

**Inquiry into Australia's international research collaborations:
Submission on
*International Centres in Theoretical and Mathematical Physics, with specific reference to the Asia-Pacific
Centre for Theoretical Physics***

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1. The nature and extent of existing international research collaborations

The Strategic Plan for Physics developed by the National Committee for Physics and published by NBEET in 1993 identified the need for Australia to develop a National Institute for Theoretical Physics (NITP) to foster domestic and international collaborations in theoretical physics leading to Recommendation 34: "A National Institute for Theoretical Physics should be established to coordinate a research network for theoretical physics. This would involve the universities, public research bodies and industry. It would organise formal visitor programmes and workshop and consolidate the theoretical base of experimental research programmes."

The fact that no funding mechanism capable of funding such an Institute on an ongoing basis has ever been identified points to a systemic gap in Australia's research funding framework.

On the other hand, in 1996 the government of Korea took the important initiative of creating an Asia-Pacific Centre for Theoretical Physics (APCTP), with an annual budget in excess of USD1M. Despite the fact that the Koreans have provided nearly all the funding for the APCTP, it has always been run as an international centre, with a non-Korean President.

Australia has been a partner in the APCTP since its inception, with a token subscription of USD10K per year. This is less than 1% of the APCTP budget, but in some years Australia has failed to raise even this amount. Furthermore the subscription funds have always been returned to Australia to help sponsor workshops and summer schools, badged as External Activities of the APCTP. Thus the comparison between Australia and Korea in relation to funding for the theoretical and mathematical enabling sciences is stark.

Australia has also contributed a member to each of the two governing bodies of the APCTP, the two current members being the authors of this submission, Paul Pearce and Robert Dewar. The submission reports on recent developments in the APCTP that may provide opportunities for enhancing Australia's participation in the rapidly expanding Asia-Pacific research community.

The specific developments referred to are the appointment of Emeritus Professor Peter Fulde of the Max Planck Institute for Complex Systems (MPIPKS) as President of the APCTP, and his visit to Australia in late November 2009 to discuss Australia's role in the APCTP.

Professor Fulde was founding Director of the MPIPKS when it was set up in Dresden, in the former East Germany, and built it up to be a hub for international collaborations in modern aspects of theoretical physics and related areas of research. He is translating the innovative approaches he developed at MPIPKS, such as the Junior Research Groups program, to APCTP.

2. The benefits to Australia from engaging in international research collaborations.

Other submissions will no doubt address this topic more generally. In the context of the APCTP, given the rapidly growing research strength of Korea, China and India, and the well-established strength of the Japanese (all APCTP members), our economic links to the region, and the relative geographic proximity of Asia, it seems manifestly clear that Australia should build research collaborations with this region.

3. The key drivers of international research collaboration at the government, institutional and researcher levels.

Ongoing, consistent government commitment is crucial to international research centres as such centres are built over decades. (The Kavli and Perimeter Institutes have endowments from private benefactors, but government support is still critical.) Consistency is particularly important in building links with Asia.

At the researcher level, such Centres operate by hosting a few long-term researchers and many more shorter term early career and postdoctoral researchers, and also by fostering research networks that bring researchers together in focussed workshops, sometimes lasting for periods of several months. The research topics change continually according to developments at the frontiers of research, and are usually initiated and organised by researchers not permanently at the Centre.

4. The impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these.

The centres of the type referred to in §3 are not short-term, focussed projects like Centres of Excellence and Co-operative Research Centres, so they do not fit within existing ARC funding programs. Apart from some small amount of ARC seed funding in the 1990s for a National Centre for Theoretical Physics as a pilot for an NITP, the ARC's Research Networks scheme has been the closest match (in spirit at least) to the kind of funding scheme required. In fact the ARC Complex Open Systems Research Network, COSNet, provided some limited support to maintain Australia as a financial member of APCTP for three years. However, funding for the entire RN program terminated in 2009 and there are no indications it will be revived.

