

Unifying the core and reaching out from the boundaries

BPSI Strategy Report and Business Plan

July 2016

Summary

This report briefly introduces the Biological Physical Sciences Institute (BPSI) and summarises BPSI activities over the three years since its inception (Summer 2013). Some achievement metrics are presented. It then outlines the key strategy of the BPSI. The alignment and contribution to the University Research Strategy is highlighted. The report makes a case for continuing and enhancing departmental support.

BPSI seeks support from its core stakeholder science departments (Physics, Biology and Chemistry) and the Research and Enterprise Directorate (R&E) under three headings,

- Administrative support and costs to support a new External Advisory Board (EAB) to meet annually.
- Administrative support for events, activities and the BPSI Steering Committee (20% FTE).
- Funding to support the BPSI programme of events and activities (£3,000 per annum).
- Part-funding for three BPSI summer studentships (£1,500 per annum).

The BPSI would like to put in place an annual review of the contributions and agreements of the core departments, involving both the BPSI Steering Committee (SC) and the new EAB.

Background

The Biological Physical Sciences Institute (BPSI) was established in the summer of 2013 and is led by Professor Mark Leake, Anniversary Chair of Biological Physics. Operations are overseen by a steering committee. BPSI is a virtual institute, whose primary goal is to enable collaborations to flourish and stimulate new research endeavours at the cutting-edge interface between the Physical and Life Sciences.

BPSI SC plans and oversees the management of the BPSI events and activities, and manages any BPSI funding. The members of SC represent the core departments and other collaborators, as well as the Pro-Vice-Chancellor for Research (PVCR) and the R&E.

The current SC comprises:

- Mark Leake: Physics/Biology (Chair)
- Christoph Baumann/Jennifer Potts: Biology
- Thomas Krauss/Roland Kröger: Physics
- Fiona Polack/Simon O'Keefe: Computer Science/YCCSA
- Alison Parkin/ Anne-Katrin Duhme-Klair : Chemistry
- Martin Bees/Jon Pitchford Mathematics/Biology
- Deborah Smith (PVCR)/Brian Fulton (Dean for Sciences)
- Rachel Curwen (R&E)

Association with BPSI is defined by researchers and academics from across the full range of stages of academic careers, from students and postdocs up to established group leaders and heads of departments, from who wish to share their research interests and contact details on the BPSI website. The current membership of ca. 150 includes staff and research students from across the University's Science Faculty, from the departments of Physics, Biology, Chemistry, Electronics, Mathematics, Psychology and Computer Science. There is a stable core staff membership of ca. 80 Principal Investigators (including academics on open contracts and academics on independent research fellowships who lead a research team).

BPSI receives financial support from the core departments (£500 each from Physics, Biology and Chemistry). This is matched by R&E, giving a total annual budget of £3,000 which supports all BPSI symposia and other activities.

In 2013-14, BPSI benefitted from an agreement with the Wellcome-funded C2D2 group, which contributed administrative time. However, from 2015, BPSI has relied on ad hoc administrative support, alternating between Biology and Physics, and focusing on organisation of the Symposia.

In 2013, BPSI received £50,000 in start-up funding from the University. This was used to support a competitive funding process.

BPSI Activity

The BPSI has an active community, evidenced by its website <http://www.york.ac.uk/physics/bpsi/> and social media presence.

Three half-day BPSI symposia are held each year, aligned with teaching-free windows at the end or beginning of each term. Each symposium has a theme that spans the interface between the Physical and Life Sciences. The Symposium Chair is a PI from the focus area of the event.

One (or sometimes two) high-profile guest speaker is invited, and related York research is presented. Posters allow wider coverage of the work of researchers, and there is a poster prize (judged by the external speaker(s)). After the main talks, there is a discussion forum, followed by an evening reception which is an opportunity for the BPSI members and visitors to meet, discuss their work, and establish potential collaborations.

The symposia have attracted 70 to 100 participants. Whilst many are existing BPSI members, we also attract new researchers, and about 10% of attendees come from other Universities (notably Durham, Sheffield and Leeds). A small number of industrialists typically attend.

Figure 1 Justin Molloy (Crick Institute) giving the keynote talk in 'Single molecule studies of cell motility and cell signalling' at the BPSI Symposium 2014: Forces in Biology, University of York.



