

TEAM-A ANNUAL REPORT

2017/18

The **TAILORED**
ELECTROMAGNETIC
and **ACOUSTIC**
MATERIALS
ACCELERATOR

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A Prosperity Partnership Programme

TEAM-A is an ambitious research programme working at Technology Readiness Levels 1 - 3, on both fundamental and applied research. Our projects are funded through the EPSRC, the University of Exeter and the QinetiQ Group at Farnborough.

We aim to build upon the successful relationship that exists between the University of Exeter and QinetiQ, to develop advanced materials that can be used to control and manipulate the propagation of electromagnetic and acoustic energy. Our researchers, industry scientists, students and managers, across 3 academic disciplines, are working to produce cutting-edge science and cost-effective routes to manufacturing.

RESEARCH Topics

- New materials and structures that control the propagation of microwave and radio frequency radiation
- To exploit the use of optical, infra-red and terahertz radiation for identification, signalling and imaging
- New materials and structures that control the propagation of acoustic radiation
- To develop predictive models of the propagation of electromagnetic and acoustic radiation
- To explore novel approaches to the manufacturing of advanced materials

Priorities

- Producing excellent research
- Developing routes to manufacturing
- Training new generational entrepreneurial researchers
- Partnering to bring exploitation science and technology
- Supporting Small and Medium-sized Enterprises (SMEs)
- Strengthening of the South and South-West region's international position in advanced engineering

Performance Report: An overview

The overall aim of this partnership is to develop and exploit the University of Exeter and QinetiQ's comprehensive interdisciplinary capabilities to deliver a number of ground-breaking technologies with real potential for commercial impact, such as a hand-held THz scanner for use in security, and reduced footprint RF antennas for communication. Our work is ambitious, visionary and exploratory in nature, opening up new horizons and opportunities and with very significant scientific and industrial impact potential.

Three inter-linked overall research objectives encapsulate our programme and the major challenges involved:

1): To develop new, practicable materials and concepts for the control of the flow of electromagnetic and acoustic energy;

(2): To establish innovative, cost effective and sustainable routes for the manufacture of these materials;

(3): To create prototypes and technology demonstrators that provide companies with enough confidence to exploit technology arising from the partnership in both existing and new products.

OUR VISION - is to transform the development, manufacture and exploitation of advanced materials by creating a team that can take an integrating approach, spanning fundamental science to future products.

OUR AMBITION - is to be a recognised world leading centre for both the science and engineering behind and the exploitation of advanced new materials.

Over the past year we have been initiating the TEAM-A programme and laying down its solid foundations. Programme and project management support, funded by both partners have been established and are working effectively to enable the achievement of the highest quality science.

Our strategies and planning have been designed to produce excellent scientific research and accelerate any opportunity for impact through partnerships and capital investment.

Building A-TEAM

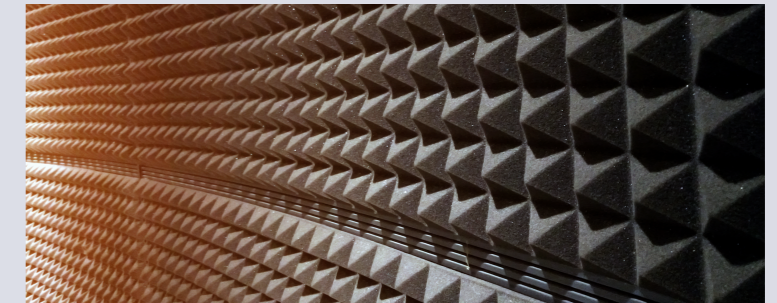
Through the mutual efforts, capital and in-kind investments of all the partnerships that make up TEAM-A, including the Centre for Additive Layer Manufacturing (CALM), the Centre for Doctoral Training in Metamaterials, the department of Innovation, Impact & Business, and the QinetiQ Group; this past annum we have begun to cultivate a collective identity and presence within the University of Exeter and QinetiQ at Farnborough.

Having had a challenging but successful first year of recruitment we are happy to welcome five new postdoctoral research fellows, and two PhD students into the programme. Now we can better look forward and focus on producing our world-class scientific research.

Research Challenges

The technical aspects of the programme are now underway in research challenges one and two, focusing on RF and microwave radiation, and THz and IR radiation research.

Our internationally renowned research challenge leads and their teams have already begun to investigate potentially better routes to achieving their research objectives.



The Initial work of research project 2.1 was presented at the UK national photonics conference, Photon 2018, and QinetiQ has begun to investigate the current research project's value to their commercial partners.

