University of Kent

Mid Term Review
UBAPHODESA
Initial Training Networks:
FP7-PEOPLE-2013-ITN
EID: 607627
Ultrawide bandwidth photonics devices, sources and applications

Content

- Membership
- Science subjects researched
- Reporting on training specialist subjects
- Reporting on training general skills
- Network events
- Milestones
- Entering the second half of UBAPHODESA

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Supercontinuum Technologies

fiber-based SC 1999

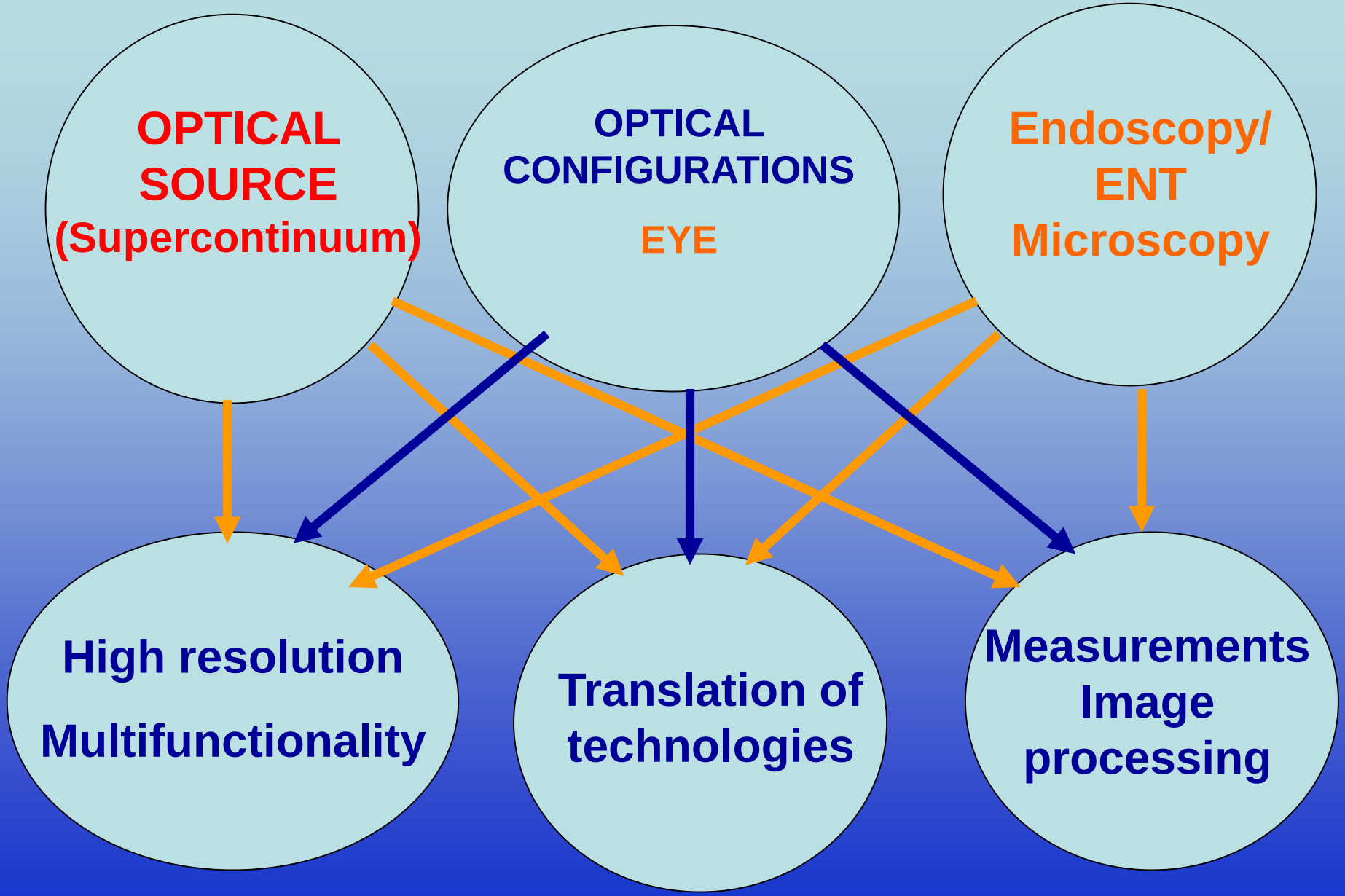
Optical coherence tomography

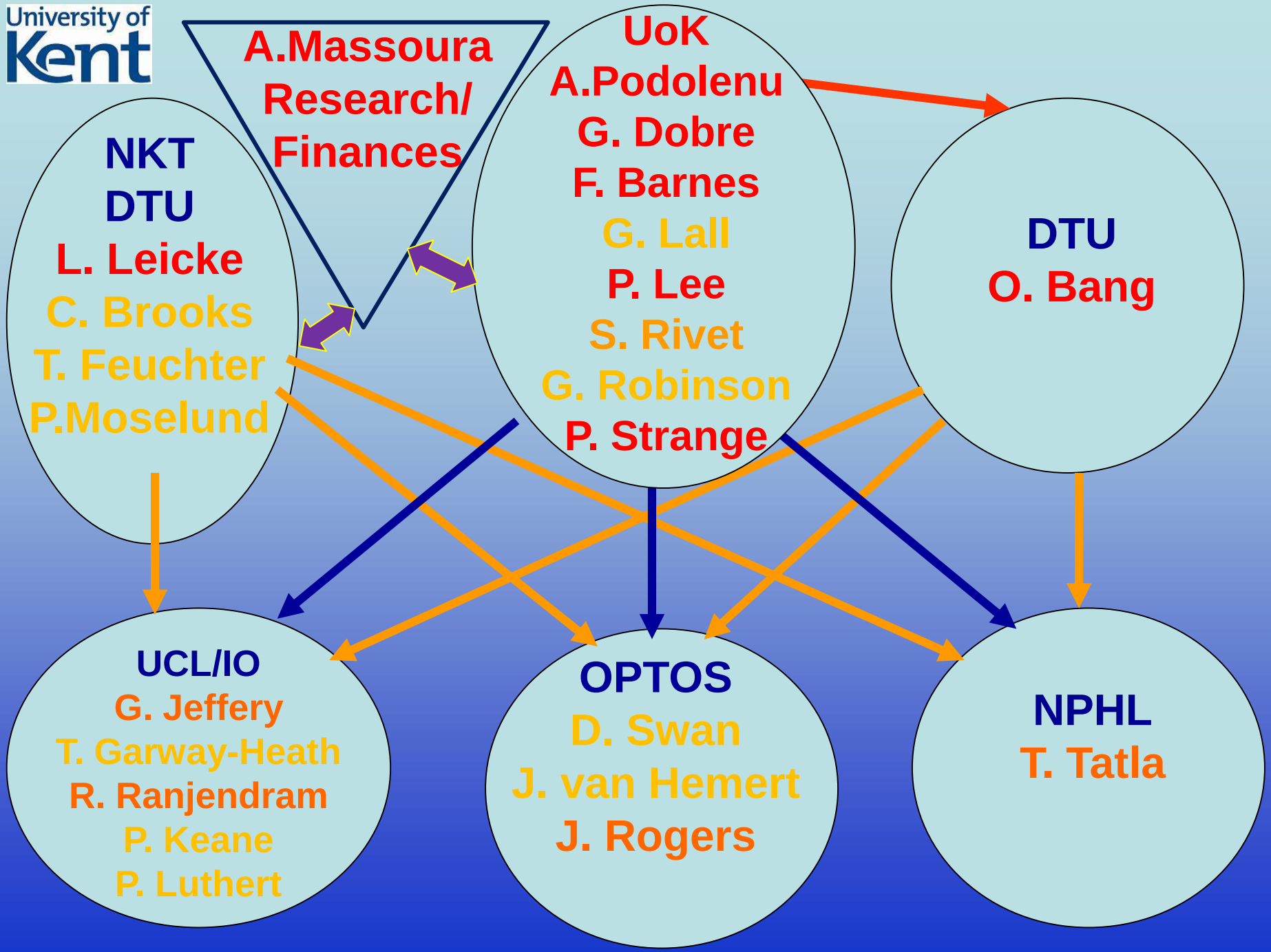
Endoscopy

OCT: 1991

Instrumentation

Interactions




University of Kent
A.Massoura
Research/
Finances
NKT
DTU
L. Leicke
C. Brooks
T. Feuchter
P.Moselund
UoK
A.Podolenu
G. Dobre
F. Barnes
G. Lall
P. Lee
S. Rivet
G. Robinson
P. Strange
DTU
O. Bang
UCL/IO
G. Jeffery
T. Garway-Heath
R. Ranjendram
P. Keane
P. Luthert
OPTOS
D. Swan
J. van Hemert
J. Rogers
NPHL
T. Tatla

Research subjects and education topics

- Physics of supercontinuum (SC)
- Photoacoustics
- White light interferometry, optical coherence tomography
- Dispersion in broadband light
- Ophthalmoscopy and Endoscopy
- Microscopy and cell imaging
- Labview
- Field Programmable Gate Arrays (FPGAs)
- Graphic Cards (CUDA)

Participants

Beneficiary Number	Beneficiary short name	Private Sector *(Y/N)*	SME *(Y/N)*	Country	Month enter project	Month exit project
1 (Coordinator)	University of Kent	N	N	UK	1	48
2	NKT Photonics A/S	Y	N	DK	1	48

B.1.2. List of Associated Partners (including role and status)

N°	Associated Partner name	Short name	Country	Organisation type	SME (Y/N)	Role in the project
