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PROJECT FINAL REPORT

Grant Agreement number: 316165

Project acronym: CCQCN

Project title: Crete Center for Quantum Complexity and Nanotechnology

Funding Scheme: Coordination and Support Action

Period covered: from 1/9/2013 to 28/2/2017

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Executive Summary

During the lifetime of the CCQCN (Crete Center for Quantum Complexity and Nanotechnology) project, research has been rigorously conducted in all main directions, namely:
Research Direction 1: Magnetics and Magnetic Nanodevices
Research Direction 2: Strongly Correlated Condensed Matter Systems
Research Direction 3: Complex Materials and Metamaterials.

CCQCN researchers have produced 188 research papers (of which 138 are already published papers in peer-reviewed high-caliber journals, 30 are working papers and papers submitted to refereed journals, 4 are published book chapters, and 16 are papers already published in conference proceedings). 323 total outgoing visits took place (in twinning institutions, major international research groups, international conferences and events) from CCQCN members and researchers, as well as 149 incoming visits to CCQCN (in addition to the visits of researchers participating to the 10 CCQCN-organized workshops and conferences, or the additional 10 co-organized conferences and workshops), thus strengthening the research potential of CCQCN.

Regarding the hired research personnel, an overall of 27 Experienced Researchers (ERs) had been hired, along with 7 Senior Experienced Researchers (SERs). 2 administrative assistants had also been hired as well as one technician (computer specialist), as planned in the DoW. Workshops have been held as planned, the website of the project (http://qcn.physics.uoc.gr) is in operation from the very beginning, and outreach events and post-doc days have taken place systematically. The Center collaborates with the regional authorities (Regional Innovation Council of Crete, Region of Crete, Heraklion Chamber of Commerce and Industry) for contributions relevant to the region's Smart Specialization Strategy.

Regarding the research infrastructure, the equipment procurement process (for both laboratory and computational equipment) has been successfully completed. The High-Performance Cluster (HPC) has been in operation since March 2015. The Cryogen-free optical/electrical access cryostat/superconductive magnet assembly has been acquired and in operation since 2015, as is the Broad/Narrow band light excitation and single photon detection instrumentation. The procurement process for the acquisition of (a) the ink-jet printing system and the accompanying equipment, (b) the atomic layer deposition reactor, (c) the chemical vapor deposition system, as well as various parts and enhancements, was completed in 2016.

In order to ensure the long-term sustainability of the Center, the following actions have been taken:

a) Incorporation of CCQCN to the University of Crete's academic organization and administration structure. In February 3, 2017, it was published in the official Gazette of the Greek Government (Greek Government's Gazette Volume 2, ΦΕΚ #254/3-2-2017, Decision #182) the official decision of the incorporation of CCQCN to the Advanced Physics Lab of the University of Crete, establishing the new "Advanced Physics Lab – Center for Quantum Complexity & Nanotechnology").
b) Participation to the submission of five (5) Horizon 2020 (FET-OPEN and RISE) proposals along with its twinning institutions; one proposal has been successful, with CCQCN coordinating the consortium.
c) Collaborating with the Region of Crete in the Region's Initiatives funded by Structural Funds earmarked for Crete, supporting the formation of a spin-off company, and exploring IPR options.
d) Taking into account the recommendations of the project's External Evaluation Committee to achieve long-term sustainability and long-term research excellence.

Summary description of project context and objectives

Starting its operation on September 1, 2013, the Crete Center for Quantum Complexity and Nanotechnology (CCQCN) project (FP7-REGPOT-2012-2013-1 project; Project number: 316165) has actively pursued high-caliber theoretical, experimental and computational research in promising areas of Condensed Matter Physics and applications.

The CCQCN is located at the premises of the Physics Department of the University of Crete and its members are professors of the Physics Department of the University of Crete, pursuing research in areas such as:

- Josephson junctions (theory)
- Ultrafast phenomena (theory)
- Magnetics (theory)
- Quantum metamaterials(theory)
- Holographic models for strongly correlated electrons
- Graphene (experiment)
- Nanoelectronics, flexible semiconductors (experiment)
- Measurements, atomic physics(experiment)
- Superconductivity (experiment)
- Computational condensed matter physics

The main objectives of the CCQCN are linked to the following actions taken to fulfill them:

Action 1: the strengthening of the research potential of the Center through the recruitment of research personnel, with ten experienced researchers (ERs) to be hired in order to perform research work in the target areas of the Center, and, additionally, employing five senior experienced researchers (SERs) with higher qualifications.

Action 2*:* development of strategic partnerships (twinning) with nine major research organizations in Europe. The partnership will involve research contacts, exchange of personnel via visits, common organization of events, and generally a strong willingness from all sides for establishment of a close collaboration for research. CCQCN members, senior-experienced researchers (SERs) and experienced researchers (ERs) interact actively with researchers, via twinning links, in the following leading institutions:

- Max Planck Institute for Dynamics and Self-Organization, Goettingen
- Institute for Solid State Research (IFW), Dresden
- Cambridge University, incl. Department of Applied Mathematics and Theoretical Physics (DAMTP) Cavendish Laboratory and Center for Advanced Photonics and Electronics including specialized scientists in the focus areas in other UK institutions
- Leiden University
- Laboratory of Analysis and Architecture of Systems (LAAS-CNRS), Toulouse
- Institute of Solid State Physics, Technion, Haifa including I-Core collaboration and scientists in Israel
- Cologne University
- Physics Institute, Karlsruhe Institute of Technology (KIT)
- Laboratoire de Physique Theorique de l'Ecole Normale Superieure (LPT ENS), including scientists of the Paris area.

Action 3: organization of major meetings (including a kick-off meeting) and focused workshops. The kick-off meeting sets up the stage for the participants while selected external scientists will give scientific input on the scope of the Center. Eight meetings in workshop/conference format will target specific focus areas of the project and serve the purpose of familiarize members with current research topics and the establishment of contacts with exterior leading experts. The meetings address important research aspects of the project and serve additionally toward the purpose of dissemination of the results obtained, as well as increase the visibility of the group in Europe and beyond. Additional meetings will be supported if funds permit it.

Action 4: establishment of an International Advisory Committee (IAC) consisting of three outstanding outside senior researchers in the field that are world-class scientists and the Coordinator of CCQCN. The scope of the IAC is to monitor the progress made during the implementation of the project, facilitate decisions regarding the most beneficial implementation of the project and give advice on all aspects of the Center activities.

Action 5: procurement of a state-of-the-art high-performance computational facility (HPC) and experimental equipment (to enhance its low temperature and micro-nanoelectronics facilities), thus enabling its large number of researchers to advance collaborative research work in the focus areas.