Professor Fulde, during his visit to Australia in November last year, met with representatives of the ARC, including an Executive Director, Professor Phyllis Tharenou, and described his vision for building the APCTP in a partnership between Korea and the other APCTP member countries. Professor Tharenou explained the ARC Act precludes support for ongoing subscriptions to international bodies.

She did however suggest that an initiative to build the relationship between Australia and the APCTP might fit within the Learned Academies Special Projects Scheme (LASP), and a LASP proposal (see Appendix I) was accordingly submitted to the Academy of Science (AAS) on 27th of November, 2009. However, this was too late to be included in the agenda for the AAS Executive Committee meeting in early December and the AAS did not support putting the proposal to the ARC. There will not be another LASP round for three years.

Thus, in the immediate term, a practical measure for avoiding collapse of Australia's engagement with the APCTP would be to encourage the ARC to support an initiative similar to that proposed in Appendix I and to amend the ARC Act to allow it to continue to support Australia's membership of APCTP on an ongoing basis. Alternatively, this could be done via the International Science Linkages program within DIISR.

5. Principles and strategies for supporting international research engagement.

The overall principle is that research networking is an integral part of a healthy national innovation system. (See Appendix II.)

The strategies we propose are two-fold:

1. Support the development of a broadly based Australian National Institute for Theoretical Physics for both domestic research collaborations and to act as node in an international network of like centres.
2. To build the relationship with the APCTP along the lines recommended in §4 and Appendix I.

Appendix I: LASP Proposal 27 November 2009

Learned Academies Special Projects (LASP)

Administering Organization: Academy of Science

Collaborating Organization:

Asia Pacific Center for Theoretical Physics (APCTP): <http://www.apctp.org>

List of Researchers:

Prof. Robert Dewar FAA, ANU (Current member of APCTP General Council)

Prof. Erich Weigold FAA, ANU (Former member of APCTP General Council)

Prof. Bruce McKellar FAA, Melbourne (Former member of APCTP Board of Trustees)

Prof. Paul Pearce, Melbourne (Current member of APCTP Board of Trustees)

Prof. Peter Fulde, Max Planck Institute for the Physics of Complex Systems, Dresden (President, APCTP)

Prof. Seunghwan Kim, POSTECH (Executive Director, APCTP)

Title of Research Project: Asia Pacific Initiative in Theoretical Physics

Research Themes: Advancement of Australian research

- i. National and international collaboration in research
- iii. Professional development for early and mid-career researchers

Research Themes: Substantive research topics

vii. Australia and the Asia-Pacific region

ix. Other areas – theoretical physics

The “other areas” research theme is subject to approval by the ARC but Phyllis Tharenou (Executive Director, Program Coordination, ARC) sees this as fitting within the LASP scheme and strongly encouraged the application.

Summary Description:

International centres, such as the Kavli Institute in Santa Barbara, Isaac Newton Institute in Cambridge and ICTP in Trieste, are the focus of international efforts in research collaboration and training in Theoretical Physics. Unfortunately, Australia does not have such a Centre for Theoretical Physics. It is therefore of vital importance that Australia fully and actively participates in our regional centre – the Asia Pacific Center for Theoretical Physics (APCTP) based in Pohang, South Korea. The aim of this program is to strengthen Theoretical Physics in Australia by extending research cooperation with the APCTP and jointly training Australian early-career researchers in theoretical physics.