Seeking opportunities & supporting Innovation

The Idea & Incubation Innovation Fund's first successful project; Non-Destructive Evaluation – Collaborative working and technology exploration between TEAM-A and a local SME Theta Technologies is nearing its successful competition; with Theta's measurements now transferred to QinetiQ for further exploration. Should QinetiQ's testing yield encouraging results further investment and potential programme expansion may be anticipated. A second project titled Complex Poisson's ratio and bulk modulus estimation has been approved between Dr Simon Horsley (UoE) and Prof. Chris Lawrence (QQ); said project is aimed at knowledge transfer and the potential start of a longer-term collaboration that could lead to Dr Simon Horsley being involved in future TEAM-A projects.

An early success has resulted in a joint research endeavor between TEAM-A and Pepsico. More detail will follow as the project progresses.

Researchers from RC 1 have been collaborating with the University Warwick to improve the photomodulators in RP 1.1.

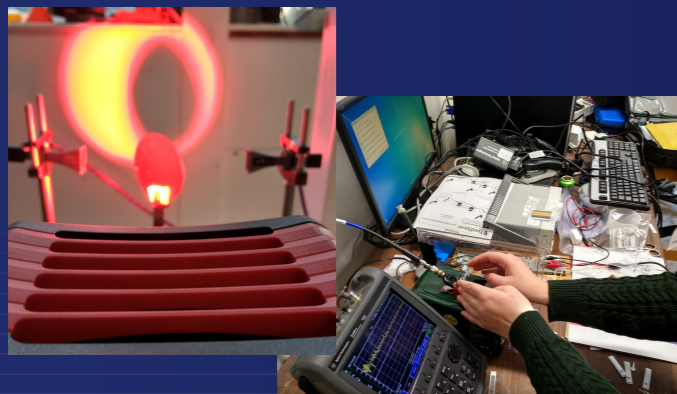


PEPSICO

TEAM-A CHALLENGES

Research challenge One

This challenge concentrates on the development of new materials and structures that control the propagation of microwave and radio frequency radiation, led by Professor Alastair Hibbins (UoE Physics) and Professor Frank Smith (QQ).



This will be mostly based at Exeter initially, but as the research matures the focus will switch to evaluation and testing at QinetiQ due to the UK-unique facilities that are available at their Farnborough headquarters.



Research challenge Two

Focusing on the development of novel metamaterials and structures to exploit the use of optical, infra-red and terahertz radiation for identification, signalling and imaging. This Challenge which consists of three complementary research projects, is led by Professors Geoff Nash (UoE Engineering) and Chris Lawrence (QQ), is predominantly based at Exeter during its early stages of development, with QinetiQ's input steadily increasing with the testing of prototypes.



Research challenge Three

Here our researchers are developing new materials and structures that control the propagation of acoustic radiation. This challenge is jointly led by Mr Rob Freeman (QQ) and Professor Alastair Hibbins (UoE Physics), building upon many years of research into acoustic metamaterials and their electromagnetic analogues. By combining research expertise, unique characterisation facilities and practical experience of acoustic control, we aim to harness low TRL technologies. This is based at both Exeter and QinetiQ to exploit their combined unique characterisation facilities.