1	Institute of Ophthalmology, University College London	IO	UK	Public	N	RES/TR/SEC
2	Northwick Park Hospital	NPH	UK	Public	N	RES/TR/SEC
3	Technical University of Denmark	DTU	DK	Public	N	RES/TR
4	Optos plc	Optos	UK	Private	N	RES/TR

EXCELLENT SCIENCE

- University, first *en-face* OCT image of the retina and the first OCT/SLO, 1st in the UK in OCT, UoK;
- World leader in Supercontinuum, NKT;
- Oldest eye hospital in the world, the largest ophthalmic research centre in the world : MEH/UCL-IO;
- Main UK acute hospital in upper and lower Gastro-Intestinal endoscopy, NPHL;
- 1st University in the Nordic Region, DTU
- World leader in panoramic imaging and largest eye imaging company in the UK, Optos

Training on specialist subjects

Teaching specialist lectures

- PH800 “Biomedical Optics”
- A. Podoleanu, initially developed for the Marie Curie ITN training site coordinated between 2006 – 2010. Main parts: optical coherence tomography (OCT), optical sources and optics of the tissue.
- The course totalled over 40 lectures, 70% exam and 30 CW (an essay and a class test). All passed with marks between 2.1 and 1st

Specialist topics

5 more academics from a different school in the Faculty of Sciences:

- **Dr. George Dobre**, *SPS*: optics design,
- **Prof. Paul Strange** , *SPS*: quantum theory
- **Dr Peter Lee**, *EDA*: signal processing, FPGAs (2h);
- **Dr. Gary Robinson**, *School of Biosciences*: imaging cells, Technology transfer and advise on IPRs;
- **Dr G. Lall**, *School of Pharmacy*: neural function, pacemakers (2h);
- **Dr F. Barnes**, *School of Computing*: Graphics cards, parallel computing, CUDA (2h).