The hiring of the researchers, the procurement of the infrastructure, the interaction (twinning) with the leading European institutions and the strong visitors/workshops/conference-organization program of the Center are strong enablers toward major advancements in research in order to turn CCQCN into a Center of Excellence with long term viability.

An internal and an external evaluation are integral parts of the project. The external evaluation of the CCQCN project comprises the main work conducted in WP7 (Project Evaluation); according to its objectives “the Center will work with the European Commission and form an External Evaluation Committee that will perform an evaluation of the Center’s achievements and activities. The evaluation report will be used towards the sustainability and excellence status of the Center…the evaluation of the project through the External Evaluation Committee (EEC) will be very valuable especially in this direction, i.e., organizing the transition from the EU funding period to the Center’s self-sustainability…[the Center] will use the recommendations to fix possible problems and strengthen possible weaknesses…” in order to support the effort toward the long-term sustainability of the Center.

Main S&T results

Main achievements per Work Package (WP)

CCQCN has successfully concluded the planned (in the DoW) work, delivering all deliverables and achieving all milestones envisaged. The detailed presentation of the planned work is presented in the relevant deliverables and the first and second periodic reports.

The main achievements per WP (WP1-WP7) are presented below.

WP1: Strengthening the Research Potential

7 SERs and 27 ERs (as well as 15 ER/SER short-term appointments, and 10 research support short-term hirings) were hired during the lifetime of the project, via the appropriate EU and Greek State's rules and procedures for employment of researchers.

The total number of SER+ER positions is considerably more than the number of positions (15) presented to the DoW original plan (this increase is due to the current world-wide economic climate as well as to Greek State's lower salaries due to contemporary harsh economic conditions, which lowers salary levels and, thus, offers additional positions).

The total CCQCN p-month effort is 789 p-months (compared to the originally planned, in the DoW, total p-month effort of 510 months [170 for SERs and 340 for ERs], or the total p-month effort of 593 months stated in the amended DoW); there is an almost 50% increase in the research effort during the lifetime of the project (compared to the original plan for p-effort).

Details are presented in the first and second periodic reports and in Deliverable 7.1 as well as in other relevant deliverables (such as D1.2 and D1.4).

WP2: Infrastructure

The HPC (High Performance Computing) system became operational in March 2015; it was named The METROPOLIS Supercomputing Facility in order to commemorate the legacy of Nickolas Metropolis, a Greek-American pioneer in computational physics. The Opening Ceremony (Inauguration) took place on March 27, 2015, with Greek State Authorities, Regional Authorities, and University of Crete Authorities participating.

Regarding laboratory equipment, the Cryogen-free optical / electrical access cryostat / superconductive magnet assembly has been acquired and is operational. So is the Broad/Narrow band light excitation and single photon detection instrumentation. Acquisition of (a) the ink-jet printing system and the accompanying equipment, (b) the atomic layer deposition reactor, and (c) the chemical vapor deposition reactor, as well as various parts and enhancements (for both laboratory and HPC equipment), had been successfully completed by M39 (November 2017).

WP3: Personnel exchanges, twinning and international visits

During the M1-M39 period, CCQCN members and researchers have made 323 total outgoing visits (107 of which took place in twinning institutions) took place (in twinning institutions, major international research groups, international conferences and events), and 149 incoming visits (60 of which were from twinning institutions) have been made to CCQCN, thus strengthening the research potential of CCQCN.

The break-down of the number of outgoing visits to twinning institutions is the following:

Max Planck Institute for Dynamics and Self-Organization, Goettingen – 4 visits

Institute for Solid State Research (IFW), Dresden – 13 visits

Cambridge University, incl. Department of Applied Mathematics and Theoretical Physics (DAMTP) Cavendish Laboratory and Center for Advanced Photonics and Electronics including specialized scientists in the focus areas in other UK institutions – 37 visits

Leiden University – 8 visits

Laboratoire de Physique Theorique de l'Ecole Normale Superieure (LPT ENS), including scientists of the Paris area, and Laboratory of Analysis and Architecture of Systems (LAAS-CNRS), Toulouse – 25 visits

Institute of Solid State Physics, Technion, Haifa including I-Core collaboration and scientists in Israel – 11 visits

Cologne University – 5 visits

Physics Institute, Karlsruhe Institute of Technology (KIT) – 4 visits.

As mentioned before, at the same time, 149 incoming research visits were conducted, 60 of which were from twinning institutions, to CCQCN.

The break-down of the number of incoming visits from twinning institutions (not including workshops participation) is the following:

Institute for Solid State Research (IFW), Dresden – 4 visits

Cambridge University, incl. Department of Applied Mathematics and Theoretical Physics (DAMTP) Cavendish Laboratory and Center for Advanced Photonics and Electronics including specialized scientists in the focus areas in other UK institutions – 25 visits

Leiden University – 4 visits

Laboratoire de Physique Theorique de l'Ecole Normale Superieure (LPT ENS), including scientists of the Paris area; and Laboratory of Analysis and Architecture of Systems (LAAS-CNRS), Toulouse – 22 visits

Institute of Solid State Physics, Technion, Haifa including I-Core collaboration and scientists in Israel – 3 visits

Physics Institute, Karlsruhe Institute of Technology (KIT) – 1 visit.

These visits have strengthened the research potential of CCQCN, which is documented in the Center's research production of 188 research papers (working papers, papers submitted to refereed journals, published papers) during the project's duration (of the 188 research papers produced, 138 are already published papers, 30 are working papers and papers submitted to refereed journals, 4 are published book chapters, and 16 are papers already published in conference proceedings).

All the Center's research papers are presented at the end of this document (Appendix I).

How do CCQCN's actual research visits compare to planned ones (in DoW): As stated in the amended DoW, pages 12 and 13, a total of (a) 270 outgoing visits, and (b) 140 incoming visits, have been planned for the entire duration of the project (M1-M39). Thus, the planned (in DoW) numbers have been reached (with the number of outgoing visits [=323] and the number of incoming vists [=149] overcoming the planned numbers) by M39, bringing the total number of actual outgoing and incoming visits greater than the planned numbers.

CCQCN has signed Memoranda of Understanding for strengthening its research links and dissemination activity with the Center for High Technologies in Uzbekistan, with the Institute for High Technologies in Kazakhstan, the International Research Center for Renewable Energy, State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, People's Republic of China, and the Institute of New Energy, Futian District, Shenzhen, People's Republic of China.

