

PROJECT DOCUMENTATION

1st Advisory Board HIGHLIGHT REPORT

A high level summary update of TEAM-A's KPI achievement since the programme's beginning. Further detail will be provided upon request and during Advisory Board meetings.

Project: The Tailored Electromagnetic Materials Accelerator (TEAM-A)

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1 Highlight Report History

1.1 Document Location

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The source of the document will be found at this location – TEAM-A SharePoint > Shared Documents > 0044: Advisory Board > 0044.1_UD1. Contact the TEAM-A administration for access.

1.2 Revision History

Date of this revision: 04/10/2019

Date of next revision: October 2020

Revision date	Previous revision date	Summary of Changes	Changes marked
		First issue	

1.3 Approvals

This document requires the following approvals.

Name	Signature	Title	Date of Issue	Version
TEAM-A Leadership Board				1

1.4 Distribution

This document has been distributed to:

Name	Date of Issue	Version
Prof. Geoff Nash	27.09.2019	1
Prof. Chris Lawrence	27.09.2019	1
Michelle Spillar	27.09.2019	1
Dr Richard Bryant	27.09.2019	1
Francesca Riches	27.09.2019	1
Jade Hayes	27.09.2019	1
Prof. Mark Goodwin	27.09.2019	1
Dr Benny Hallam	27.09.2019	1
Prof. Sajad Haq	27.09.2019	1
Jessica Bonham	27.09.2019	1
Luis Lopez-Bracey	27.09.2019	1

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3 KPI Status Summary

See 0045_TEAM-A Impact Exploitation Plan_V2 for a detailed account of TEAM-A's KPIs.

KPI	Detail of Output
Scientific Excellence	
Peer-reviewed papers published/submitted	<p>3 papers published and 6 submitted for review. The 3 published papers include:</p> <ol style="list-style-type: none"> 1. I. R. Hooper, L. E. Barr, S. M. Hornett, E. Hendry, N. E. Grant, J. D. Murphy. 'High Efficiency THz and RF Photomodulators'. Scientific Reports. 2. M. Baraclough, S. S. Seetharaman, I. R. Hooper, W. L. Barnes. 'Microwave metamaterial analogues of molecular aggregates'. Nature Materials. 3. D. Matsunaga, J.K. Hamilton, F. Meng, N. Bukin, F. Y. Ogrin, J. M. Yeomans, and R. Golestania. 'Controlling collective rotational patterns of magnetic rotors'. Nature Communications.
Conferences/seminars attended	<p><u>9 conferences</u> have been attended to present posters/ demonstrations, gather information and learn. <u>1 Research Fellow led conference</u> was sponsored on 9th of July 2019, 81 researchers from 10 different countries arrived at the University of Exeter for the very first Exeter International OSA Network of Students (IONS) conference.</p>
Research proposals supported	<p><u>1 successful proposal</u> supported, Prof. Euan Hendy of the University of Exeter "Computational spectral imaging in the THz band". <u>1 further proposal</u> in the 'pipeline'.</p>
Collaboration	
Talks/presentations at partner sites	<p>7 QinetiQ Tech-Talks attended/ supported. 2 Customer focus groups hosted by The University of Exeter.</p>
Exchange of equipment	<p><u>RF surface wave launcher</u> – Borrowed from Exeter to support a MOD-funded project at QinetiQ (QQ). Work completed, enabling QQ to calibrate their equipment and test ideas relating to how surface currents can influence radar cross-section.</p> <p><u>THz source</u> – Lent to Prof Euan Hendry and now used in the far-field THz scanner that is being developed under TEAM-A (RP2.2). Saved the project ~£20k in material costs (the price of a new THz source).</p>