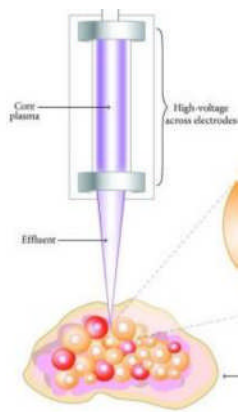
Symposia themes to date have explored: imaging across multiple length scales, mathematical tools to address life science questions, chemical biology research, the measurement and application of forces in biology, biological engineering approaches, and the use of light to study life. Future themes will continue to build on interdisciplinary research activity across the University, and are likely to focus on areas such as biophysical immunology and the biophysics of microbial infection.

In 2013-4, the University start-up funding supported six collaborative initiatives, with allocated funds ranging from £6k-16k per project, selected by BPSI SC. The projects funded involved principal investigators from four different home departments (Biology, Chemistry, Electronics, HYMS, Physics), with a cumulative total of 15 co-applicants from all projects, from a total eligible pool of ~80 academic researchers who were members of the BPSI at the announcement of the funding call. The scientific themes of the projects were broad, spanning multiple length scales of biological processes from single molecules through to cells, tissues and even whole ecosystems, and spanning multiple time scales from milliseconds through seconds, minutes and days. The projects included significant developments in experimental technologies relating in particular to novel methods of bio-sensing, but also included developments of novel analytical tools. All projects showed clear evidence for having utilized the allocated funds to establishing either new technologies or new methods (both experimental and analytical), and were all generally at a stage of generating

promising original preliminary results, appropriate for methods-type publications and larger scale external grant proposals.

Project	Applicants
BIO-SENS-A: Biologically-modified Surface ENgineered Silicon Arrays	Alison Parkin (Chemistry), Thomas Krauss (Physics) & Steve Johnson (Electronics)
Combining single-molecule force transduction and nanofabrication for investigating DNA molecular machines	Thomas Krauss (Physics), Christoph Baumann (Biology) & Mark Leake (Biology/Physics) & Peter McGlynn (Biology)
Construction and application of Selective Plane Illumination Microscope (SPIM) for large tissue imaging	Mark Coles (Biology/HYMS), Peter O'Toole (Biology)
Development of a high-contrast label-free imaging technique to study neuronal-microglial interactions in real-time	Peter O'Toole (Biology).
Job Hunting: Predators and Prey for Task Allocation in Swarm robotics	Jon Timmis (Electronics)
Probing DNA repair and recombination using single-molecule biophysics	Mark Leake (Biology/Physics) & Peter McGlynn (Biology)

Several of the co-applicants, and their extended research team members, had been invited to speak at research meetings (eight in total) at which results were disseminated for work funded by the BPSI. One of the projects successfully utilized funds to leverage a highly discounted cutting-edge microscope system at a saving of six months capital charges to the University (ca



£70k), as well as leveraging new recruitment through an externally funded masters student to work on this equipment. Eight new collaborations have been reported stemming from the funded project, two international, of academics not originally named in the proposals. Significant strengthening of the internal collaborative links between the applicants on the projects was reported as a result of the funding. Funding applications to external bodies involved six new research proposals requesting cumulative funds of ca £2.8M to BBSRC (three proposals), CRUK, EPSRC/MRC, EU and the Wellcome Trust. Several of these, as evidenced below in the 'BPSI metrics', were successful. BPSI was also directly involved in an EPSRC 2013/14 joint CDT bid with Durham in biophysics.

Figure 2 Plasma physics tools to destroy cancer cells [O'Connell (Physics), Maitland (Biology)].

BPSI Metrics

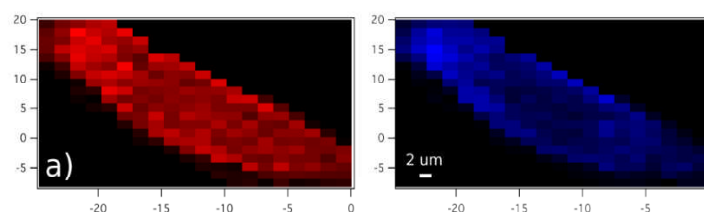


Figure 3 Developing Raman spectroscopy to probe bone cells [Hancock (Physics), Genever (Biology)].

