needed, we will target recruitment of Faculty with a unique public engagement profile.
- Provide **guidance, training, mentoring and support** as required to equip all researchers with the skills needed to undertake high-level research as well as to apply for research funds that enable the institution to grow (e.g. writing workshops for papers and research proposals; research awaydays; dedicated mentoring, especially for early-career researchers).
- Advocate for the provision of **dedicated Professional Services staff** to continue to support research activities for managing REF processes, doctoral programmes, conference organisation, policy engagement, communications and impact work, bid development, etc.
- Provide the professional support and internal structures required to help realise the University's goal of '[putting] **collaboration at the heart of everything we do'** (Sussex 2025); building opportunities and incentives for collaboration and engagement in the design of our policies and practices. Support institutional collaboration as a valuable source of new ideas aimed at exploring innovative applications of research with rapid feedback. Building on the huge value of local and regional academic collaboration, MPS will continue to play an active role in the successful South-East Physics Network (SEPnet).
- Continue to use the services of **External Research Advisers** in the development of research and impact strategy.
- Most of our **world-leading research** can only be achieved through **world-leading facilities,** necessitating significant **international collaboration**. We actively engage in these collaborations and position ourselves to take leading roles in areas aligned with our specialist expertise. We encourage researchers to take on such roles and enable those who embrace them to fulfil them to the full.
- Ensure that appropriate and effective incentives are available to researchers who are particularly successful in attracting research income and **producing world-leading research outcomes**.
- The School is committed to **acting on feedback** on research arising from individual Personal Research Plans. The Director of Research and Knowledge Exchange is responsible for digesting the results from Personal Research Plans and coming up with actions as and when needed.
- While all research groups will play an important role in supporting many of the activities below, the research centres will provide an extra focus by organising themed seminars, hosting conferences and visiting scholars, **mentoring and developing and nurturing collaborations.**
- Provide **generous conference attendance funding and administrative support** at the level required to meet, and possibly exceed international standards.
- Encourage **international research** activity by inviting leading scholars for centrally financed visiting scholarships (as and when these become available), actively developing nascent partnerships and managing and maintaining existing ones.
- Ringfence **workload and funding for impact-case work for REF** via existing workload allocation models.
- **Host major national and international conferences** by providing financial and human resources (see Colloquium by Fields medallist, Prof Alessio Figalli, organised by the Dr Perry James Browne Research Centre on Mathematics and its Applications, ICAP spin-off conference organised by AMO).
- Formalise **cross-campus links with key synergy Schools (**e.g. strong links developed via DISCUS with EngInf, Global Studies IDS etc) to foster interdisciplinarity. This could be supported by the strategic use of Research Culture Funds.
- **Enhance workload planning** to ensure staffing needs are met over the medium-long term, e.g. continual liaison between departments and RDMs to ensure current Research Assistants/Fellows and Professional Services posts are written into research grants.
- Continue an **active research seminar series** with regular participation and attendance by faculty at all levels.
- We recognise that, in a research-intensive University, research informs teaching. Therefore, we promote the integration of research in our teaching and advocate the **removal of clashes between teaching and research activities** (e.g. smarter timetabling and leaner processes).

4. Grow our external research funding.

TASKS:

- Advocate for the provision of enhanced **dedicated Professional Services support** for managing research bids both at pre- and post-award level.
- Enhance further the quality of the **internal peer review process** of research funding applications and couple this with (i) a mentoring scheme using the experience of highly successful faculty, and (ii) carrying out a post-outcome review to improve applications. Exploit the records of professional activities in Element and the research management system Worktribe to identify the best reviewers for each grant application.
- Continue to aggressively support major research bids, through **match funding**, strategically prioritising research which aligns with key synergy areas and areas of significant strength.
- **Diversify our external research funding** by creating and appropriately supporting opportunities for working on industry-sponsored projects, consultancy engagements, and other non-standard forms of research or knowledge exchange activity, e.g. via strategic exploitation of HEIF money. In particular, we aspire to attract contract research and industrial collaboration. Our spin-out companies AMD and Universal Quantum offer valid examples.
- The newly established Excellence Centre in Quantum Technologies, DISCUS and the PJB-RCMA research centres will also **serve as a gateway for the translation of research** and a mechanism for **diversifying our research income.**
- Work to become a **"go-to place"** for academic and non-academic partners in our strongest research areas. In particular, we recognise the vital importance of interactions with the Innovation and Business Partnerships team and the Sussex Innovation Centre to facilitate and support our interaction with businesses.
- **Use cross-departmental, cross-school, national and international synergies for funding applications** to diversify research income streams and foster interdisciplinarity, exemplifying the University's ambition to 'reclaim our reputation as the university of choice for those committed to interdisciplinary research and engagement' (Sussex 2025)
- **Position ourselves to capitalise on key strategic funding opportunities.** Build on our successes by further developing interdisciplinary and international collaborations that will lead to access to an even wider range of funding bodies, enabled by strategic recruitments.
- **Engage and be proactive** in gaining nominations to panels/reviews of major research funders. **Actively participate** in funding intelligence committees at the University level.
- Ensure **networks are actively developed and maintained** and are appropriately utilised in marshalling collaborators to pursue key funding opportunities. This could be fostered by the strategic exploitation of devolved budgets.
- The QT Excellence Centre, DISCUS, PJB-RCMA research centres will play an important role in **developing local, national and international collaborations**, be it in fundamental or interdisciplinary research.
- Leverage our core expertise to take advantage of emergent nationwide interest in Quantum Technologies and Artificial Intelligence (see e.g. recent Centre for Doctoral Training in Quantum Information Science and Technologies, (QIST)).