WP4: Workshop organization, outreach and dissemination

During the lifetime of the project (M1-M39), the following ten (10) CCQCN workshops have taken place in Greece (with a total of 460 participants, from whom 94 are twinning incoming participants):

- Workshop on Theoretical Physics, 5-10 September 2016, Heraklion (29 participants, from whom 9 are twinning incoming participants).
- Spin Orbit Coupling and Topology in Low Dimensions, 27 June-02 July 2016, Spetses, Greece (39 participants, of whom 4 are twinning incoming participants).
- Quantum Metamaterials & Quantum Technology, 20-24 June 2016, Spetses, Greece (35 participants, of whom 8 are twinning incoming participants).
- Non-Hermitian Photonics in Complex Media: PT-symmetry and beyond, 15-18 June 2016, Heraklion, Greece (41 participants, of whom 5 are twinning incoming participants).
- Quantum Magnets, September 13-19, 2015, Kolymbari, Greece (50 participants, of whom 10 are twinning incoming participants).
- Spin-Orbit Coupling in Surface or Interface States (Correlated electronic materials), June 8-12, 2015, Spetses, Greece (45 participants, of whom 7 are twinning incoming participants).
- Quantum Metamaterials, June 1-6, 2015, Spetses, Greece (33 participants, of whom 9 are twinning incoming participants).
- Quantum Phononics - From Transport and Optomechanics to Quantum Biology, 27-29 May, 2015, Heraklion, Greece (29 participants, of whom 2 are twinning incoming participants).
- Quantum Field Theory, String Theory and Condensed Matter Physics [Holographic Applications], September 1-7, 2014, Kolymbari Crete (99 participants, of whom 32 are twinning incoming participants)
- CCQCN Kick-off Meeting (inauguration workshop) September 5-7 2013, Heraklion (60 participants, of whom 8 are twinning incoming participants)

Additional Workshops/Conferences:

As is described in the DoW (WP4) "CCQCN can organize possible additional workshops (if the funds permit it) in research areas related to the research activities of the Center and its members". With funds permitting, CCQCN has additionally organized/co-organized 10 conferences/workshops (the websites of which can be found in CCQCN's website) as well as mini-workshops. In 2016, CCQCN organized and co-organized the following workshops and conferences:

- 11th Hellenic Polymer Society International Conference, held at the Foundation for Research and Technology (FORTH), Heraklion, Crete, during November 3-5, 2016.
- 2nd Hellenic Workshop on 2-dimensional Materials, held at the Foundation for Research and Technology (FORTH), Heraklion, Crete, during November 1-2, 2016.
- 6th International Symposium on Transparent Conductive Materials (TCM2016), Platanias, Chania, Crete (9-13/10/2016).
- Metamaterials 2016 (10th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics – Metamaterials 2016), Platanias Chania Crete (17-22 September 2016).
- 23th Summer School and Conference «Dynamical Systems and Complexity» (27 August – 3 September 2016), Aristoteleio University of Thessaloniki camp in Kalandra, Halkidiki, Greece.
- International Conference "CRETE HAS ENERGY" Heraklion (22-23 March 2016).

In 2015, CCQCN co-organized the international workshop/conference "Stochastic Methods in Finance and Physics" (20-24 July, 2015*)* in Heraklion, Crete, Greece. In 2014, the Center organized the "Fourth International Workshop on Statistical Mechanics and Dynamical Systems" (focusing on complexity and dynamical systems), which took place in Athens, 17-19 July 2014. CCQCN organized and partially supported this workshop because it focused on issues related to the research activities of the Center and its members. CCQCN co-organized the 4th PhD Summer School – Conference on "Mathematical Modeling of Complex Systems", which took place in Athens on July 14-25, 2014. CCQCN sponsored a session at the ICCMSE 2014 Conference (the 10th International Conference of Computational Methods in Sciences and Engineering), 4-7 April 2014, Athens.

The Workshops on Theoretical Physics (5-10 September 2016, Heraklion) and on Quantum Field Theory, String Theory and Condensed Matter Physics [Holographic Applications] (Sept 1-7, 2014, Kolymbari Crete) were co-organized with the Crete Center for Theoretical Physics of the Physics Department of the University of Crete (CCTP).

The detailed Outreach activities of CCQCN are presented in a subsequent section.

WP5: Management and International Advisory Committee

Day-to-day operations have been overseen by the CCQCN Coordinator and the Management Committee, supported by 2 administrative assistants (who also support the twinning visits, the newly hired ERs and SERs regarding administrative issues, the secretarial support of the workshops/conferences, as well as the administrative, and financial aspects of the operation of the Center) and a computer specialist (supporting the digital infrastructure). Activities include contacts with the International Advisory Committee (IAC) members (as planned and presented in the DoW) and regional contacts (i.e. Crete Region).

The International Advisory Committee, comprises three outside senior scientists and is a complementary body that assists the Management Committee of CCQCN in the research directions, hirings, twinning and workshops. The scope of the IAC is to monitor the progress made during the implementation of the CCQCN project and advice toward the most beneficial implementation of the project and on all aspects of the Center activities. The IAC fully assesses the evolution, achievements, success and/or possible problems of the project. IAC has prepared two (2) Advisory Reports, taking into account the evolution, achievements, success and/or possible problems of CCQCN as revealed in the M1-M12 (M1=September 2013) period of the lifetime of the project (1st

Advisory Report) and as revealed in the M13-M30 (M30=February 2016) period of the lifetime of the project (2nd Advisory Report). The IAC has found the evolution, achievements and success of CCQCN extremely convincing and conforming to the DoW as planned.

WP6: Organization and management of intellectual property and innovation capability

The "Guide to Innovation Exploitation – Formation of Spin-Off Companies" has been prepared, uploaded to CCQCN's website, and embedded to Deliverable 6.2. This Guide complements the "Guide to IPRs and Patents", which had been prepared (M18) and uploaded.

CCQCN researchers have worked with subcontractor STEP-C, which provides support, to explore IPR and commercialization aspects of their work. The formation of one spin-off company has been achieved. Networking with the Chamber of Commerce of Heraklion, the Region of Crete and regional authorities, start-up high-tech companies, the Foundation of Research and Technology-Hellas (FORTH), the ATEI-Crete have been initiated and pursued. Industry-Academia events have been conducted. CCQCN researchers have continued their IP training and selected researchers updated their IP competencies by attending a specialized European Patent Office (EPO) workshop.

The Center's Exploitation Innovation Committee, in collaboration with STEP-C, has been instrumental in the Center's communication with the Regional authorities (Regional Innovation Council of Crete, Region of Crete, Chambers of Commerce and Industry) for relevance to the region's Smart Specialization Strategy and for dissemination of research and infrastructure resources.