Quantifiable outputs demonstrating the success of BPSI as an initiator of collaborative research on the interface of physical and life sciences are primarily successful research proposals. Some proposals (*) grew directly out of the work supported from the 2013-14 start-up funds (£50, 000). Others have arisen through the networking activities of the BPSI Selected highlights, listed in the University of York Pure database, and demonstrate the need for BPSI because of a strong cadre of academics in relevant areas. The list to date includes the following (FEC funds indicated). Two grants (#) below were not directly primed by BPSI activities but involved a significant co-I contribution from BPSI members.

1. * BBSRC, BB/P000746/1. 'Pushing proteins off DNA - how do helicases unwind protein-coated DNA?' 2016-19. £502k. [Peter McGlynn (Biology) & Mark Leake (Physics/Biology) BPSI members]
2. * EPSRC, EP/N027639. 'Programming DNA topology: from folding DNA minicircles to revealing the spatial organization of bacterial genomes' 2016-21. £748k. [Agnes Noy (Physics) & Mark Leake (Physics/Biology) BPSI members]
3. * MRC Discovery Award, MC_PC_15073. 'Biophysics of Infection and Immunity: From Molecules to Cells to Tissues', 2016-2018. £680k.[10 BPSI members]
4. * BBSRC, BB/N006453/1. 'Replication repair in real life: analysing how broken DNA replication machines are rebuilt inside cells', 2016-2019. £876k. [Peter McGlynn (Biology) & Mark Leake (Physics/Biology) BPSI members]
5. EPSRC Equipment bundle (EP/M028127/1) Technologies for the future. 2015. £1.4M. [Steve Johnson (Electronics) BPSI member]
6. Royal Society Wolfson Research Merit Award. Wavelength-scale biosensors..., £60k, 1/09/15-30/09/20. [Thomas Krauss (Physics) BPSI member]
7. * BBSRC (BB/L018160/1). Label-free, Real-time, Spatial-resolution (LRS) immunoassay. 1/06/14-30/09/15, £182k. [Thomas Krauss (Physics), Steve Johnson (Electronics) & Mark Coles (Biology) BPSI members]
8. # EPSRC EP/M027538/1. TARGeTED: Tackling Antimicrobial Resistance through Goal-orientated Thinking in the EPS Disciplines, EPSRC £403k, 2015-2017. [5 BPSI members].
9. # BBSRC/Innovate UK (Innovate UK application led by Unilever). Real-time visualisation and modelling of biofilm inhibition by lactam £100k total (£50k for York); plus further commitment from Unilever. 1/3/16 - 31/10/15. [Martin Bees (Maths) & Laurence Wilson (Physics) BPSI members]

Two extracts highlight the importance of the BPSI in stimulating successful interfacial grant proposals.

1. Mark Coles (BPSI, Biology/HYMS), PI of the MRC Bridging the Gaps grant (grant 3 above), states, simply, that “the grant builds on the success of BPSI”.
2. One of the industrial engagement activities stimulated by BPSI activities is evidenced in the following summary from Peter O’Toole, Director of the Technology Facility (Biology). This programme and collaboration arose directly from the BPSI start-up grant awarded to develop a high-contrast label-free imaging technique to study neuronal-microglial interactions in real-time.

We became the UK demo site for the Zeiss Light-Sheet microscope (£350k). This enabled the internal user base to gain free access to this system and was used by the groups of Betsy Pownell, Paul Genever, Chris Elliott, Sean Sweeney, Mark Coles, Gonzalo Blanco. Supported 4 students (2x MSc, 1x U/G), and saw multiple external engagements that helped increase our knowledge base and input to internal users. The loan was for around 9 months. Assuming a 5 year depreciation, this is worth around £50k, plus a service support of around £10k for that peR&Ed. We would usually do 10 years of depreciation, this making it ~£25k + ~£10k service = £35k of in kind access and usage... It also helped support the MPhys student who created the OpenSPIM system with input from Zeiss and invaluable cross comparisons made to check sample v instrument issues and overall performance rating. We did not charge for any external work as it was collaborative.