Associated partners PH800 (over Skype to the other site)

- UCL Institute of Ophthalmology (IoO), Moorfields Eye Hospital in London: Dr. Pearse Keane, taught 3 hours *en-face* OCT, disease evaluation using OCT
- Professor Ole Bang, Technical University of Denmark (DTU), taught 5 hours on the Physics of supercontinuum, to students at NKT in Denmark and
- Prof. John Schofield, Maidstone Tunbridge Wells NHS Trust, 3 hours on histology, tissue preparation

PH800 Exam paper

- 6 short questions
- 4 long questions

- A Podoleanu: all apart from
- S4: Dr. Sylvain Rivet (other staff UoK)
- L9: Prof. Ole Bang, DTU

Exam devised by end of January, sent to an external examiner, revised version end of February, exam in May

General skills

- Individual reports with details on seminars, short presentations on writing reports, etc.
- In KENT: Unit Enhancement of Learning and Teaching
- At NKT, 1st Network event, the workshop:

a) ESRs exercised presentation skills;

b) ESRs exercised their training in reporting;

c) Training in forming companies;

d) Training in IPRs

ESRs coming to Kent

- **Felix (ESR4), in UoK booked on *Getting published, targeting the top journals and writing book proposals*, 17 March 2016**

Internal presentations

- **Each ESR presented at UoK and NKT regular meetings, more than 10 times**

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SPECIALIST TRAINING

CLINICAL

LASERS

Workshop on supercontinuum sources
and bio-imaging applications such as OCT

Venue: NKT Photonics, Blokken 84, 3460 Birkerød

Thursday 24th September

TIME	TOPIC	SPEAKER
09:00-09:15	Welcome	Lasse Leick
09:15- 09:30	Presentation on UBAPHODESA	Adrian Podoleanu
9:30- 9:50	Broadband Master-Slave Interferometry Using a supercontinuum Source	Michael Maria, UoK
9:50- 10:10	Acousto-optic tuneable filter for dispersion characterisation of an OCT system	Catherine Chin. UoK
10:10- 10.30	Coffee break	
10:30- 10:50	Ultra broadband OCT for submicron resolution	Sophie Caujolle, NKT
10:50- 11:10	Spectroscopic low coherence interferometry using a SuperK source and an ultra broadband spectrometer	Felix Fleischhauer, NKT
11:10- 11:30	High energy supercontinuum source for photoacoustic microscopy	Magalie Bondu, NKT
11:40-12:00	Polarization-sensitive OCT tomography system immune to fibre-based influences	Manuel Marques, UoK
12:00-12:20	Two-photon Microscopy and its Axial Performance	Yong Hu, UoK
12:20-13:00	Lunch break	
13:00-13:45	OCT in dermatology – a developing story	Gregor Jemec Roskilde Hospital
13:45- 14:05	Speckle variance OCT in clinical work	Lotte Themstrup, Roskilde Hospital
	Break	
14:30-14:50	Presentation on ShapeOCT and LOISE projects	Deepak Jain, DTU
14:50- 15:10	Supercontinuum based 1300 nm SD OCT for dermatology	Niels Møller Israelsen, DTU
15.10- 15.30	Fs pumped 1300 nm supercontinuum; noise and fiber design	Rasmus Engelsholm, DTU
15:30-15:50	Break	
15:50-16.10	High-power non linear frequency converted laser diodes	Dominik Marti
16:15-17:15	Lab tour (voluntary)	NKT

NKT Photonics the power of light

SEVENTH FRAMEWORK PROGRAMME

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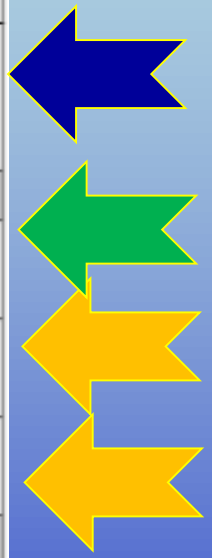
IPRs, innovation and forming companies

Friday 25th September

TIME	TOPIC	SPEAKER
09:00-09:15	Welcome	Lasse Leick
09:15- 10:00	What is the value of patents for high tech companies in photonics and bioimaging?	Anette Hegner, Hegner & Partners
10:00-10:15	Break	
10:15-10:45	NKTs model for innovation and entrepreneurship	Lasse Leick
10.45-11.05	Starting up Norlase	Peter E. Andersen, DTU
11:05-11.25	Starting up OCTLight	Thor Ansbæk OCTLight
11:30-12:30	Lunch break and end	



Talks: Please limit talks to 15 minutes to allow 5 minutes for questions

Applying for grants (learning by applying)

- Michael (ESR1),
- Sophie (ESR3) and
- Felix (ESR4) contributed to grant applications such as MC ITN (Jan. 2016)

Ethics

- **Human participants**

- **Activities initially planned in the 2nd half brought forward**
- **ESR2: Basal Cell Carcinoma of Eye Lids**
- **Based on NHS approval, application approved by the Faculty of Sciences Committee**
- **This needs to be repeated with the ESR 4, 5, but we envisage that ESR3 will also be involved**