Exchange of staff	<p><u>THz material characterisation work</u> – Dr Emma Newton at QQ has been trying to develop new materials for THz control, but lacked equipment to characterise their electromagnetic properties. Access to Exeter’s facilities (owned by Prof Euan Hendry) with assistance from experienced users (Dr Lauren Barr) enabled Dr Newton to assess the materials, providing valuable input to QQ’s materials strategy and saving the expense of setting up a new facility (an issue of both time and money).</p> <p><u>Transmission Electron Microscope (TEM)</u> – Dr Layla Malouf of QQ utilised Exeter’s Living System’s Institute to analyse nanoparticle distributions in brittle polymers. Here Exeter also advised on how to prepare and microtome samples, saving QQ research time and the cost of purchasing a TEM.</p> <p><u>Thermal cameras</u> – Two of the current TEAM-A projects based at Exeter (RP2.1, RP3.5) involve the use of fast heat pulses in ‘2D materials’ such as graphene. In particular, the IR beacons of RP2.1 are based around the use of high frequency pulses of radiation to enable coded identification signals. Whilst Exeter have access to thermal imagers, instruments capable of fast framerate (50Hz plus) measurements are lacking: as these are expensive and specialised. QQ possess such cameras – both long- and short-wave – and in May 2019 QQ transported them to Exeter for a day to support the project. This proved highly useful and saved Exeter £200k+ (the cost of the equipment). Future (longer) visits are planned (the next in Nov/Dec 2019). The opportunity will also be taken to invite students from the Metamaterials CDT to see such instruments in action, and to image any samples of interest.</p> <p><u>RC3 – Prof Oana Ghita’s (UoE) advice to the Acoustic Materials team at QQ</u> re: printed elastomers – A discussion as to the feasibility of printing elastomeric materials to support customer requests for coating manufacture. Several visits and phone calls made, introducing Prof Ghita and Dr Maria Mann (PDRF) to the team at QQ. The main summary is: the materials can be printed but the scale required (100s of square metres from foot-square samples) would be difficult to meet at present; however, designs could usefully be tested before mass production via expensive moulds; Exeter do not have suitable facilities but can act as advisors to find appropriate suppliers and assess their offerings; this will be pursued in future months, as part of a larger customer project that is still under discussion.</p>
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	<p><u>RC1 – Prof Oana Ghita’s (UoE) advice to the RF Materials team at QQ re: printed RF attenuators</u> – Following successful discussions, this has become the main thrust of RP5.1, with samples made at Exeter being tested (mechanically and electromagnetically) at QQ. Dr Shahid Hussain is the resident expert on the requirement, and has hence become the QQ CO-I for RP5.</p> <p><u>RC2 - Rupert Anderton’s (QQ) advice to the THz research</u> – Rupert Anderton has provided input and support to RP2-2, particularly regarding advice on the requirements for a THz scanner, and has subsequently provided letters of support for Prof Hendry’s recently successful research proposal “Computational spectral imaging in the THz band”.</p>
<p>Commercial Activities</p> <p>Industrial Engagement</p>	<p><u>PepsiCo:</u> Now three projects (Commercially Sensitive):</p> <ul style="list-style-type: none"> ○ “Digitization of Snacking” – COMMERCIALY SENSITIVE - Project based at Exeter, supporting a new Research Fellow. ○ Microwave oven design – COMMERCIALY SENSITIVE – Project based at QQ, providing equipment that will enable the characterisation of the output of the first project ○ RF Spectroscopy – using unique equipment based at QQ Farnborough, Dr Joshua Hamilton (PDRF) is characterising foodstuffs relevant to PepsiCo’s business interests, over a far broader range of temperatures and frequencies than was previously published and practical. Two papers planned. <p><u>Technical Composites Ltd:</u> Following an introduction from Profs Hibbins and Sambles (UoE), we have been discussing two NATEP proposals with Mike Sloan (ManDir). The first relates to the development of a joint QQ/UoE patent on RF filters into a radome material; the other relates to new magnetic materials for aerospace applications. In the first round of reviews both were marked highly, although the former requires development to a demonstrator (to be undertaken in RC1). The other is proceeding to final review, with the intention of it being undertaken within TEAM-A if it is funded.</p> <p><u>William Blythe Ltd:</u> Dr Mike Butler (Business Development Manager) visited Exeter on the 16th Sept to speak to the TEAM-A CO-Is, PDRFs and PhDs about his career, business and customer requirements. He set four ‘challenge areas’ in which he believes William Blythe’s inorganic materials could be applied to develop new products: these are currently being</p>

	<p>assessed. He is also sending a range of powdered materials for optical/IR assessment at Farnborough QQ, by Dr Alexander May (PDRF), to determine whether these could be developed into specific products in the paints and coatings market: if so, a small project funded by Dr Butler is anticipated.</p> <p><u>RFID opportunity</u> (COMMERCIALY SENSITIVE): a high-street retailer has been discussing RFID challenges with Prof Hibbins, leading to TEAM-A being invited into the discussions to draw upon QQ expertise in the setting up of complete RFID systems. This has been paused due to the customer lacking the funds to pursue this before the new financial year (Apr20 onwards).</p> <p><u>Bank of England</u>: We have recently registered our interest in bidding for work with the Bank via DASA proposals (https://www.gov.uk/government/news/market-exploration-innovative-security-features-for-bank-notes). This follows a face-to-face meeting last year (2018), proposing that TEAM-A offers a route to innovative solutions due to its combination of academic and industrial expertise, which was well received. We anticipate a full call for proposals within the next few months, and we are hence already exploring possible concepts via TEAM-A funding.</p> <p><u>Metaboards</u>: A small start-up company working on metamaterials. QQ and UoE have independently made contact with the company over the last couple of years, and are now in discussion with them over possible DASA projects or other forms of collaboration – early stages.</p>
Innovation projects	6 projects funded, 3 of which are currently ongoing. Key partners include Theta Technology (SME), The University of Warwick, PepsiCo and The University of Exeter. A key point to note is the University of Warwick project led on to a fully funded EPSRC grant and the PepsiCo project has led to the funding of a Research Fellow and a PhD Studentship.
Website articles / marketing	5 articles published by our Research Fellows and 1 by TEAM-A's first summer Intern, details can be seen here: http://emps.exeter.ac.uk/team-a/ps/poissonsratio/ .

<p>Staff development</p> <p>Training courses attended</p>	<p>4 Research Fellows have attended The Royal Society's Media and Communication Skills course. Project administration have also attended Project Management qualification courses provided by the Association for Project Management.</p>
<p>Progress to self-sufficiency'</p> <p>Additional revenue generated</p>	<p>TEAM-A have received additional funds from PepsiCo to support both a Research Fellow and a PhD.</p>
<p>Outreach activities</p>	<p>TEAM-A Research Fellows attend a QQ-based Women in Engineering outreach day and the programme has successfully hosted its first 6 week summer internship. For insight into the internship, please view here: http://emps.exeter.ac.uk/team-a/ps/measuringlfas/.</p> <p>A strategic approach to future outreach activities is being solidified at Exeter W/C 07/10/19.</p>