National Research Priority: Frontier technologies for building and transforming Australian industries

Priority Goal: Breakthrough science

FOR Field of Research Classification:

0204 Condensed Matter Physics 40%
0206 Quantum Physics 40%
0299 Other Physical Sciences 20%

International Collaborating Countries: (APCTP Member Countries)

South Korea, China, Japan, Taiwan, India, Vietnam, Malaysia, Thailand, Philippines, Singapore, Lao, Mongolia

INDICATIVE BUDGET Yearly Budget x 3 Years

Personnel: 2 x Australian Postdoctoral Research Fellows @ 50%	3 x \$86,000
APCTP Membership	3 x \$11,000
Travel (RFs Relocation + Listed Researcher Visits to APCTP)	3 x \$10,000
Total Requested Funding	\$321,000

APCTP Commitment: (In addition to provision of facilities and infrastructure)

2 x Australian Postdoctoral Research Fellows @ 50% 3 x 90 million Won

• The APCTP membership fee of US\$10,000 is returned to Australia to support external APCTP activities such as research workshops and summer schools held in Australia.

PROJECT DESCRIPTION Asia Pacific Initiative in Theoretical Physics

Aims, Significance and Outcomes:

The aim of this program is to strengthen Theoretical Physics in Australia by extending research cooperation with the Asia Pacific Center for Theoretical Physics in Pohang, South Korea and to jointly train Australian early-career researchers. The Korean government has recognized the importance of Theoretical Physics as a driver of a modern technological economy and has invested heavily in the APCTP. The Max Planck Institute has recognized the rapid growth of science in the Asia-Pacific by investing in the formation of Junior Research Groups at the APCTP. Many member countries of the APCTP do not have a strong tradition in science. As scientifically advanced nations in the region, it is incumbent on countries such as Japan and Australia to offer leadership and fully and actively participate in all of the activities of the APCTP. This program would provide valuable postdoctoral training for two Australians placed in the young and dynamic Junior Research Groups (JRG) consisting of and led by early career researchers (ERCs) at the APCTP. These positions would be 50% supported by the APCTP. The Australian Research Fellows would be mentored by visits from the listed senior Australian academics. The outcome would be stronger scientific ties within the Asia-Pacific region.

Approach, Methodology and Governance:

Two Australian Research Fellows would be chosen by the listed researchers in consultation with the APCTP and placed in one of the following:

APCTP Independent Junior Research Groups: (Current groups – more are being formed)

- Modern field theoretical methods in condensed matter physics: Leader: Prof. Xin Wan (China): topological order, gauge theories, fractionalization, entanglement. Current group members include Hyun Jung Lee (Korea), Ki Hoon Lee (Korea), Zixiang Hu (China).
- Multiscale modeling in condensed matter physics: Leader - Prof. Xin Zhou (China): Ab initio electronic structure theory especially based on wavefunction methods, embedding, microstructures, shape memory materials. Current group members include Shun Xu (China), Linchen Gong (China), Shijing Lu (China).
- Other groups working on topics in field theory, string theory and statistical mechanics. These groups currently include 4 researchers from Japan, 2 from Korea, 1 from China, 1 from Vietnam and 1 from the US. There are presently no researchers from Australia.

The JRG leader and Prof. Seunghwan Kim would take charge of the day-to-day supervision of the Australian Research Fellows. Peter Fulde is an internationally recognized expert on these topics and spends 3 months a year at the APCTP. The recently refurbished APCTP facilities are excellent. Because of its international character, the working language of the APCTP is English. Most of the APCTP staff speak English and are very helpful. While it is desirable to place Research Fellows in Asia, it is still not easy for foreigners to live and work productively in Asia. For these reasons, it is important to have supplementary guidance and mentoring coming from regular visits to the APCTP by the listed senior Australian researchers. These scientists have supported the APCTP and made regular visits over many years. The increased activity and frequency of visits will greatly increase collaboration between Australia, the APCTP and countries in the Asia-Pacific region.