5. Ensure transparent and reliable processes for the allocation of research resources following high standards of integrity.

TASKS:

- Establish **transparent processes** for the allocation of resources (match funding, impact funding, seed funding) as well as ensuring fair and open access to research leadership positions. The Research Strategy Group in Physics and Astronomy and the Mathematics Research Committee are the two advisory bodies that provide informed recommendations on the allocation of resources.
- Regularly review processes and policies to ensure **full compliance with equality, diversity and inclusion (EDI)** principles.
- Equality, Diversity and Inclusion (EDI) is fundamental to the school's culture and articulated in **our 7-point Guiding Principles**. Our EDI strategy builds on a strong University commitment; establishment of an EDI unit and the introduction of an institutional EDI Strategy.
- The School of Mathematical and Physical Sciences holds an Athena SWAN bronze award and EDI is overseen by the Director of Equality, Diversity and Inclusion. MPS has two Equality, Diversity and Wellbeing Champions. Notably, the MPS Director of EDI monitors and provides recommendations for all internal selection procedures.
- MPS also **operates flexible informal procedures**. For instance, any staff member can choose to work from home at any time if appropriate.
- MPS's strategy seeks to **recruit, support and retain the highest-quality researchers** irrespective of ethnicities, genders, sexualities, disabilities, ages and beliefs. EDI considerations are embedded in our recruitment procedures.
- **Equality and Diversity training is mandatory** for everybody, Unconscious Bias and Recruitment and Selection training is mandatory for staff involved in recruitment, thus fostering an **inclusive, supportive and transparent culture.**

6. Communicate, promote and celebrate research internally and externally.

TASKS:

- Support **impact generation and external engagement and communicate successes** through web, media, social media and bespoke publications.
- Develop a **stronger web presence for research**, focused around core themes while also linking with the research profiles of Departments and Centres, to ensure academic colleagues, potential collaborators, new potential staff, students, funders and policymakers are fully aware of the School's strengths and expertise. We advocate for appropriate Professional Service support for external communication.
- Create **research communication training programmes** to enable researchers to promote personal research more effectively and engage widely, both internally and externally.
- Promote **internal events** to celebrate the research successes of our School and share research interests and best practices.
- Instil a **culture that recognises and rewards** research success by communicating accomplishments widely and awarding prizes.
- Provide **regular and timely communication** about research topics through our quarterly research activity report, as well as producing an annual research report showcasing success across the School.
- Identify **central research themes** for the school and provide extra resources for their communication & promotion.
- Cultivate a **strong, coherent research identity** by actively promoting key synergy areas and high-performing research groups, consistently championing areas of core research strength.

7. Create a flourishing doctoral student cohort and dynamic PhD programme.

TASKS:

- **Research studentships** are the backbone of the research strategy of MPS as they enable the recruitment of high-potential young researchers, who in turn provide vital support to our research activities. We advocate for **strong and bold initiatives** to attract the best PhD students, via **aggressive match-funding** of PhD studentships and **financial support** for outstanding international students.
- Provide **comprehensive and attractive doctoral training programmes** that produce excellent research scholars in the spirit of the School's research programmes and engender the skills and experience required for today's hyper-competitive graduate market.
- **Grow the doctoral student cohort** by identifying innovative ways of funding studentships.
- **Lead Centres for Doctoral Training:** We are fortunate to have two CDTs in the School – DISCnet and the CDT in Quantum Information Science and Technologies (QIST). These bring a strong cohort of students and provide enhanced training and strong industry links.
- **Integrate doctoral students from the start into research groups** and the wider research community, allowing them a crucial role in contributing to the research culture of the School.
- Attract increasing numbers of **high-quality applications to the doctoral programme** by actively monitoring the programme's competitiveness against rival offerings.
- The University of Sussex has a set of approved **Principles to Govern Doctoral Studies**, which provide the university-level strategic framework for doctoral education. MPS is using these university-level principles to guide its post-graduate provision. Our doctoral research students are the main contributors to our research environment. Doctoral study thus plays a central role in our research strategy, underpinned by substantial investment and strong support structures.