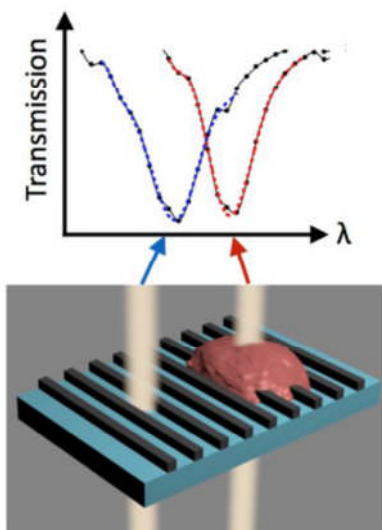


Figure 4 BIO-SENS-A:
Biologically-modified Surface
ENGINEERED Silicon Arrays
[Parkin (Chemistry), Krauss
(Physics) & Johnson
(Electronics)].

Following each Symposium the BPSI collated attendee feedback via the online Symposium registration system, used to assist in shaping future Symposia. For example chemical biology was a popular suggestion and indeed was the BPSI's most recent Symposium. The implementation of using posters as a focus for networking discussions also arose from member suggestions. More recently we also called for email evidence from different stakeholders, and had responses from senior external attendees, principal investigators and more junior researchers, a selection of which is indicated below:

From Professor Graham Leggett, Professor of Chemistry, University of Sheffield, Chair of the EPSRC funded 'Understanding the Physics of Life' UK network:

I think that the BPSI is an unusual centre, and that as such, it offers York the possibility to build a distinct but focussed activity at the biology/physical science interface. A lot of people would like to do this, of course, but not all are as well organised as you plainly are and importantly you seem to have a critical mass of people with interest and in yourself, a senior academic who has become the authentic cross-disciplinary animal. So this is all good. I would say that there may be opportunities for regional engagement in this area, and leadership by the BPSI might be valuable. We have our own activities in Sheffield, but perhaps there is the possibility to do something across Yorkshire in this area. Just a thought. I guess that you need a certain amount of core funding the BPSI's activities to remain viable. I would have thought that if enough new grants were arising that could be attributed to BPSI members, an argument could be made to the University that a small amount of cash for partnership building would pay a dividend. Whether they would be enlightened enough to see it that way is another matter, of course - we all know what universities are like...

From Professor Andrew Turberfield, Professor of Physics, University of Oxford, former Chair of the Institute of Physics Biological Physics Group:

My lasting impression is of the audience for my talk – large, lively, interested and clearly very broad. If you can keep up that level of interest across the sciences you will be doing well.

From Dr Justin Molloy, Head of Single Molecule Enzymology Laboratory, Crick Institute, London:

*1) very impressive list of academic staff...to BPSI ... broad range of expertise across physical sciences and quantitative biology. 2) Good time now to develop the strategy...
TEACHING: A) new (recycled) - BSc 3rd year option courses? B) Interdisciplinary Masters Course... at "York Level" you have plenty of local expertise. C) PhD programme... our 4-yr WT-UCL/Birkbeck/NIMR PhD in structural, chemical and computation biology was very successful ... could have wider involvement... Leeds/Sheffield/HYMS (MD/PhD?) Is there already good involvement at Graduate/post doc level do you think? ...
RESEARCH: A) Pump-priming funds - you have this already and it seem to work well.. can this be extended and also broadened?... B) Ways to develop interdisciplinary research collaborations.... perhaps via new technologies/ methods?....apply to Leverhulme? C) Need a*

way to get people to apply for joint project funding.... this could be by encouraging specific interactions via seminar program. And then perhaps 1 or 2 more focussed groupings... Protein-DNA interactions // Cell biophysics/mechanics // Optically-based methods// surface chemistry// etc..... You have very good strength in bio-imaging, single molecules/structural biology/optical techniques. Are there any really big pots of money in the offing?... can you position yourselves to access such a call or maybe approach Research Councils in a responsive mode. Assemble (matchmake) research teams (groups of maybe 2->5 PIs) that could apply for Wellcome Trust Collaborative awards. You already have a steering group - how wide is the representation... do you have sufficient membership/input from across the Academic Departments. You have an annual symposium and other meetings - this is good – what else could be done to strengthen links (maybe focus efforts on building links with White Rose consortium + Durham)?

From Professor Martin Howard, Project Leader of Computational and Systems Biology, John Innes Centre:

Indeed it was a very enjoyable visit! I felt I got a good sense of what was going on in York. In particular the symposium format of an external speaker coupled with several shorter internal talks worked very nicely. Steer for the future: go on doing it; there isn't nearly enough of this style of interdisciplinary seminar in the UK.