Appendix II:

Review of the National Innovation System, 2008

Submission from the ARC (/ NHMRC) Research Networks

Authors:

Robert Dewar Convenor, ARC Complex Open Systems Research Network (COSNet)
Leah Boucher Network Manager, Fluorescence Applications in Biotechnology and Life Sciences (FABLS)
Matthew Carroll Program Manager, ARC/NHMRC Research Network in Ageing Well
Robert Dale Convenor, ARC Research Network in Human Communication Science (HCSNet)
Marimuthu Palaniswami Convenor, ARC RN on Intelligent Sensors, Sensor networks and Information Processing
Ann Sanson Coordinator, ARACY ARC/NHMRC Research Network - Future Generation
Kevin Bryant Visiting Fellow, Innovation Management and Policy Program National Graduate School of Management (NGSM) Australian National University Chair, COSNet Management Committee

Organisation: This submission has been prepared on behalf of all 24 ARC/NHMRC funded research networks (see the list in Appendix A)

Type of organisation: Not for profit research networks funded by ARC/NHMRC

Address: C/- ARC Complex Open Systems Research Network Department of Theoretical Physics Research School of Physical Sciences and Engineering Building 59 ANU COLLEGE OF SCIENCE
Canberra ACT 0200

State or Territory: The Networks operate throughout all States and Territories in Australia

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Declaration of Interest:

All of the authors gain professional benefit through the activities of one or more Networks and the Convenors/Coordinators/Managers have part or all of their salary paid via the ARC/NHMRC grant to their Network.

Introduction

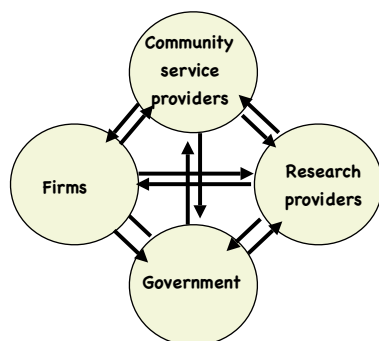


Fig. 1 The four subsystems of the national innovation system and the interaction pathways between them (adapted from p. 5 of the NIS Call for Submissions).

Strong interactions between (and within) the subsystems of the National Innovation System (NIS) are crucial to its effective operation, as shown in Figure 1.

This need is recognised in the NIS Call for Submissions by its identification of “Networking and collaboration problems” as a potential systemic weakness in an innovation system.

In an initiative to address this issue, the Australian Research Council (ARC), in some cases jointly with the National Health and Medical Research Council (NHMRC), in 2004 provided funds to set up and operate 24 Research Networks for five years.

This submission is the result of discussions between representatives of these Networks in Melbourne, Sydney and Canberra, aimed at identifying the many ways in which the Networks are contributing to the NIS, and pointing out the high risk of failure of the ARC/NHMRC’s initiative unless a plan for its continuation is urgently developed.

We submit that:

1. Another competitive round of the Research Network program should be called after the ARC completes its current review of the program, with increased funding to address critical areas.
2. The ARC and NHMRC should provide bridging funding for the existing Research Networks until funding of those successful in the new round can start.
3. Funding to the ARC and NHMRC should be increased to allow this to happen.

The Scope and Impact of the Research Networks

The 24 Research Networks are listed in Appendix A. They span all areas of research, from the physical sciences through social sciences to the humanities, and are funded to promote *interactions* (see below), both within the Research Provider subsystem and between researchers and the other subsystems of the NIS (as well as international interactions, which are crucial in this globalised world).

Research *projects* and *personnel* are funded through other programs of the ARC and NHMRC. The Research Networks are not funded to do research but to facilitate, enhance and leverage it. They can be very large and broad, often with many hundreds of participants, and are funded at quite modest levels, so that most participants benefit only indirectly. In these respects they differ from the European model for Research

Networks, funded through the Framework agreements, which combine networking and research funding roles.

In summary, we see the primary advantages and accomplishments of the Research Networks, in relation to the Review's priorities, as addressing three key requirements for innovation:

Gathering and exchanging information. The Networks have provided a mechanism for national mapping of research activities, knowledge and capacity in their particular domains. They are useful for identifying and enhancing areas of potential strength as well as gaps and weaknesses. They have built strategic research agendas aligning emerging research directions with national and global priorities. Networks effectively act as service directories and data warehouses (providing access to datasets and other infrastructure), thereby reducing transaction and instrumentation costs and increasing effectiveness.