WP7: Project Evaluation

The internal and the external evaluation of the CCQCN project have been conducted and the findings have been presented in the relevant deliverables (D7.1 and D7.2). The External Evaluation Committee (EEC), which had been formed in collaboration with the EC authorities (namely, the Project Officer) in Spring 2016, comprised Prof. Siddharth S. Saxena (of Cambridge University's Jesus College and Cavendish Laboratory) as Chairperson, Prof. Uzy Smilansky (Department of Physics of Complex Systems, at the Weizmann Institute of Science), and Prof. Theo Geisel (Director at the Max Planck Institute for Dynamics and Self-Organization and Professor of Theoretical Physics at the University of Göttingen) as members.

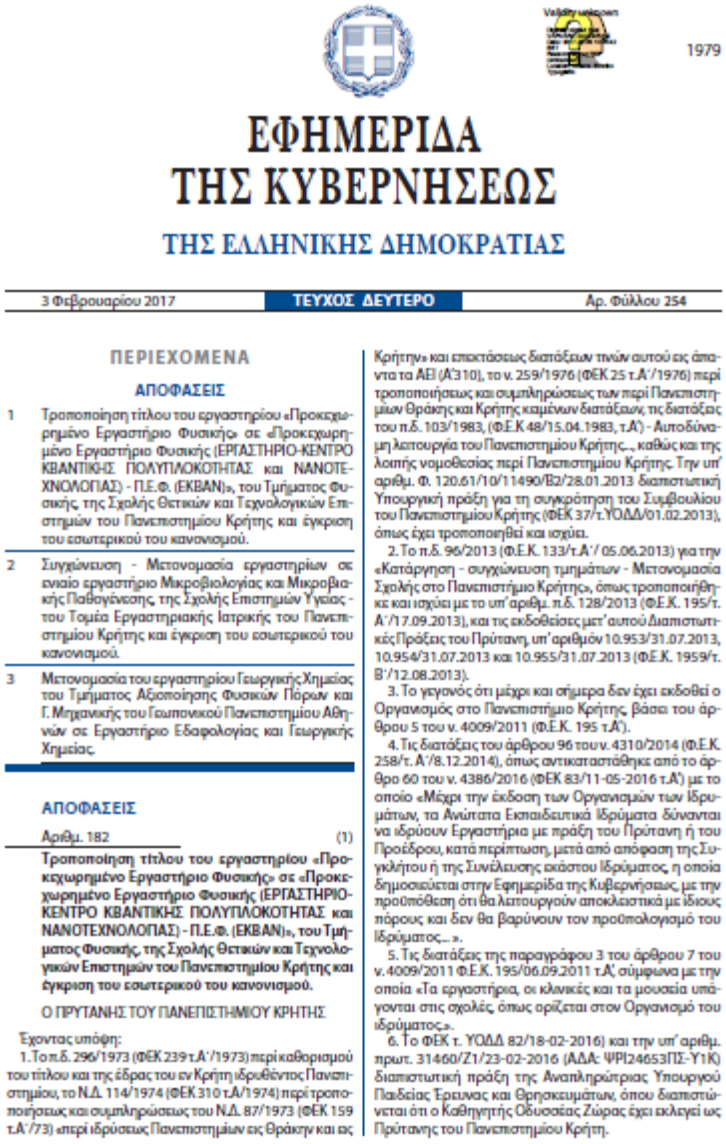
The EEC members conducted in-situ visits during: (a) the Quantum Metamaterials & Quantum Technology (20-24 June 2016, Spetses, Greece) workshop, and (b) October 13-15, 2016, in the CCQCN premises, where the external evaluators were presented with details of the Center's activity and accomplishments, and conducted laboratory visits and personal interviews. The Center's researchers presented their research work in posters for the external evaluators to see and discuss; photographs below depict instances from this interaction. CCQCN handed-in the project's deliverables to EEC members, including deliverable 7.1 (Internal Evaluation Report), which details all actions, activities and accomplishments during the implementation (EU-funded period) of the CCQCN project; that time period spans M1 (September 2013) - M39 (November 2016).

In addition, CCQCN's Scientific Responsible (Project's Coordinator) Prof. G. Tsironis visited the Chairman of the EEC at Cambridge University (in February 2017; M42), in order to discuss, expand, and finalize the preparation of the External Evaluation Report.

Main CCQCN Actions taken to ensure long-term sustainability

The following actions have been successfully pursued by CCQCN's Coordinator and Management Committee in order to ensure the long-term sustainability of the Center:

- Incorporation of CCQCN to the University of Crete's academic organization and administration structure. In February 3, 2017, it was published in the official Gazette of the Greek Government (see scanned page below, of the Greek Government's Gazette Volume 2, FEK #254/3-2-2017, Decision #182) the incorporation of CCQCN to the Advanced Physics Lab of the University of Crete, establishing the new "Advanced Physics Lab – Center for Quantum Complexity & Nanotechnology").



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ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ
ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

3 Φεβρουαρίου 2017 | ΤΕΥΧΟΣ ΔΕΥΤΕΡΟ | Αρ. Φύλλου 254

ΠΕΡΙΕΧΟΜΕΝΑ

ΑΠΟΦΑΣΕΙΣ

1 Τροποποίηση τίτλου του εργαστηρίου «Προκεχωρημένο Εργαστήριο Φυσικής» σε «Προκεχωρημένο Εργαστήριο Φυσικής (ΕΡΓΑΣΤΗΡΙΟ-ΚΕΝΤΡΟ ΚΒΑΝΤΙΚΗΣ ΠΟΛΥΠΛΟΚΟΤΗΤΑΣ και ΝΑΝΟΤΕΧΝΟΛΟΓΙΑΣ) - Π.Ε.Φ. (ΕΚΒΑΝ)», του Τμήματος Φυσικής, της Σχολής Θετικών και Τεχνολογικών Επιστημών του Πανεπιστημίου Κρήτης και έγκριση του εσωτερικού του κανονισμού.

2 Συγχώνευση - Μετονομασία εργαστηρίων σε ενιαίο εργαστήριο Μικροβιολογίας και Μικροβιακής Παθογένεσης, της Σχολής Επιστημών Υγείας - του Τομέα Εργαστηριακής Ιατρικής του Πανεπιστημίου Κρήτης και έγκριση του εσωτερικού του κανονισμού.

3 Μετονομασία του εργαστηρίου Γεωργικής Χημείας του Τμήματος Αξιοποίησης Φυσικών Πόρων και Γ. Μηχανικής του Γεωπονικού Πανεπιστημίου Αθηνών σε Εργαστήριο Ε.δαφολογίας και Γεωργικής Χημείας.