From Professor Bruce Turnbull, Chemical Biology and Medicinal Chemistry Group, Astbury Centre, University of Leeds.

I really enjoyed my visit to York and it was very interesting to see such a diverse range of science that is ongoing there. I think the meeting format worked well and looked like it was bringing people in York together to discuss science. From past experience in the Astbury Centre, one thing you might want to consider (sorry if I am telling you something that you are already doing...) is to get the students and postdocs organising social events for the whole centre. This does need people to really buy into it until events are running routinely, but it helps make sure that everyone from the students upwards feels that they have ownership of the Centre.

From Professor Mark Howarth, Biochemistry Dept, University of Oxford:

I enjoyed a lot the internal and external talks and it was nice to chat to the poster presenters. Best of luck with it.

From Dr Mark Coles, senior lecturer HYMS/Biology, University of York:

BPSI has had a critical role in the successful MRC Discovery award. This grant was successful and we are in the process of hiring 4 postdoctoral scientists. This grant involved a number of PIs who are active members of BPSI... I was an applicant on a university pump priming application led by Steve Johnson on digital microfluidic devices that have the potential to provide game changing technology in the development of new therapeutics.

From Dr Laurence Wilson, lecturer Physics Dept, University of York:

The BPSI seminars have been genuinely useful in suggesting new applications for our microscopy and imaging techniques, thanks to questions and comments from the audience.

From Dr Agnes Noy, EPSRC Research Fellow, Physics Dept, University of York (attracted to York from Leeds through attending BPSI Symposia):

About BPSI symposiums: I think they are totally great!! Length, timing, frequency and speakers!! I really enjoyed talks from Bruce Turnbull, Martin Horward and Mark Howarth

From Dr Adam Wollman, postdoc Physics/Biology Depts, University of York:

I think the BPSI is essential for doing interdisciplinary work at York. I've interacted with many people from many different departments which I would not have done otherwise at the Symposia. These also provide a relaxed forum to talk and discuss with existing colleagues and collaborators.

From Mr Zhaokun Zhou, PhD student, Physics Dept, University of York:

I greatly enjoy both the symposiums and the clubs since they offer high relevance to my own project as well as the convenience of being in York campus. But would it be more productive if every attendee submits a short paragraph or even a sentence of what his/her interests is pR&Er to the symposiums and has the intro accessible to all attendees. This can be done either by print or a time-limited URL. The latter even allows the attendees to edit the personal info during the events (I imagine many will be busy/negligent enough to wait till the event to write). Another thought is that the advertisement of events can go beyond York. I do not meet many students working in spectroscopy for example. It would be nice to be able to meet them during the symposiums. I assume others would like to meet their 'competitors' from other institutes as well.

BPSI future strategy for 2016-21

Over the next five years the BPSI proposes to:

- Build on the current successes, through the unified core cohort of interdisciplinary PIs, to ensure that York can respond to interfacial funding opportunities in an agile and timely manner.
- Reach out to new potential BPSI members by targeted activities at the physical/life sciences interface.
- Continue its role in promoting new research opportunities (the mailing list has proved to be a powerful and valuable tool), and seek to develop better awareness of upcoming opportunities and initiatives, by providing support and opportunities for members and liaising with the Science Faculty and the University Research Theme champions.
- Through its membership and activities, to seek to influence the national (and international) research agenda at the physical and life sciences interface.
- Aim to nurture our emerging activities with an expectation for developing international-level recognition for the BPSI with the explicit intention of improving the success of future large scale interdisciplinary research grant proposals and assisting to enable relevant interdisciplinary CDT bids.

BPSI is one of many components in the University's interdisciplinary research focus. However, whilst many of the current initiatives struggle to maintain momentum and participation, BPSI's light-touch approach has been successful in maintaining an active membership. It is a highly cost-effective forum that will continue to provide significant return on investment. BPSI aligns well and, through its members, contributed directly to strategic objectives at University and national level.

From the University Strategy (<http://www.york.ac.uk/research/strategy/>), BPSI aligns well with most of York's bases for research success, as follows.