Facilitating collaborations. A key factor in promoting innovation, this is a core activity of the Networks. They have a strong record of fostering innovative collaborations across disciplines, institutions, sectors and internationally, with a fundamental ability to overcome institutional barriers to collaboration. Network-facilitated collaborations involve industry, policy makers, service providers, international organisations, consumers and other stakeholders in ways which no other existing scheme can parallel. Through these collaborations, the Networks have already successfully facilitated significant grants (from ARC, NHMRC, DEST/DIISR International Science Linkages and other funders) and leveraged-in substantial additional funding from external sources including collaborating universities and international agencies. The collaborations serve important knowledge transfer and capability-building functions, facilitate interdisciplinary discourse, and broaden and deepen the national base of scientific understanding which underpins our innovation system.

Building interdisciplinary research capacity. The Networks are driving a cultural shift towards collaborative communities of researchers. They have already supported the career development of many hundreds of PhD students and early career researchers (ECRs), partially assuming the role of institutional graduate schools in the US and Canada and helping to fill the "postdoctoral vacuum" in the context of an ageing research workforce. They have conducted master classes, methods workshops, and ECR-led conferences, and provided mentoring from the best researchers (nationally and internationally) in the relevant fields. They have brought together scholars and students who were previously isolated within centres and smaller or remote campuses, enhancing their scientific life. All this has been delivered at the coalface in a very cost-effective way because of the devolution of decision making to the Networks. Evidence suggests that the Networks present the availability of focussed intellectual capital in Australia, facilitating collaborations with international organisations and centres, thus leveraging significantly the outcomes for Australia.

The Future of the Research Networks

The ARC has confirmed that there is no plan currently in place to continue funding of this scheme past the end, in mid 2009, of the current funding agreements, although it is currently reviewing the operation of the existing program. While the review may well suggest changes in the details of how another generation of Research Networks would operate (perhaps to bring them closer to the European model), we feel that a scheme of this nature is essential to the NIS. Hence point 1 of our submission, *that another Research Network round be called in due time*. The question of the optimum funding level for Networks with large and diverse memberships should also be examined.

In the next section we summarise what we see as the undesirable consequences of a hiatus in funding, which underlies point 2 of our submission, *that the existing funding agreements be extended until a continuation plan can be implemented*.

The new round should be competitive and open both to existing Networks and to new ones. The bridging funding would prevent loss of momentum within the Networks and allow them to consolidate the gains that are only now becoming apparent. It would allow those existing Networks that are successful in the new funding round to continue without major interruption.

Although we argue that the Research Network program is cost-effective, we recognise that the research programs of the ARC, in particular, are seriously underfunded. In order to avoid exacerbating this situation we therefore also submit *that extra funding be provided to the ARC and NHMRC specifically to continue the Research Network program*.

The Costs of a Break in Funding

The three core objectives of the Research Networks, as formulated by the ARC, are

- (i) to build on the research of individuals and small teams by enhancing the scale and focus of their research,
- (ii) to encourage interdisciplinary research, and
- (iii) to facilitate collaborative and innovative planning and implementation of research projects.

A break in Network funding would seriously impede progress on all these objectives.

