Next steps

Quantum Sensors for Fundamental Physics, St. Catherine's College, Oxford, UK

16 October - 17 October 2018
Oxford, UK

Ian Shipsey

Quantum Sensors for Fundamental Physics
Statement to UKRI Executive Board 9/2018

Quantum Sensors for Fundamental Physics

Over the past five years thanks to the investment in the national Quantum programme rapid advances have been made in quantum technology, computing and metrology in the UK. These tools are now at a stage which could allow them to be used, and further developed, in fundamental science. Despite the potential, quantum sensing methods are not currently widely used in research in fundamental physics undertaken in the STFC and EPSRC communities. Several targets for exploration exist including the search for dark matter, gravitational wave research, tests of gravity, searches for a possible time variation in the fundamental constants of nature, test of fundamental symmetries with greatly improved sensitivity, many-body physics, and other areas.

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This SPF activity would bring together the STFC and EPSRC communities to tackle these challenges and provide the opportunity to utilise these new methods. This work will be inherently interdisciplinary combining the UKs world leading physics community with the equally ground breaking quantum information scientists. This programme will align to the governments science priorities as this exciting area of research would allow for the creation of a programme capable of attracting the globally best creative, original, young experimentalists and theorists. In addition this would allow the UK to retain its position as a partner of choice in this area.

The programme will deliver:

- Collaborative R&D funding streams
- Opportunities to attract and train young scientist in a multidisciplinary area

Slide from day 1

Quantum Sensors for Fundamental Physics

Why is this good for all the partners?

The exciting science will benefit all the partners involved: universities, labs & hubs

Leverage the current Hubs to bring state of the art sensors to this new application.

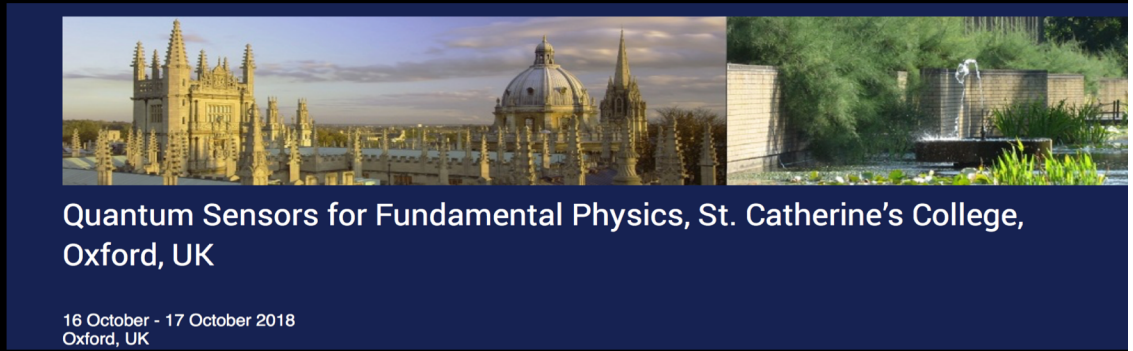
There will likely be a tension between performance and “manufacturability” but the Phase II Hubs should be able to deliver research to push performance, and additional support for user communities from STFC that could feed into and benefit from the Hubs activity

Why is this good match to the SPF?

This would be a genuinely new partnership between STFC EPSRC and other partners
- so plays well to the UKRI era.

Quantum Sensors for Fundamental Physics - Next Steps

Slide from day 1



The workshop has four goals

#1 To survey the extraordinary science opportunities and UK capabilities to exploit this science in a world-class programme

#2 To demonstrate to UKRI the immense interest in the UK in QSFP

#3 To begin to form teams around key experiments that would be funded by QSFP

#4 To work with STFC and EPSRC on the QSFP bid. On Day 2 there will be an overview of the Quantum Programme by Liam Blackwell (EPSRC) and the Strategic Priorities Fund by Jason Green (STFC) and the questions will be introduced that need answers for the bid. Then at the end of the day there will be a Town Hall with an opportunity to help formulate answers.

Quantum Sensors for Fundamental Physics - Next Steps

The submission into SPF wave 2 will be made by STFC/EPSRC in December 18. The draft template of the bid is due November 18. STFC write and submit this with our input. This will request the funding to create the QSFP programme (£25-40M)

If the SPF bid is successful in gaining the funding for a QSFP programme (March 19) an open call will be made to the community with a deadline of ~June 2019

QSFP Opportunities Funding from STFC was awarded to build a community and consortium to prepare for the call. We will support workshops that facilitate the formation of teams and the development of proposals around key experiments that would be funded by QSFP.

We will also appoint a International Review Board of world-leading experts from outside the UK that will review the proposals providing crucial feedback to strengthen them


First AION Workshop
at Imperial College London
March 25/26 2019
AION
Imperial College London
Organised by:
T. Bowcock,
O. Buchmueller [Coord.],
J. Coleman,
J. Ellis [Theory],
I. Shipsey
2-Day Workshop:
Day 1: Instrumentation
Day 2: Physics case
If you like to participate or require further information please contact:
fundamental-physics-admin@imperial.ac.uk
with "AION" in title.

Quantum Sensors for Fundamental Physics and Society- Next Steps

We envisage ~ 3-4 larger projects and a few smaller projects might emerge:

resonant searches for axion & UL dark matter (possibly partnering with ADMX)

Atom interferometry first stages of AION partnering with MAGIS

ion-traps for fundamental physics

opto-mechanical (foundational QM & other fundamental physics)

SC-loops for fundamental physics

+ ……..

There is of course no requirement to work within the QSFP framework just described but the benefits of doing so are clear

Quantum Sensors for Fundamental Physics - Next Steps

4 Dec. 18 Groups self organise and produce outline paper, identify work package leadership and writing team Request support for workshop & travel

January consortium meeting to hear presentations from each workpackage, cross-fertilise, give feedback, merge if required, last chance of any late-breaking new ideas

End March 2018 Draft workpackages due for review by IRB

End April 2018 Final workpackages due for review by IRB, formal costings initiated

Commencing March begin bi-weekly meetings for group charged with developing the wider aspect of the proposal including metadata & coordinating with STFC/EPSRC towards submission

May consortium meeting to review and sign off the proposal
Mid- June proposal submission

Instrumentation: The Great Enabler

“New directions in science are launched by new tools much more often than by new concepts.

The effect of a concept-driven revolution is to explain old things in new ways. The effect of a tool-driven revolution is to discover new things that have to be explained”

Freeman Dyson