Research challenge Four

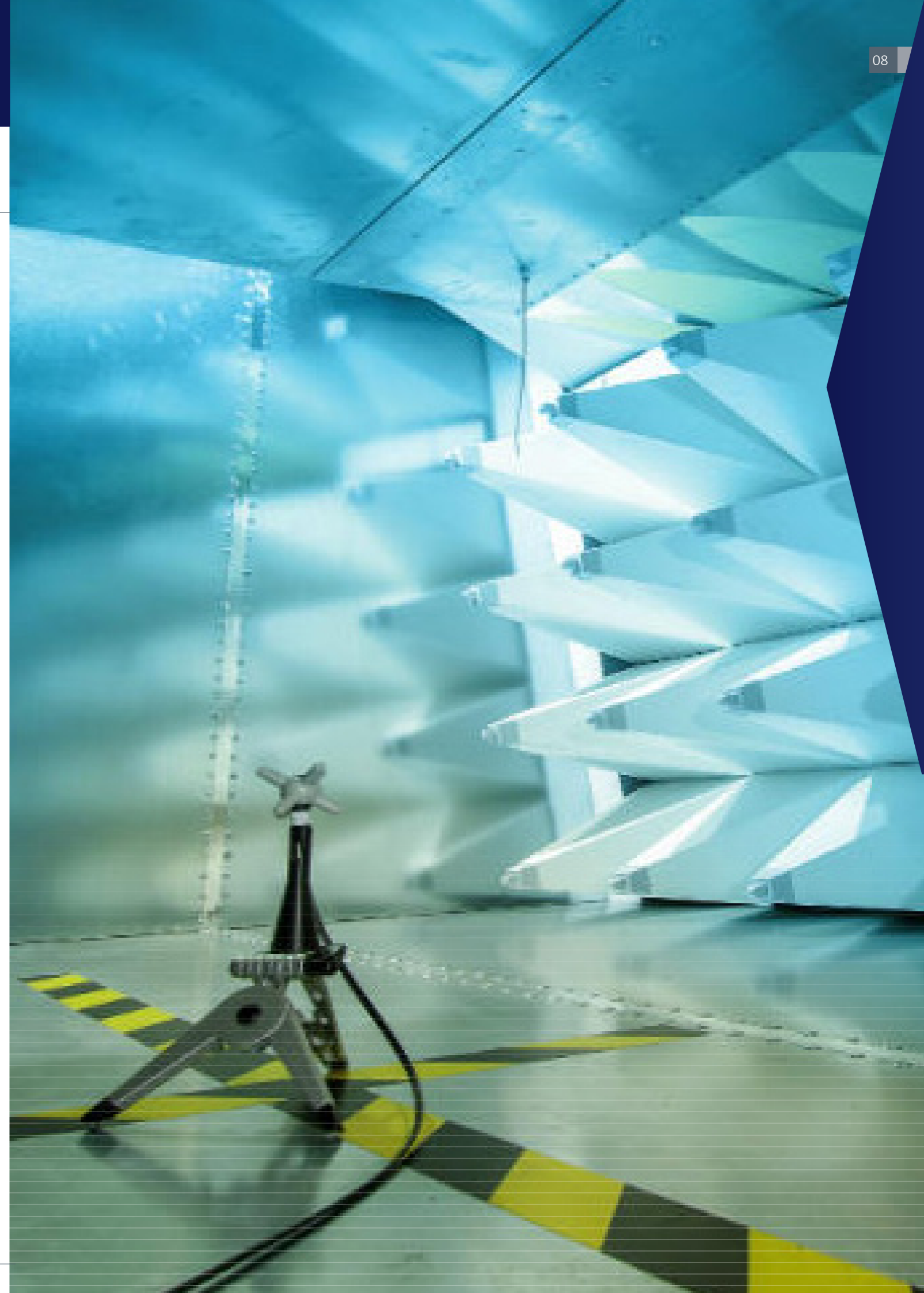
Consisting largely of theory and simulation work to develop predictive models of the propagation of electromagnetic and acoustic radiation, supporting the other research challenges. This challenge is led Dr Jaqueline Christmas (UoE Computer Science) and Dr Pete Hobson (QQ). The models developed here are applicable to any task related to real-world imagery through air or water. The ability to design better camouflage has obvious relevance to UK MOD and its allies, but is also relevant to materials for remote ID (e.g. assessment of beacons and markings produced in research challenge two). Although mostly based in Exeter, this challenge draws heavily on QinetiQ's knowledge of end-user requirements, model development, facilities for laboratory and field-based trials.

Research challenge Five

Here we build on challenges one to four to explore novel approaches to the manufacturing of advanced materials. The manufacturing capabilities studied in this package will support all other research challenges in some way, often by suggesting routes to prototype, but more fundamentally by seeking novel capabilities (e.g. uniform and complex magnetic particles from synthetic biology) and commercially attractive economies in terms of cost, ease of manufacture and scalability. This challenge is split across the two partner sites and jointly led by Professor Oana Ghita (UoE Engineering) and Mr Chris Spooner (QQ).