- Research excellence: BPSI has provided a forum for the top science researchers at York to come together, to identify synergies, and to progress the University's interfacial research in new and exciting way that are at the forefront of physical and life sciences research. This is evidenced by the proposals and grant income listed above, and by the publication records of the BPSI members, linked to the website. Whilst we cannot claim that BPSI is the sole reason for these initiatives, its regular symposia, website and social media, as well as regular mailouts to members, provide the physical and virtual basis for initiating and developing these collaborations.
- Innovation: BPSI start-up grants required proposers to make a case for why conventional funding was not available, and, like C2D2, sought to support initiatives that would underpin innovative research going forward. Since 2014, BPSI has had no direct control on the "innovativeness" of its members' work, but again, the range and quality of

funded programmes bears witness to our leading role in underpinning and catalysing innovative research.

- International perspective: BPSI is firmly rooted in the York departments. Its claims to internationalisation are through its members' profiles and through the excellence of the work it is catalysing.
- Impact: whilst BPSI has only been in existence since 2013, we can claim some small impacts already, notably in the collaborations with Zeiss that arose from the start-up funded project, noted above. Interfacial work of the sort that BPSI is catalysing has the potential to create significant impact, both in the core departments, and in the collaborating departments (e.g. Mathematics, an area that can find it hard to evidence impact outside the collaborative context).
- Collaboration and partnership: again, drawing on BPSI-catalysed accepted proposals, we can see productive collaborations involving at least 20 investigators. Many of these groupings were formed at BPSI events or through links made via the BPSI steering committee. Notably, for instance, Mark Coles, Steve Johnson, and Thomas Krauss. Also Mark Leake and Peter McGlynn who received BPSI funding and used the preliminary results obtained to secure two BBSRC grants together. And similarly, attracting independent research fellows to the University (Agnes Noy, Physics, who wanted to be hosted in York on her 5 year EPSRC research fellowship 2016-21 primarily on the back of the activities of the BPSI). However, BPSI's catalysing activities, through the Symposia format, the website and social media, provide an excellent informal platform for generating new and previously unforeseen partnerships. Whilst many BPSI-catalysed activities are truly interdisciplinary, there are also collaborative initiatives within traditional disciplines, which serve to strengthen and "publicise" the 'core' of York interdisciplinary science researchers; many of which are in areas badged by funding councils as being explicitly 'interdisciplinary' per se, but also serve to significantly assist in establishing a 'core' of York based interdisciplinary researchers. Although BPSI does not have a significant direct presence outside the University, the initiatives that develop, and the high profiles of those participating attracts outside interest and new collaborators.
- Integrity: apart from citing the track record of BPSI members, we should note that integrity in research is fundamental in the life sciences, and the strong ethical underpinnings of life sciences research at York can only be a positive influence on BPSI catalysed collaborative research.

In terms of the key University research themes, a simplistic alignment is to the "Technologies for the Future" theme led by BPSI SC member Thomas Krauss. Many of the funded initiatives that BPSI can claim a role in concern new technologies which bring together expertise from several traditionally-separate areas. There is also a hidden pool of collaborations that match this theme, that have not yet produced grants or high-profile publications. For example, interactions

between Mark Leake, and Tony Wilkinson and Fred Anston (YSBL) stimulated from an initial discussion focused on a poster at a BPSI symposium.

More generally, like other groups in the University (e.g. YESI, C2D2, YCCSA), BPSI members themselves recognise alignment with most, if not all of the theme areas. For instance, members in Biology, Electronics and Computer Science work on simulation and analysis approaches that both draw on and contribute to the “risk” theme, through the need to evidence the fitness for purpose of their approaches in ways that the traditional research community can access and understand. BPSI is perhaps the least formal, but arguably the highest participation grouping underpinning the (scientific) interdisciplinary initiatives that these themes seek to develop going forwards.