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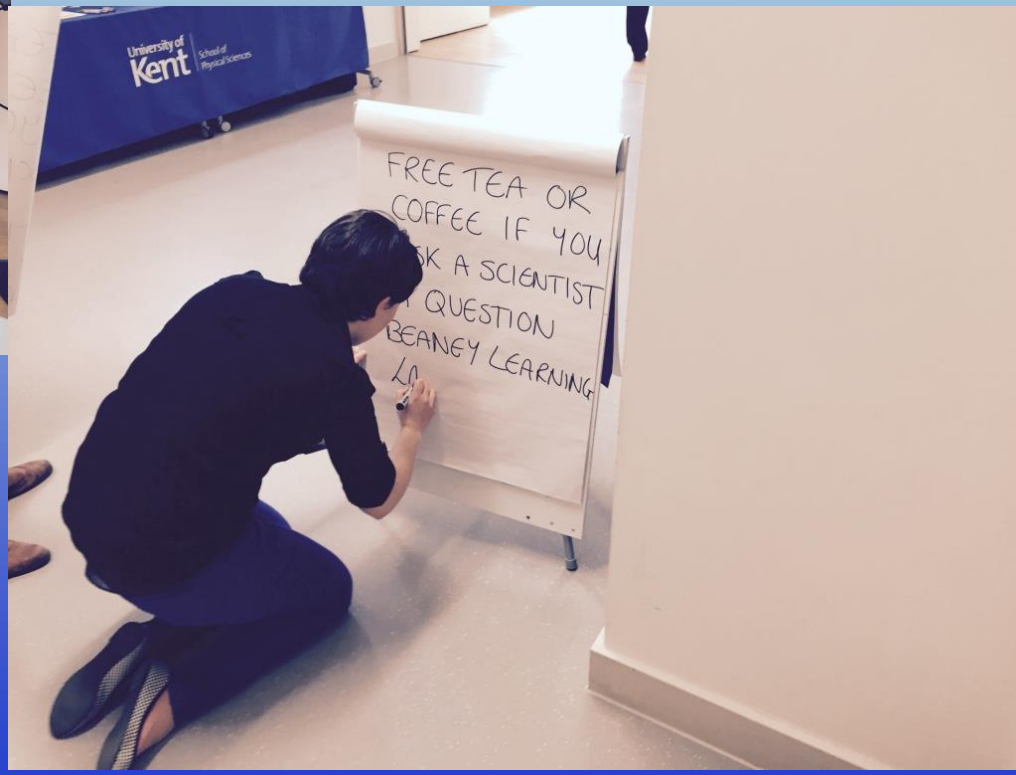
OUTREACH

Beaney House of Art and Knowledge
14 March 2015



Beaney House of Art and Knowledge
14 March 2015

http://www.kent.ac.uk/physical-sciences/research/aog/news-events-directory/beaney-outreach-15.html

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Catherine Chin, George Dobre

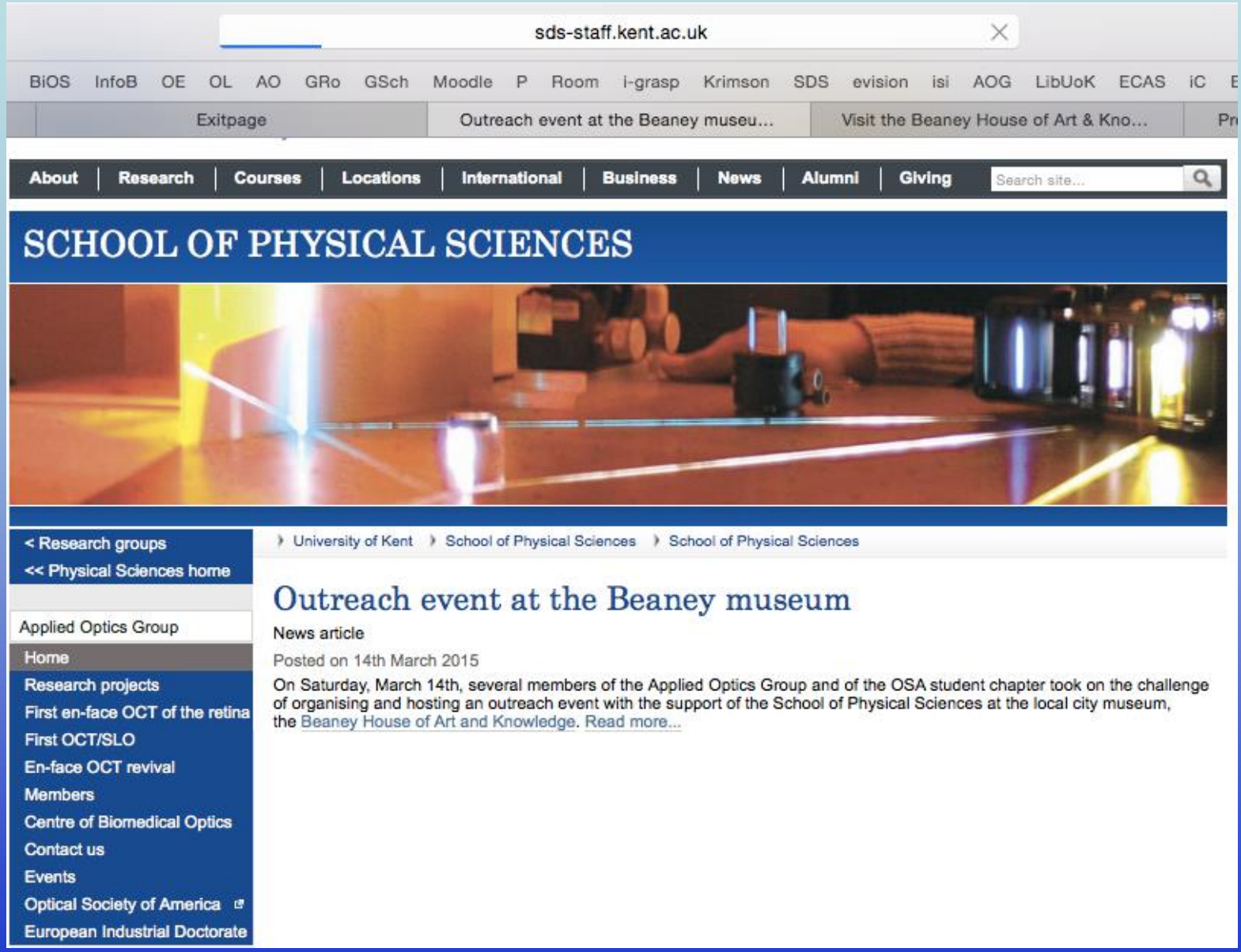
Beetles project at Simon Langton Grammar School for Boys, 28 Sept 2015