ΑΠΟΦΑΣΕΙΣ

Αριθμ. 182 (1)

Τροποποίηση τίτλου του εργαστηρίου «Προκεχωρημένο Εργαστήριο Φυσικής» σε «Προκεχωρημένο Εργαστήριο Φυσικής (ΕΡΓΑΣΤΗΡΙΟ-ΚΕΝΤΡΟ ΚΒΑΝΤΙΚΗΣ ΠΟΛΥΠΛΟΚΟΤΗΤΑΣ και ΝΑΝΟΤΕΧΝΟΛΟΓΙΑΣ) - Π.Ε.Φ. (ΕΚΒΑΝ)», του Τμήματος Φυσικής, της Σχολής Θετικών και Τεχνολογικών Επιστημών του Πανεπιστημίου Κρήτης και έγκριση του εσωτερικού του κανονισμού.

Ο ΠΡΥΤΑΝΗΣ ΤΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΚΡΗΤΗΣ

Έχοντας υπόψη:

1. Το π.δ. 296/1973 (ΦΕΚ 239 τ.Α΄/1973) περί καθορισμού του τίτλου και της έδρας του εν Κρήτη ιδρυθέντος Πανεπιστημίου, το Ν.Δ. 114/1974 (ΦΕΚ 310 τ.Α/1974) περί τροποποιήσεως και συμπληρώσεως του Ν.Δ. 87/1973 (ΦΕΚ 159 τ.Α΄/73) «περί ιδρύσεως Πανεπιστημίων εις Θράκην και εις Κρήτην» και επεκτάσεως διατάξεων τινών αυτού εις άπαντα τα ΑΕΙ (Α'310), το ν. 259/1976 (ΦΕΚ 25 τ.Α΄/1976) περί τροποποιήσεως και συμπληρώσεως των περί Πανεπιστημίων Θράκης και Κρήτης καμένων διατάξεων, τις διατάξεις του π.δ. 103/1983, (Φ.Ε.Κ 48/15.04.1983, τ.Α΄) - Αυτοδύναμη λειτουργία του Πανεπιστημίου Κρήτης..., καθώς και της λοιπής νομοθεσίας περί Πανεπιστημίου Κρήτης. Την υπ' αριθμ. Φ. 120.61/10/11490/Β2/28.01.2013 διαπιστωτική Υπουργική πράξη για τη συγκρότηση του Συμβουλίου του Πανεπιστημίου Κρήτης (ΦΕΚ 37/τ.ΥΟΔΔ/01.02.2013), όπως έχει τροποποιηθεί και ισχύει.

2. Το π.δ. 96/2013 (Φ.Ε.Κ. 133/τ.Α΄/ 05.06.2013) για την «Κατάργηση - συγχώνευση τμημάτων - Μετονομασία Σχολής στο Πανεπιστήμιο Κρήτης», όπως τροποποιήθηκε και ισχύει με το υπ' αριθμ. π.δ. 128/2013 (Φ.Ε.Κ. 195/τ. Α΄/17.09.2013), και τις εκδοθείσες μετ' αυτού Διαπιστωτικές Πράξεις του Πρύτανη, υπ' αριθμόν 10.953/31.07.2013, 10.954/31.07.2013 και 10.955/31.07.2013 (Φ.Ε.Κ. 1959/τ. Β΄/12.08.2013).

3. Το γεγονός ότι μέχρι και σήμερα δεν έχει εκδοθεί ο Οργανισμός στο Πανεπιστήμιο Κρήτης, βάσει του άρθρου 5 του ν. 4009/2011 (Φ.Ε.Κ. 195 τ.Α΄).

4. Τις διατάξεις του άρθρου 96 του ν. 4310/2014 (Φ.Ε.Κ. 258/τ. Α΄/8.12.2014), όπως αντικαταστάθηκε από το άρθρο 60 του ν. 4386/2016 (ΦΕΚ 83/11-05-2016 τ.Α') με το οποίο «Μέχρι την έκδοση των Οργανισμών των Ιδρυμάτων, τα Ανώτατα Εκπαιδευτικά Ιδρύματα δύνανται να ιδρύουν Εργαστήρια με πράξη του Πρύτανη ή του Προέδρου, κατά περίπτωση, μετά από απόφαση της Συγκλήτου ή της Συνέλευσης εκάστου Ιδρύματος, η οποία δημοσιεύεται στην Εφημερίδα της Κυβερνήσεως, με την προϋπόθεση ότι θα λειτουργούν αποκλειστικά με ίδιους πόρους και δεν θα βαρύνουν τον προϋπολογισμό του Ιδρύματος...».

5. Τις διατάξεις της παραγράφου 3 του άρθρου 7 του ν. 4009/2011 Φ.Ε.Κ. 195/06.09.2011 τ.Α΄ σύμφωνα με την οποία «Τα εργαστήρια, οι κλινικές και τα μουσεία υπάγονται στις σχολές, όπως ορίζεται στον Οργανισμό του Ιδρύματος.».

6. Το ΦΕΚ τ. ΥΟΔΔ 82/18-02-2016) και την υπ' αριθμ. πρωτ. 31460/Ζ1/23-02-2016 (ΑΔΑ: ΨΡΙ24653ΠΣ-Υ1Κ) διαπιστωτική πράξη της Αναπληρώτριας Υπουργού Παιδείας Έρευνας και Θρησκευμάτων, όπου διαπιστώνεται ότι ο Καθηγητής Οδυσσέας Ζώρας έχει εκλεγεί ως Πρύτανης του Πανεπιστημίου Κρήτη.

- CCQCN has achieved a high retention percentage of its researchers. Specifically, of the 22 ER and SER researchers who were employed by the end of the research dimension of the project (that is, by November 2017), 15 researchers have been retained by funding them from European and national (Greek) projects. One of the SER researchers has applied successfully for a professorship position at the Physics Department of the University of Crete (a "brain-gain" example, since he was attracted from abroad); another

SER is managing the Center's spin-off; four SERs continue their research by being financially covered by national projects. Overall 4 SERs (out of the 5 SERs employed by the end of the project) have been retained. Counting the ERs as well, regarding ER/SERs CCQCN has achieved a 50% retention rate.

- CCQCN has participated in the submission of five (5) Horizon 2020 (FET-OPEN and RISE) proposals along with its twinning institutions (Cambridge University, Karlsruhe Institute of Technology [KIT], Technion). One proposal (NHQWAVE) has been successful, with CCQCN co-ordinating the consortium. CCQCN has also participated to consortia, with non-twinning partners, submitting proposals to other H2020 calls. CCQCN has supported the Greek Government's S&T Funding Authority (GGET-Greek Ministry of Education and Research) toward the European project QUANTERA and CCQCN's representatives have attended high-level meetings and workshops of the European Initiative on Quantum Technologies (which leads to the third EU Flagship Programme on Quantum Technologies).