Beyond the University of York, the existence of BPSI aligns well with the future of science. The Nurse Report¹ (2016) highlights the need to support existing and new research at the interdisciplinary interfaces, with a specific recommendation to manage cross-cutting funds for multi- and interdisciplinary research. The Lord Stern Call for Evidence² (2016), which called for evidence of the research excellence framework, gathered data for the role of quality-related research funding in the UK, and has highlighted ‘multi and interdisciplinary research’. Research council strategies seek to increase investment in interdisciplinary research in areas aligned with the activities of the BPSI, such as cross-funding involving MRC, BBSRC and EPSRC for next-generation imaging, antimicrobial resistance and ‘bridging the gaps’ between disciplines in biomedical science: BPSI members are involved in successful bids under all these initiatives. The recently published Stern Review³ clearly highlights the importance of interdisciplinary research, for example (p28) to enable ‘researchers to explore longer-term and riskier projects such as the development of new collaborations to undertake interdisciplinary research’

The key challenges -- language, funding and conflict with intra-discipline research practices -- of interdisciplinary research are highlighted by the British Academy Working Group on Interdisciplinarity⁴ (2016). The BPSI symposia provide a successful forum to ‘translate’ the language of different disciplines. This has led to new, unusual research collaborations, and catalysed research and funding proposals that bring together complementary expertise.

¹ Sir Paul Nurse, 2016. A Review of the UK Research Councils. BIS/15/625, 1-33.

² Lord Nicolas Stern, 2016. Lord Stern’s Review of the Research Excellence Framework. Call for Evidence. IND/16/1, 1-10.

³ Lord Nicolas Stern, 2016. Building on Success and Learning from Experience. An Independent Review of the Research Excellence Framework. IND/16/1, 1-56.

⁴ David Soskice et al. 2016. Crossing paths: Interdisciplinary institutions, careers, education and applications. British Academy Working Group on Interdisciplinarity, 1-108.

BPSI Funding proposal and business case

Now that BPSI has an established presence, both virtually and through physical events, the BPSI SC is proposing to establish a small but hopefully influential EAB. The aim of the EAB will be to provide independent and external support and advice to the BPSI and its membership on future innovations, collaborators, and Symposium topics.

The benefits that we seek to gain through an EAB, however, would also include

- Raising the profile of BPSI, its members, and the interfacial potential of the University of York, through directly engaging people who are themselves influential in the wider community.
- Providing direct input on emerging research opportunities, complementing the strategic and policy insights gained from involvement of existing members with national and international funding bodies and research councils
- Navigating the BPSI through a transitional period over the next ca. five years from being primarily an inward-facing institute from its current state into a an outwardly embracing and sustainable centre which directly assists its members in generating competitive larger scale research grant proposals.
- Helping to shape BPSI into a larger scale centre with large, regular research income streams and greater interactions with industry.

Assuming that the following administration and funding proposals can be met, BPSI SC will seek a 5 to 7 high-profile and influential EAB members, from industry, and academia, as well as from key funders and promoters of interdisciplinary collaborative research. Several BPSI members already have valuable links which can be used to encourage membership onto the EAB, for example with Wellcome Trust, White Rose Consortium partner institutions, Durham University's Biophysical Sciences Institute (BSI) "BPSI" and the Institute of Advanced Study (IAS), links to external companies such as those engaged already in collaborative work with the Technology Facility, as well as parallel membership on valuable learned society steering panels such as those of the Institute of Physics, the British Biophysical Society and the Royal Microscopical Society.

The BPSI has been an incredibly successful investment, driven largely from the bottom-up by the enthusiasm of its core members. Start-up funding of £50,000 has resulted, directly or indirectly, in grants totalling over £5 million, much of it FEC funded.

To continue to support interfacial activity and income generation into the future, BPSI seeks resourcing, from the core departments, under three headings.

- Administrative support for Symposia and other activities, the Steering Committee, and the proposed EAB (20% FTE).
- Funding to support the BPSI Symposia and activities, as well as the costs of external members attending annual meeting of the EAB (£3,000 per annum).
- Support for two BPSI summer studentships, co-supervised by 2 or more BPSI members representing an interfacial area. The model we propose is to provide a total stipend of £1,000 per student, made up of £500 from BPSI funding and £500 (plus any other costs of the studentship) to be contributed by the co-supervisors.

Administrative support

As an entirely virtual organisation, the BPSI has no estate costs. . However, the administration of its Symposia and activities requires administration beyond that which can be provided by membership and core departments.

BPSI is seeking to formalise the current *ad hoc* arrangements. We propose that the core departments (Physics, Biology, Chemistry) identify or fund administrative resources for BPSI, amounting to 20% FTE at administrative grade 4.