- **looked at two species of beetles elytra to characterise the iridescence shown by each species.**

at NKT

- **Sophie (ESR3): taught an UG student at DTU**
- **Week 8 full day, ESR1, ESR5 will contribute to the DTU Open Day**
- **Felix (ESR4): wrote a presentation for a Day of Science (Danish Initiative, 2015)**

Web page


sds-staff.kent.ac.uk
BiOS InfoB OE OL AO GRo GSch Moodle P Room i-grasp Krimson SDS evision isi AOG LibUoK ECAS iC
Exitpage
Outreach event at the Beaney museu...
Visit the Beaney House of Art & Kno...
About Research Courses Locations International Business News Alumni Giving
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SCHOOL OF PHYSICAL SCIENCES
< Research groups
<< Physical Sciences home
Applied Optics Group
Home
Research projects
First en-face OCT of the retina
First OCT/SLO
En-face OCT revival
Members
Centre of Biomedical Optics
Contact us
Events
Optical Society of America
European Industrial Doctorate
University of Kent › School of Physical Sciences › School of Physical Sciences
Outreach event at the Beaney museum
News article
Posted on 14th March 2015
On Saturday, March 14th, several members of the Applied Optics Group and of the OSA student chapter took on the challenge of organising and hosting an outreach event with the support of the School of Physical Sciences at the local city museum, the Beaney House of Art and Knowledge. Read more...

Other secondments (no long stays in the first 18 months)

- ESR1: visit to Bispebjerg Hospital
- ESR2: Maidstone Tunbridge Wells NHS Trust (ethical approvals, tissue, histology) and School of Pharmacy, Animal Lab
- ESR3: Vienna and Roskilde Hospital
- ESR4: Copenhagen University, Department of Neuroscience and Pharmocology, 3 visits

Other secondments

ESR4 Felix

- Joergen Arndt Jensen (DTU Elektro) (12.01.2015)
- Thomas Martini Joergensen (DTU Compute) (16.01.2015)
- Glostrup Hospital (02.02.2015)
  - Ophthalmology
- Roskilde Hospital (22.04.2015)
  - Dermatology
- Institute of Biomedical Optics (09.04.2015)
  - Gereon Huettmann on OCM and SuperK

Other secondments

Magalie (ESR5):

- **Opticent Health, 2 months with short visits to:**
- **Northwestern University (research lab and hospital)**
- **Summer School**
- **DTU**
- **Glostrup Hospital**

Future secondments

- ESR4: NPH 1 month
- ESR5: IoO/ME 1 month
- Photonics West (PW)

Entrepreneurship

- **ESR1,4,5 will meet Kim Hansen, Head of marketing, to organise them being on the stand at Photonics West**

Milestones

WP No.	Milestone No.	Milestone	Lead Beneficiary	Month	
13	K	Organisation of the Kick off meeting	UoK	1	Accomplished
13	R	Recruitment strategy defined	UoK	-10	Accomplished
1	1	Comprehensive theory of noise in SC optical sources and out of interferometers driven by SC optical sources and methods to alleviate noise	UoK	18	Accomplished
2	2	Functional Tunable UV pulse source based on supercontinuum with > 10 µJ below 300 nm	NKT	18	
3	3	Microscope assembled OCT system	UoK	31	Accomplished
4	4	Optical source with multiple windows outputs	UoK	31	In time
5	5	10 µJ pulse energy ns supercontinuum source for multimodal applications	NKT	31	Accomplished
6,8,13	6	Completed postgraduate training of the 5 ESRs	UoK	36	In time
9,13	7	Workshop 1 in Canterbury and Workshop 2 in Birkerod in conjunction with board meetings	UoK	20,32	Accomplished M20
10,13	8	Organisation of conference	UoK	44	
All	E	End meeting/preparations of the final report	UoK	48	

Deliverables

Annex I - UBAPHODESA final.pdf (page 24 of 33)