- CCQCN (vesting its regional development role) has collaborated with the Region of Crete in the initiative of the Region of Crete to launch the Crete Center for Energy Technologies (KETEK) in order to focus on modern energy technologies. This Crete Center for Energy Technologies is part of the Region of Crete Smart Strategic Specialization (S3) policy. Energy efficiency is of primary importance to the Region of Crete. The island of Crete becomes the top Greek tourist destination every summer, with an immense need for energy generation and steady-state distribution. CCQCN participates in this regional initiative by providing its "METROPOLIS Supercomputing Facility" for advanced scientific projects. Participation to such initiatives offer the opportunity to establish links with key regional partners such as the Foundation for Research and Technology Hellas (FORTH), the Heraklion Chamber of Commerce and Industry, STEP-C, and the Technological Educational Institute of Crete. In October 2016, CCQCN was included in the Region of Crete funding initiative to strengthen the 3 Higher Education Institutions (HEIs) of the Crete Region, namely the University of Crete, the Technical University of Crete, and the ATEI-Crete.

Main S&T Results & Long-Term Research Strategy

Research has been rigorously conducted in all main research directions, namely:

Research Direction 1: Magnetics and Magnetic Nanodevices
Research Direction 2: Strongly Correlated Condensed Matter Systems
Research Direction 3: Complex Materials and Metamaterials,

along theoretical/analytical, computational, and experimental lines of research. All research papers can be accessed at the CCQCN's website http://qcn.physics.uoc.gr/content/journals and http://qcn.physics.uoc.gr/content/preprints, as well as in Appendix I at the end of this document.

As presented in Deliverable 7.2, regarding the long-term strategy of the Center, it is important to focus on research areas offering "mutual-fertilization" among fields/areas/institutions, as well as offering the potential for technology applications and commercialization. These long-term research strategic dimensions have been highlighted in the roadmap currently under preparation by the European Commission laying the ground for the launch in 2018 of a €1 billion flagship initiative on quantum technologies, which can put Europe at the forefront of the second quantum revolution, bringing transformative advances to science, industry and society. The flagship initiative is expected to turn Europe's research results in areas like quantum secure communication, quantum sensing and quantum simulation and computing into concrete technological opportunities that can be taken up by industry. The roadmap calls for an ambitious strategy to set the bases of a world-class quantum industry in Europe that will unlock the full potential of quantum technologies and bring commercial products to public and private markets, combining education, science, engineering and entrepreneurship. The €1 billion initiative announced by the European Commission will provide this ambitious, coordinated and long-term strategy needed to support joint science, engineering and application work, including IPR, standardisation, market development, training and public procurement.

CCQCN research groups have proved that they have the capability to orient themselves (under the influence of this "external field") to such areas, in collaboration with twinning and other European partners, forming research consortia and submitting applications to calls for proposals for funding. For example, as presented in deliverable D7.2, the CCQCN "complex materials and quantum metamaterials" group (Tsironis, Lazaridis, Makris, Neofotistos, Matthaiakis, Hizanidis, Navez, Ivic et al.) can team-up with research groups in cryogenic engineering, materials chemistry, and the physics of correlated matter, to design and characterize novel nanostructures; solid-state, cryogen free technology promises compact, efficient, safe and environmentally friendly applications with potential for use in many existing fields and markets as well as enabling new and exciting opportunities. Such collaborative research effort can focus on design, model, build and test novel functional low temperature systems, operating over a wide temperature range. The CCQCN group will contribute to the improvement of fundamental physical understanding, in particular to understand the limiting factors and how best to push the technology further; work toward the development of a model that can be used to accurately determine the materials and the system parameters that will optimize the performance for a given purpose; collaborate toward building a demonstrator system and test the demonstrator system to provide accurate benchmarks for the relevant figures of merit in a highly controlled and close to ideal environment.

The same CCQCN group can pursue research on the theory of emergent quantum coherent phenomena in artificial structures and the quantitative modeling of superconducting quantum circuits and metamaterials using efficient algorithms. The CCQCN researchers have already conducted research along the following three directions:

(i) Induced Quantum Coherence in Superconducting Quantum Metamaterials. A class of minimal superconducting quantum metamaterials (SCQMM) models has been employed to investigate quantum coherence effects which are induced to the SCQMM by self-induced transparent and superradiant electromagnetic pulses.

(ii) Quantum Chimera States in Qubit-Loaded Superconducting Transmission Lines. Counterintuitive dynamical states known as chimera states have been demonstrated in "classical" SQUID arrays. However, signatures of chimera states also appear in the quantum regime [7,8]; the possibility of existence of quantum chimera states has been explored with a semi-classical approach in which the electromagnetic field is treated classically.

(iii) Quantum Ising model for D-Wave Devices. The CCQCN group has investigated quantum lattice models in ultracold gases, quantum metamaterials and photonic band gap materials, using the 1/Z expansion method, where Z is the coordination number. The latter provides a general framework of hierachical equations for n-site reduced density matrices that allow to determine systematically equilibrium properties such as the ground states and the quench dynamics of the quantum Ising model. The method reproduces fairly well the physics of the paramagnetic-ferromagnetic quantum phase transition and the excitation spectrum. The quantum Ising model can describe the dynamics of SCQMMs perturbed by an external magnetic field under the conditions of long coherence time, and it may provide insights on the understanding of the quantum fluctuations generated in an SCQMM.

Based on the aforementioned research expertise, the CCQCN group can analyze and control one-dimensional, bilinear and two-dimensional arrays, and make predictions which can be experimentally tested. High performance computing (HPC) and theoretical tools will be used in synergy to explain experimental observations and explore scalability and macroscopic quantum coherent phenomena and their relation to the properties of the elements of the quantum cells as well as structural factors. Since the size of the fabricated quantum cells is close to the point beyond which direct simulations become intractable, CCQCN can concentrate on the development of improved algorithms for HPC and a theoretical framework for emergent coherent phenomena in quantum superconducting artificial structures for which nonlinearity is a crucial ingredient. CCQCN can offer its HPC infrastructure to "complex materials and quantum metamaterials" researchers to test the "quantumness" of the investigated structures, in the technologically significant area of quantum computing.

Potential impact & main dissemination activities and exploitation of results

Potential impact

The main expected impact of CCQCN is to unlock and develop the research potential in Crete (which is one of the convergence and outermost regions of the European Union). The Center has now achieved excellent research status in its areas of expertise and has established its proposed laboratory and computational infrastructure, offering a provision of excellent facilities to the research community. The Center's activities and achievements have made it more competitive and visible internationally and have enabled its participation in state-of-the-art research and its integration to the common European Research Area.