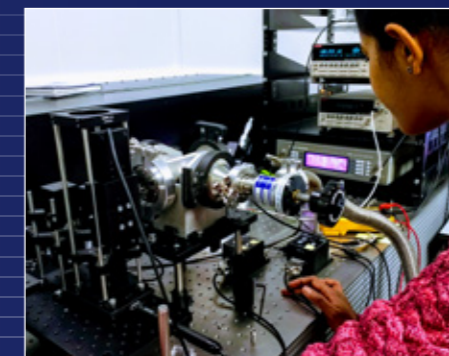
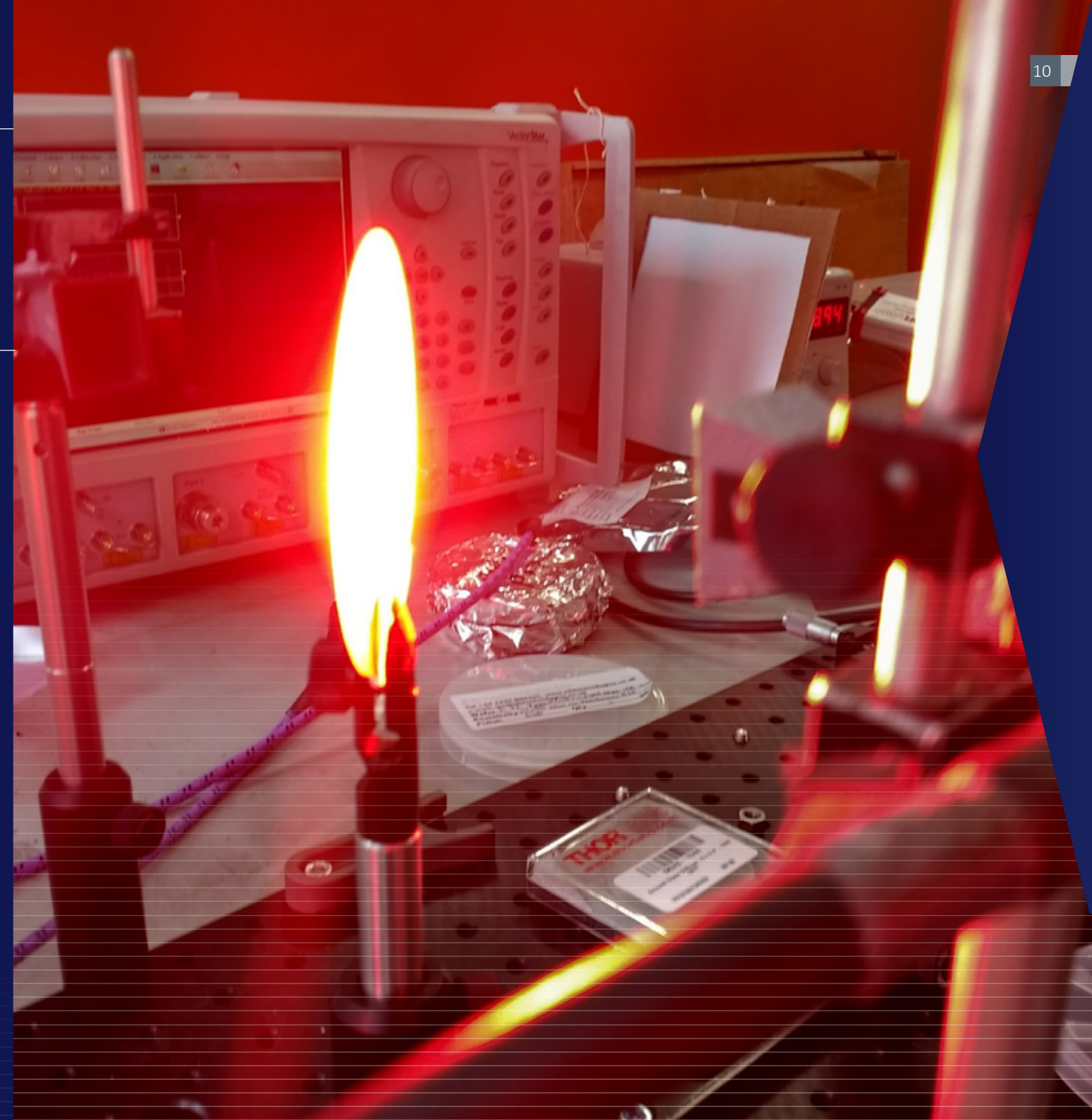
Secure foundations, financial investment & a developing identity

- All programme management plans are in place,
- The collaboration and intellectual property agreements are about to be signed,
- Five out of the eight postdoctoral research fellowships have been allocated, including one to be based at QinetiQ,
- Technical work in research challenges one and two are under way,
- Two out of the four PhD studentships have been awarded, including one to be based at QinetiQ,
- Our Idea & Incubation Innovation fund has been launched and has presently funded two projects,
- Through our Innovation fund we have supported a local SME,
- Industry engagement has already taken place and funding has been secured from a large multi-national company,
- A number of scientific papers are being prepared,
- Work has been presented at a number of conferences.



Next Annum

- Excellent scientific research,
- The recruitment of the remaining postdoctoral research fellows and PhD studentships,
- The programme's Idea & Incubation Innovation fund will be continually used to support innovative ideas and SME's,
- An increased presence of QinetiQ at the University of Exeter, and likewise with the University of Exeter at QinetiQ,
- Further revenue streams and diverse partnerships,
- An increased level of engagement with the public at large, specifically school age students.



FOR FURTHER INFORMATION CONTACT:

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The **TAILORED**
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and **ACOUSTIC**
MATERIALS
ACCELERATOR

Programme: The Tailored Electromagnetic and Acoustic Materials Accelerator (TEAM-A) EP/R004781/1

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