List of Deliverables

WP No.	Del. No.	Deliverable	Lead Beneficiary/ Other Participants	Nature[4]	Dissem-ination[5]	Month
1	1.1	Optical source with low noise level 650-950 nm based on findings in milestone 1	NKT/UoK	PR	PU	36
2	2.1	Optical tuneable source at short wavelengths	NKT/UoK	PR	PU	36
3	3.1	Ultra broadband microscope with axial and lateral resolution in the micrometer range	UoK/NKT	PR	PU	48
4	4.1	Spectroscopic OCT using supercontinuum	UoK/NKT	PR	PU	48
4	4.2	SC imaging system for high resolution imaging in ENT applications	NPH	PR	PU	46
5	5.1	Versatile SC source for multimodal applications	UoK/NKT	PR	PU	48
5	5.2	CARS/OCT system source in high resolution imaging of tissue	IO	PR	PU	46
6	6.1	Report on PG education and skills	UoK	R	PU	24, 48
7	7.1	Report on complementary training	UoK	R	PU	24, 36, 48
8	8.1.	Report on IPR education	NKT	R	PU	48
9	9.1	Report on the two workshops	UoK	R	PU	21, 33
11	11.1	Submission of papers to peer reviewed journals	UK/NKT, IO, NPH, DTU	P	PU	12, 24 36, 48
11	11.2	Delivery of presentations by ESRs at conferences	All partners	P	PU	12, 24, 36, 48
12	12.1	Delivery of outreach outputs	All partners	E	PU	4, 16, 28,46
13	13.1	Periodic progress reports/ Financial reports/ /Final report	UoK/NKT	E	PU	12,36, 24,48, 51

Completed

Completed

Completed

Deliverables

- Develop a basic version of the dissemination and use plan, months 23 (January 2016)
- NKT sales versus evolution of the field
- Lasse:

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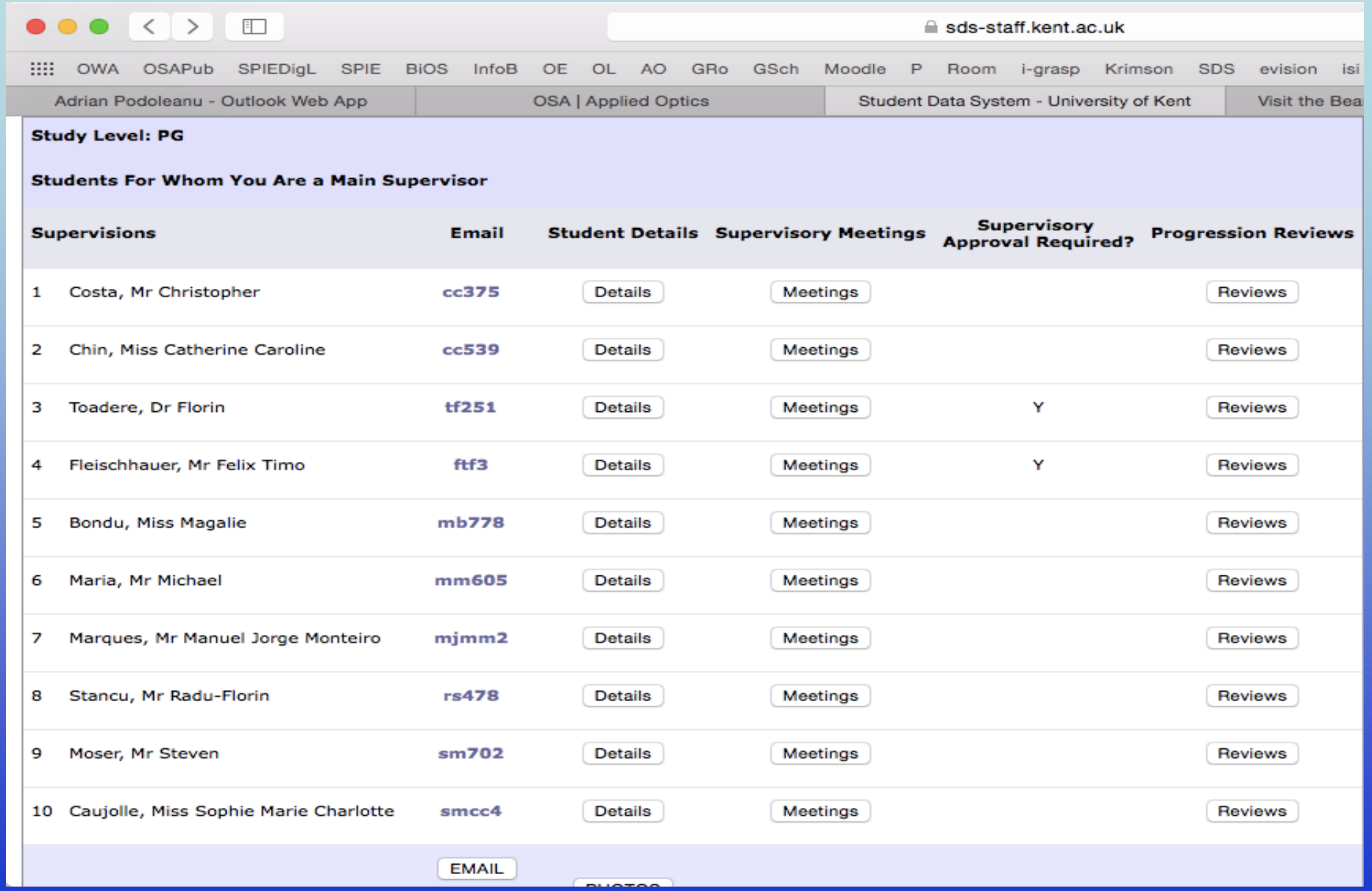
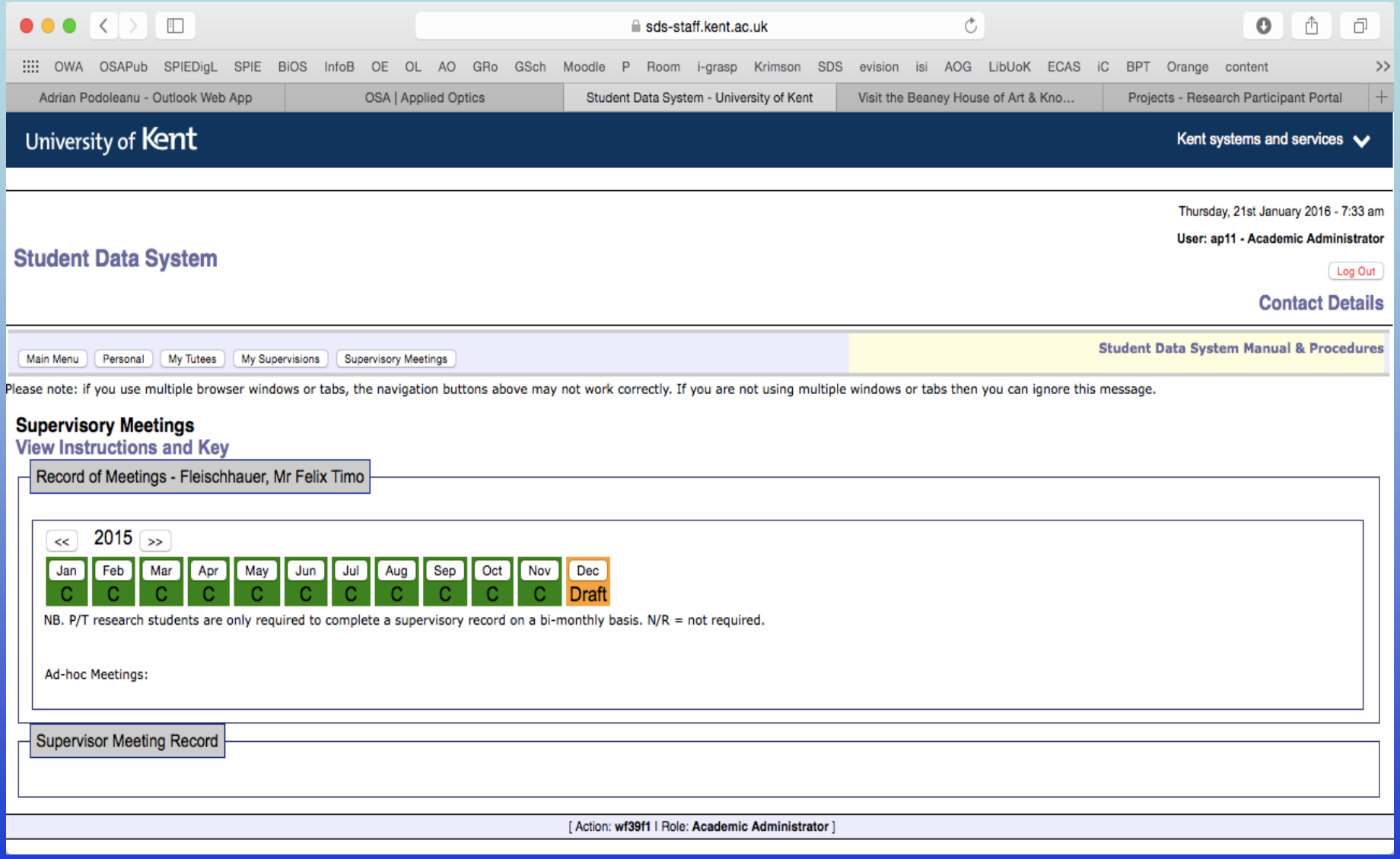
SUPERVISION