Regarding the Center's long-term impact, the following actions have been successfully pursued by CCQCN's Coordinator and Management Committee in order to ensure the long-term sustainability of the Center and to enhance its impact:

a) Incorporation of CCQCN to the University of Crete's academic organization and administration structure. In February 3, 2017, it was published in the official Gazette of the Greek Government (Greek Government's Gazette Volume 2, FEK #254/3-2-2017, Decision #182) the official decision of the incorporation of CCQCN to the Advanced Physics Lab of the University of Crete, establishing the new "Advanced Physics Lab – Center for Quantum Complexity & Nanotechnology").
b) Achievement of a high retention percentage of the Center's researchers' roster. Specifically, of the 22 ER and SER researchers who were employed by the end of the research dimension of the project (that is, by November 2017), 15 researchers have been retained by funding them from European and national (Greek) projects. One of the SER researchers has applied successfully for a professorship position at the Physics Department of the University of Crete (a "brain-gain" example, since he was attracted from abroad); another SER is managing the Center's spin-off; four SERs continue their research by being financially covered by national projects. Overall 4 SERs (out of the 5 SERs employed by the end of the project) have been retained. Counting the ERs as well, regarding ER/SERs CCQCN has achieved a 50% retention rate.
c) Participation in the submission of five (5) Horizon 2020 (FET-OPEN and RISE) proposals along with its twinning institutions (Cambridge University, Karlsruhe Institute of Technology [KIT], Technion). One proposal (NHQWAVE) has been successful, with CCQCN coordinating the consortium. CCQCN has also participated to consortia, with non-twinning partners, submitting proposals to other H2020 calls (CCQCN is currently collaborating with twinning institution Cambridge University toward submitting a joint proposal in the recent Quantera Call for Proposals). CCQCN has supported the Greek Government's S&T Funding Authority (GGET-Greek Ministry of Education and Research) toward the European project QUANTERA and CCQCN's representatives have attended high-level meetings and workshops of the European Initiative on Quantum Technologies (which leads to the third EU Flagship Programme on Quantum Technologies).
d) CCQCN (vesting its regional development role) has started collaborating with the Region of Crete in the Region's Initiatives funded by Structural Funds earmarked for Crete.

The project's External Evaluation Committee has found that CCQCN has unlocked significant research potential, has realized its high impact and should pursue activities to sustain and increase its impact. The Center has also demonstrated capability to take international leadership in selected research areas. The External Evaluation Committee has highlighted the fact (regarding its national

and regional significance) that CCQCN has successfully provided a bridge for high-caliber research to cross over the dark currents of the current Greek economic crisis. The presence of the CCQCN project has helped off-setting the current economic difficulties due to the severe economic crisis in Greece, allowing for unlocking the research potential and sustaining high level research, excellence and dynamism. When the crisis ends, the seed of the project will blossom even better in the future, due to the renewed optimism and the infrastructure that has been put in place, when national funding will gradually become available.

In brief, the CCQCN project has, thus, realized its expected impact, comprising the following dimensions, as envisioned in the DoW of the project:

(a) *Establishment of a major research Center of Excellence in Physics in South-East Europe*. The presence of a large number of young scientists and renowned visiting scientists and researchers (including Nobel Prize winners) in project's workshops and activities in Crete, over the project's lifetime, and the research work that has been produced, as well as the acquired state-of-the-art laboratory equipment and computational infrastructure, has enhanced significantly both the visibility and the long-term sustainability of the Center.

(b) *Offering a model example for other LFRs of Europe*. CCQCN has created a model for scientific development in a remote area of EU and other LFRs may follow in the same direction. This fact raises the scientific status of the country and the region.

(c) *Attraction of younger scientists from around the world.* Younger Greek (as well as non-Greek scientists) that work in the US and EU have come back to Greece to work in this dynamic research environment created by the CCQCN. The Center has thus restricted the brain-drain and reversed it in some cases.

(d) *Establishment of durable links with the Regional government and business community.*

(e) *Establishment of durable links with the Greek State and its administration of research (such as the Ministry of Education and Research, and the General Secretariat of Research and Technology).*

(f) *Building capacity (know-how) on innovation exploitation, IPR management, patents and spin-off company formation, to be diffused to the regional research community.*

(g) *Countering the current Greek economic crisis.* The presence of the CCQCN project has helped off-setting the current economic difficulties due to the severe economic crisis in Greece, allowing for unlocking the research potential and sustaining high level research, excellence and dynamism. When the crisis ends, the seed of the project will blossom even better in the future, due to the renewed optimism and the infrastructure that has been put in place, when national funding will gradually become available.

Main dissemination activities and exploitation of results

Main workshops

As already mentioned in the previous section, during the lifetime of the project (M1-M39), the following ten (10) CCQCN workshops have taken place in Greece (with a total of 460 participants, from whom 94 are twinning incoming participants):

- Workshop on Theoretical Physics, 5-10 September 2016, Heraklion (29 participants, from whom 9 are twinning incoming participants).
- Spin Orbit Coupling and Topology in Low Dimensions, 27 June-02 July 2016, Spetses, Greece (39 participants, of whom 4 are twinning incoming participants).
- Quantum Metamaterials & Quantum Technology, 20-24 June 2016, Spetses, Greece (35 participants, of whom 8 are twinning incoming participants).
- Non-Hermitian Photonics in Complex Media: PT-symmetry and beyond, 15-18 June 2016, Heraklion, Greece (41 participants, of whom 5 are twinning incoming participants).
- Quantum Magnets, September 13-19, 2015, Kolymbari, Greece (50 participants, of whom 10 are twinning incoming participants).
- Spin-Orbit Coupling in Surface or Interface States (Correlated electronic materials), June 8-12, 2015, Spetses, Greece (45 participants, of whom 7 are twinning incoming participants).
- Quantum Metamaterials, June 1-6, 2015, Spetses, Greece (33 participants, of whom 9 are twinning incoming participants).
- Quantum Phononics - From Transport and Optomechanics to Quantum Biology, 27-29 May, 2015, Heraklion, Greece (29 participants, of whom 2 are twinning incoming participants).
- Quantum Field Theory, String Theory and Condensed Matter Physics [Holographic Applications], Sept 1-7, 2014, Kolymbari Crete (99 participants, of whom 32 are twinning incoming participants)
- CCQCN Kick-off Meeting (inauguration workshop) Sept. 5-7 2013, Heraklion (60 participants, of whom 8 are twinning incoming participants)

With funds permitting, CCQCN was able to organize / co-organize 10 additional conferences (the websites of which can be found in CCQCN's website) and mini-workshops. In 2016, CCQCN organized and co-organized the following workshops and conferences:

- 11th Hellenic Polymer Society International Conference, held at the Foundation for Research and Technology (FORTH), Heraklion, Crete, during November 3-5, 2016.
- 2nd Hellenic Workshop on 2-dimensional Materials, held at the Foundation for Research and Technology (FORTH), Heraklion, Crete, during November 1-2, 2016.
- 6th International Symposium on Transparent Conductive Materials (TCM2016), Platanias, Chania, Crete (9-13/10/2016).
- Metamaterials 2016 (10th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics – Metamaterials 2016), Platanias Chania Crete (17-22 September 2016).
- 23th Summer School and Conference «Dynamical Systems and Complexity» (27 August – 3 September 2016), Aristoteleio University of Thessaloniki camp in Kalandra, Halkidiki, Greece.
- International Conference "CRETE HAS ENERGY" Heraklion (22-23 March 2016).