It is also important to recognise that the Research Networks are still developing:

- *Building something as complex as a Research Network takes time.* Most Networks spent 12–18 months getting established and finalising contractual arrangements with Contributing Organisations. All these contracts would lapse. Skilled staff (managers and administrators), who are difficult to recruit and train, would be lost, as would large numbers of members who volunteer their time and skills. Existing Network Convenors, who are leaders in their fields, may also find it difficult to return to the Networks after a hiatus. Websites and databases would cease to be maintained. It would be costly and inefficient to start from scratch again.
- *Building trusting relationships with stakeholders takes time.* Networks facilitate much broader connections than other schemes, crossing disciplinary, institutional, sector and national borders. Many critically important stakeholder doors (e.g. in industry) are only just starting to open now. There would be a loss of legitimacy and continuity with such stakeholders should the Networks cease to operate for a time.
- *Cultural change takes time.* The Networks are about cultural change, shifting to collaborative, interdisciplinary, inter-institutional, and inter-sector modes of research. Some Networks are still rapidly expanding as different groups discover their relevance, and many programs and collaborations are just starting to bear fruit. While strong collaborative relationships have been forged through the Networks, maintaining

existing collaborations requires continued support for communication and contact (especially in the context of high staff turnover) and there is opportunity for many further collaborations which need seeding. No other existing structure in the Australian research landscape can easily replace Network functions such as facilitation of collaborations and ECR career development, nor has this new mode of research as its focus. Loss of momentum in this process of cultural change would be a substantial cost.

Concluding Statement

As we have indicated above, the Research Networks have demonstrated that they play a critical role in driving innovation in Australia and internationally through building collaborations between researchers and the users of research. They provide, at low cost, a valuable range of functionalities not addressed by any other funding mechanism. The implications of ceasing the Research Networks program, including loss of momentum and core personnel, and the damaging of relationships with stakeholders, will have a serious impact on Australia's ability to meet the scientific challenges ahead. As such, we believe that there is a very strong case for a further competitive round of the Research Networks scheme, provision of bridging funding to existing Networks, and the provision of additional funding to the ARC and NHMRC for these purposes.

Appendix A: List of ARC (/ NHMRC) Research Networks

ARC Asia-Pacific Futures Research Network <http://www.sueztosuva.org.au/>
ARC Communications Research Network <http://www.acorn.net.au/>
ARC Complex Open Systems Research Network <http://www.complexsystems.net.au>
ARC Cultural Research Network <http://www.uq.edu.au/crn/>
ARC Financial Integrity Research Network <http://www.firn.net.au/>
ARC Governance Research Network <http://www.griffith.edu.au/govnet/>
ARC Molecular and Materials Structure Research Network <http://mmsn.chem.usyd.edu.au/>
ARC Nanotechnology Network <http://www.ausnano.net/>
ARC Network for Early European Research <http://www.neer.arts.uwa.edu.au>
ARC Research Network for a Secure Australia <http://www.secureaustralia.org/>
ARC Research Network for Advanced Materials <http://www.materials.com.au/>
ARC Research Network for Earth System Science <http://www.arcness.mq.edu.au>
ARC Research Network for Economic Design <http://pluto.ecom.unimelb.edu.au/ednetwork/index.cfm>
ARC Research Network for Understanding and Managing Australian Biodiversity
<http://www.adelaide.edu.au/efin/>
ARC Research Network in Enterprise Information Infrastructure <http://www.itec.uq.edu.au/~cii/>
ARC Research Network in Human Communication Science <http://www.hcsnet.edu.au>
ARC Research Network in Spatially Integrated Social Science <http://www.siss.edu.au>
ARC Research Network on Intelligent Sensors, Sensor Networks and Information Processing
<http://www.sensornetworks.net.au/>
ARC/NHMRC Research Network - Future Generation <http://www.aracy.org.au/arcnetwork.htm>
ARC/NHMRC Research Network for Parasitology <http://parasite.org.au/arcnet>
ARC/NHMRC Research Network in Ageing Well <http://www.ageingwell.edu.au/>
ARC/NHMRC Research Network in Genes and Environment in Development
<http://www.nged.adelaide.edu.au>
ARC/NHMRC Research Network: Fluorescence Applications in Biotechnology and Life Sciences
<http://www.physics.mq.edu.au/research/fluoronet/> ARC-NZ Research Network for Vegetation Function <http://www.vegfunction.net/>