Student Data System



Supervision process



Visits

From UoK to NKT

- AP and GD (Board), 8 March 2015
- AP and M. Maria (ESR1), 31 March to 3rd June 2015
- AP, GD, C. Chin (ESR2), 23-25 Sept 2015, WS and Board
- AP, 27 Nov 2015

Visits

From NKT to UoK

- Lasse, Frederik Nielsen, Thomson Karsten, ESR3,4, 9 Oct. 2014 (Board);
- Intensive teaching of PH800: 18,19 Jan. 2015, Sophie (ESR3), Felix (ESR4), Magalie (ESR5);
- Felix (ESR4) and Thomas Feuchter met Ranj and Glen (IoO/MEH) 27 March 2015

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Continuous contact on Skype

Monthly meetings on Skype

Backup-Contacts with other researchers in Kent, Dr. Adrian Bradu (with ESR4) and PhD Manuel Marques (with ESR3)

WORK PACKAGES

WP No.	WP Type	Work Package Title	Deliverables (D) / Milestones (M)	Lead Partic.	Start month	End month
1	RTD	Establishment of connection between noise and usefulness of SC in clinical applications such as OCT	M1, D1.1	NKT	1	36
2	RTD	Intrinsic fluorescence excited with SC	M2, D2.1	NKT	1	36
3	RTD	Ultra broadband system for histology and submicron resolution of cells	M3, D3.1	UoK	13	48
4	RTD	SC generation in specific windows for versatile OCT investigations and spectroscopic OCT	M4, D4.1, D4.2	UoK	13	48
5	RTD	Multi modal approaches and applications	M5, D5.1, D5.2	UoK	13	48
6	TR	Postgraduate training	M6, D6.1	UoK	6	48
7	TR	Complementary training	M7, D7.1	UoK	3	48
8	TR	Training in IPR and entrepreneurship	D8.1	NKT	20	48
9	DISS	Workshops in year 2 and 3	M7, D9.1	UoK	20	32
10	DISS	Conference in year 4	M8	UoK	44	44
11	DISS	Dissemination of results and web page	D11.1, D11.2	UoK	12	48
12	OUT	Outreach	D12.1	UoK	4	46
13	MGT	Management and board meetings	K, E, M8, D13.1	UoK	1	48