The key uses for this administrative support are:

- Arranging date and location for a maximum of three BPSI SC meetings per annum.
- Arranging and servicing the EAB annual meeting.
- Co-ordinating date and location for each Symposium; booking rooms and refreshments.
- Making arrangements for Invited Speaker(s) for each Symposium.
- If BPSI funding is available, co-ordinating applications and funding arrangements, as well as prompting for and collating outputs of funding.
- Overseeing administrative arrangements for newly proposed BPSI summer student internships.
- Coordinate the emails about opportunities etc. to the membership

Since appropriate administrative staff are likely to exist already it may be that a pragmatic approach for the stakeholder departments would be to formalise cover from existing staff. However, for completeness a draft job description is attached to the end of this report.

Support for Events and Activities

The BPSI symposia are valuable networking events, as well as showcasing the interfacial research of the Physical and Life Sciences at York. The FEC budget for each symposium,

including the expenses of invited external speaker(s), badges and advertising costs, and refreshments at the networking breaks has been no more than £1,000.

Costs for EAB (with its envisaged outreach and impact roles) will comprise expenses for members travelling to York, and the EAB lunch during the one-day annual meeting.

Support for BPSI summer interns

The BPSI receives many email enquiries from science students seeking summer research experience on the interface of the Physical and Life Sciences. BPSI members would like to be able to take advantage of this evident demand. Summer students have been shown to be an effective way of developing new collaborations and novel research areas, through the necessity of supervisors interacting. BPSI has reviewed summer schemes, including YCCSA's summer school and the existing summer programmes in Biology, Physics, Chemistry, and Maths. The summer school model undoubtedly provides a deep introduction to interdisciplinary research, but requires staff and administrative resourcing. The lightweight summer-studentship models of the departments are flexible and attractive. We envisage that the establishment of summer interns will also serve to stimulate engagement with the Nat Sci – Biophysical Sciences undergraduate programme in York. For example, engagement via summer research project and/or BSc/Integrated Masters project offerings, and a prize for 'top' final year UG/integrated Masters dissertation at the physics and life sciences interface.

BPSI proposes that it be accepted as a partner of the departments operating summer-studentship schemes, allowing it to bid for internal funding, and to promote its projects through the participating departments. We believe that this requires a memorandum of understanding to be negotiated the core departments, and with any other departments that wish to collaborate in studentships in the Physical and Life Sciences. BPSI would commit to engaging with its membership to develop its own funding for interns, which would, in turn, be available to help support departmental interns working on interfacial projects.

We propose that the stakeholder departments of Physics, Biology and Chemistry each contribute £500 annually in subsidy towards three summer intern stipends, or given the option to instead dedicate an allocated summer studentship from an existing departmental pool to the BPSI. The three summer studentships will be awarded through a competitive process following a model similar that that currently employed by YCCSA. A successful summer student project will require minimally two co-supervisors from different science departments of the University, and must be judged by the BPSI SC to be within the stated remit of the BPSI. The expectation is that three studentships will be awarded, with the BPSI contributing at least £500 to the stipend

of each with an expectation that co-supervisors will top this up to levels commensurate with departmental summer studentship levels from their own funds.

Summary of funding requests to the stakeholder departments and the Research and Enterprise Directorate

The BPSI proposes to formalise the existing *ad hoc* arrangement that each core department commit annual sum per annum in contribution to cover to BPSI, and that the R&E match funding committed by the departments. To expand the activities of the BPSI we propose to fund the BPSI core networking activities from the existing £3k annual budget, and to cover reasonable costs of the newly proposal annual EAB meeting from within this £3k budget, to be contributed as £500 from Physics, Biology and Chemistry stakeholder departments, and matched by £1,500 from the R&E. To subsidise the three newly proposed summer internships we propose an additional contribution of £500 from Physics, Biology and Chemistry stakeholder departments respectively, or the departments offered the option to allocate a summer internship dedicated to the BPSI from its existing pool. Thus, in summary, an annual contribution of £1.5k from the R&E, plus £500 from each of Physics, Biology and Chemistry Departments, plus either an additional £500 or a dedicated annual summer internship from each of Physics, Biology and Chemistry Departments, in addition to the provision of minimal but reasonable administrative to cover to be provided from each stakeholder department which will alternate annually.

Professor Mark Leake, Director of the BPSI on behalf of the BPSI SC.

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