Implementation

- The School DRaKE is responsible for the implementation of the measures set out in this Strategy. They will liaise with Head of School, HODs, Directors of Research in both Departments, Research Group leads/coordinators and research support staff to determine priorities, establish appropriate timelines and assign tasks accordingly.

- Departments are encouraged to develop/update their own research strategies in light of the above. Support is available from the DRAKE as well as Research group leads.

Appendix A: SWOT analysis

Context

These are times of unprecedented change in the external research funding landscape:

- UKRI active from 1 Apr 2018, along with OfS and Res England
- Brexit: implications for research talent and access to EU capital & research funds
- New strategic prioritisation by Government
- National sectoral disquiet around pensions, Equality, Diversity & Inclusion, HE culture & practices

Coupled with substantial internal changes:

- Institutional sensitivity to fluctuating student numbers
- Development & subsequent implementation of Sussex 2025

SWOT Analysis

Strengths

- Global reputation for research quality and impact
- Research excellence across a range of research areas
- World class academics: ability to attract and retain excellent staff
- High-profile Fellowships (enhances our international reputation, and attracts excellent early career researchers, especially through proleptic lectureships)
- Leadership in two Centres of Doctoral Training
- Relatively well-resourced to support research: dedicated research management team and annual research budget, department DRKEs and Impact Leads
- Great potential for inter-/cross-disciplinary working, within Sussex and externally
- Academic networks (SEPNET, NExT)
- Agility in growing and diversifying research income
- High-volume & high-profile public engagement activity, with strategic deployment of faculty

Weaknesses

- Decreasing funding for postdoctoral researchers
- Limited awareness of & responsiveness to external factors & global competition
- Close to critical mass in some areas, e.g. Materials Physics
- Under-investment in developing talent & skills pipeline at Masters, doctoral and ECR level
- Lack of developmental support for new investigators, ECR and junior faculty, training for managers needed.
- Lack of support for marketing our research to the wider world, e.g. contact with business is hampered
- Key faculty members leaving due to concerns from the University about fluctuating student numbers
- Lack of collaborative spaces
- Quality of peer support with grant apps, e.g. no college of reviewers
- Relatively small size of Departments: number of EPSRC studentships not meeting demand

Opportunities

- Uniquely placed to exploit new funding streams, e.g. UKRI Impact Acceleration Account, KTPs
- Great potential for developing more/better links with industry & external partners to leverage research funding
- Chance to strengthen interdisciplinary ties as UK and EU funding policy shift to mission focused approach
- Internationally renowned postgraduate teaching
- Closer links between Mathematics and Physics
- Interdisciplinary links across schools (e.g. Data Science and DISCUS) -needs coordination, formalization and strategic planning
- World-leading expertise in emerging research areas, e.g. Quantum Technology and Data Science
- Research placement programme
- Leveraging academic and alumni networks
- Innovation and Business Partnerships team to support KE activities (e.g. interaction with businesses and public engagement)
- More resilience to income fluctuations with the new faculty structure

Threats

- Political & regulatory factors: structural changes in HE market may lead to increased competition, greater regulation, loss of ability to cross-subsidise research from teaching, etc.
- Loss of key staff: this would risk viability of research groups, and will affect our reputation and research income
- Funding studentships – internally and grants
- Impact of NSS is disproportionate for STEM
- Funding per head for STFC science is reducing
- Challenging undergraduate recruitment environment, resulting in low student numbers

Appendix B: Overview on Research Strategy development process

- Research Strategy skeleton drafted jointly by School DRAKE with input from ResearchManagement Team (April 2021)
- Initial feedback on Research Strategy skeleton from leadership team and RDOs (June 2021)
- School-level research strategy presented to SMT during away day on the 7th of July 2021
- Publication of the School Research Strategy (end of July 2021)
- Directors of Research of both Departments are invited to use this to inform Departmental research strategies (1st of August 2021)
- Revised version of SWOT analysis drafted by DRaKE and Departmental Directors of Research (January 2024)
- Revised version of the strategy drafted by DRaKE, discussed with Departmental Directors of Research and distributed across the School (July 2024)

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