B.3.2. Network-wide training events

	Training events, workshops & conferences	Lead Organising Institution	Planned date/length	Planned venue
1	Workshop WS1 in year 2	UoK	Month 20/ 1 day	UoK
2	Workshop WS2 in year 3	UoK	Month 32/ 1 day	NKT
3	Conference in year 4	UoK	Month 44/ 2 days	UoK

	Training events, workshops & conferences	Topics	Length
1	Workshop WS1	Presentations by ESRs; Presentations by supervisors Lecture on Ethics; Training in IPR (speaker from Elke and Fife, UK)	One full day
2	Workshop WS2	Presentations by ESRs; Presentations by supervisors Lecture on Ethics; Training in entrepreneurship; Training in IPR (speaker from Hegner & Partners) Visits of the NKT facilities	One full day
3	Conference	Presentations by ESRs; Presentations by supervisors Lecture on IPR (speaker from M&C); Presentations by invited speakers; Presentations by other participants Visits of the UoK facilities	At least two full days

Output (papers, awards)

- 1 paper published
- 1 paper in press
- 1 poster award ESR4, Felix, Danish Optical Society Meeting, on, 19/11/2015, Best Poster Award
- 1 patent application
- 13 conference participations
- 4 papers at Photonics West

Dissemination

- **ESR1: 3 conferences: presented at Laser Europe, DA Career celebration and DOPS in 2015, will attend PW,**
- **ESR2: 2 conferences**
- **ESR3: 3 conferences: 2DOPS, Year of the light**
- **ESR4: attended 3 conferences and a Summer school and will attend PW**
- **ESR5: 1 conference (Yearl of Light, DTU), Summer School, will attend PW**

Career Development Plans

Career Development Plan-Year 1
(Draft)

Name of fellow: Michael Maria

Department: School of Physical Sciences, University of Kent/NKT

Name of Supervisor: Adrian Podoleanu, George Dobre, Lasse Leick, Frederik Nielsen

Date: 3rd March 2014

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (half page should be sufficient):

Establishment of connection between noise and usefulness of SC in clinical applications such as OCT WP1-1. (UoK) Connection between noise and usefulness of SC in applications such as OCT)
In Kent, Michael will evaluate the link between noise and usefulness of supercontinuum (SC) in applications such as OCT)

Objectives:
- Understanding why SC sources with smooth spectrum output exhibit strong noise in relation to OCT
- Study beat noise
- Alleviate the noise effects

Tasks and methodology:
- Evaluate reduction of beat noise using balance detection
- Assemble interferometer configurations to reduce noise

Results:
D1.1 Optical source with low noise level 650-1100 nm based on findings in M1
M1. Comprehensive theory of noise in SC optical sources and out of interferometers driven by SC optical sources and m3sethods to alleviate such noise

WP1-2. (NKT) Design of supercontinuum for minimum noise:
At NKT, Michael will design a SC based OCT engine based on the findings in Kent

Objectives:
- Study the connection between fibre design, and spectrum shape which conditions noise
- Study how seeding pulses affect noise
- Study choice of broad band couplers and spectrometers for optimum OCT performance

Career Development Plan-Year 1
(Draft)

Name of the early stage researcher (ESR): Catherine Chin

Department: School of Physical Sciences, University of Kent/NKT

Name of Supervisor: Adrian Podoleanu, George Dobre, Lasse Leick, Frederik Nielsen

Date: 7th July 2014

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED:

Intrinsic fluorescence excited with SC
WP2-1. (NKT) Pulsed, tunable UV-light source based on Supercontinuum
WP2-2 (UoK) Characterisation of a pulsed tunable UV source and specific applications, such as intrinsic fluorescence
In Kent, Catherine will investigate how to modify a functional OCT/confocal microscope/fluorescence, to incorporate excitation of fluorophores at shorter wavelengths. This will be used on Drosophila studies and other samples under guidance from colleagues at Institute of ophthalmology, London and in the School of Pharmacy.

Objectives, Tasks and methodology and results are described in the Annex I of the UBAPHODESA grant, copy provided to the ESR.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals: Prepare the ESR for the dynamic market of Photonics and Biophotonics jobs. Empower the ESR with both technical and non technical skills for lifelong capacity to react to changes in the job market.

2. What further research activity or other training is needed to attain these goals?

It may be recommendable that after the PhD, the ESR finds a postdoc position before deciding the long career prospects, academia or industry or others.

SHORT-TERM OBJECTIVES (1-2 years):

1. Research results
   - Anticipated publications:
     At least a publication in a peer reviewed paper;
   - Anticipated conference, workshop attendance, courses, and /or seminar presentations:
     Please see below details.

2. Research Skills and techniques and presentation of research in outreach avtivities:
   - Training in specific new areas, or technical expertise etc:

Impact of the Network on the institutions involved

- Strengthened relations of UoK with DTU
- ShapeOCT, lead by the associated partner (DTU), placed UoK in another European consortium
- Created conditions of extra ITN applications (Jan. 2016)
- Stirred interests from other collaborating institutions (Maidstone Tunbridge Wells NHS Trust, East Kent Hospitals University NHS Foundation Trust
- Stirred interest of colleagues within the current institutions (Prof. C. Dainty, Prof. G. Jeffery), Dr. V. Gubala (School of Pharmacy

Presentation of each ESRs