In 2015, CCQCN co-organized the international workshop/conference "Stochastic Methods in Finance and Physics" (20-24 July, 2015*)* in Heraklion, Crete, Greece. In 2014, the Center organized the "Fourth International Workshop on Statistical Mechanics and Dynamical Systems" (focusing on complexity and dynamical systems), which took place in Athens, 17-19 July 2014. CCQCN

organized and partially supported this workshop because it focused on issues related to the research activities of the Center and its members. CCQCN co-organized the 4th PhD Summer School – Conference on "Mathematical Modeling of Complex Systems", which took place in Athens on July 14-25, 2014. CCQCN sponsored a session at the ICCMSE 2014 Conference (the 10th International Conference of Computational Methods in Sciences and Engineering), 4-7 April 2014, Athens.

Outreach

3 visits related to CCQCN Outreach activities, took place in (a) Rethymnon, Crete (21/4/2016), (b) Chania, Crete (8/7/2016), and (c) Spetses (16-17/9/2016). Specifically, Prof. Georgios Tsironis travelled to Rethymno from 20th to 22nd April 2016, as main speaker of the "Modern Physics" CCQCN Outreach event. The CCQCN Center and its research infrastructure and outcome were presented at the event by Dr. G. Neofotistos, Dr. K. Makris and Prof. G. Tsironis to the general public, educators, parents, students and local organizations of Rethymnon in Crete. Prof. Theodoros Tomaras travelled to Chania, Crete, on 8/7/2016, to give a CCQCN outreach public talk with title "Gravitational waves: the confirmation which came 100 years after their prediction" at the Chania Science Fair in Chania [part of the 5th International Conference on New Frontiers in Physics (ICNFP 2016), which was held between 6 - 14 July 2016 in Kolymbari, Chania]. Prof. Georgios Tsironis travelled to Spetses, as main speaker of the "Modern Physics" CCQCN Outreach event (September 16-17, 2016), joined by Prof. C. Moutafis and Dr. G. Neofotistos as speakers too. The CCQCN Center and its research infrastructure and outcome were presented at the event by Dr. G. Neofotistos and Prof. G. Tsironis to the general public, educators, parents, students and local organizations. Additional outreach presentations to the school communities of Chania and Heraklion in Spring 2016 (events under the auspices of the Region of Crete, on February 27 and April 9, respectively, involving students, parents, and educators) were conducted by Dr. G. Neofotistos. There was also presentation of the Center's infrastructure and results to "Press the Innovation Button" event on innovation and innovative products, organized on April 13, 2016, by the Technological Educational Institute of Crete (TEI-Crete), in Heraklion Crete. Also, participation of CCQCN -with an exhibition stand- to the "PatrasInnovationQuest 2016 (PatrasIQ 2016 Exhibition)" technology transfer event and exhibition, organized by Greek Ministry of Education, the University of Patras, the Region of Western Greece et al. on April 15-17, 2016.

Additional Outreach activities of the Center (highlighting emerging research areas, research jobs, research results, research trends, research perspective, responsible research) to the school communities of Athens and Heraklion (events under the auspices of the regional educational authorities, involving students, parents, and educators), namely: (a) presentations on November 19, 2016, to the students, parents, and educators at the 2nd General Lyceum of Heraklion on quantum and nano physics and technology including CCQCN's infrastructure and results (it was organized by the Physics Association of Crete); (b) presentation to Heraklion educators (science teachers), on December 13, 2016 (the event was planned initially on November 30, 2016 but had to be moved to December 13, 2016) on quantum/nano science and responsible research (organized by 1st and 2nd EKFE of Heraklion); and (c) presentation by Dr. G. Neofotistos on "Trends, challenges and responsible research in a new era of technology: Quantum physics coming to application" at the "Open Schools for Open Societies Conference 2016", an EDEN Conference organized by Ellinogermaniki Agogi in Athens (Nov4-6, 2016).

As the Outreach activities intensified as the Center entered its last year (2016) of the lifetime of the CCQCN project, it became important to strengthen the outreach support. Toward this end, the hirings of support personnel (Ms. Fragioudaki, Ms. Vitsaki, Ms. Damianaki, Ms. Psaroudaki, Ms.

Kolokotroni) by short-term contracts has helped to sustain this high level of activity without putting a burden on the administrative and the research personnel of the Center.

In order to further disseminate the Center's research results, a (free) advanced graduate online course entitled "Research Frontiers in Quantum Science & Technology", is currently under development in order to present research areas and results from the Center's research groups, and introduce the students to Quantum Technologies; the course is planned to be available to graduate students and researchers in 2017.

The Center collaborated with the "Inspiring Science Education" (ISE) European project to disseminate quantum science and technology education material to the ISE project's online education materials Repository (creating a schools' learning community at the Open Discovery Space online learning repository: http://portal.opendiscoveryspace.eu/community/quantum-technologies-quantum-physics-coming-application-847817) connecting a network of 5000 European schools. In 2015, the Center participated to activities of the European projects "Quantum Spinoff" and "Irresistible", which address schools and the school communities. It also organized (March 1, 2015) a "Quantum workshop" for Education Days (in Heraklion), in collaboration with Greek Physical Society and "Quantum Spinoff" and "ENTREDU" European projects.

In 2014, the Center presented its activities on February 4, 2014, in the Hi-Tech Conference at the Brussels Enterprises Commerce and Industry (BECI), a business-to-business event organized by BECI and the Greek Embassy in Brussels.

Exploitation of results

In order to better organize and manage the intellectual property and enhance its innovation capability, the Center's *Exploitation of Innovation Committee* (EIC) commenced its activity in October 2014. Dr. Michael Katharakis, from the Heraklion Chamber of Commerce and Industry, was selected to participate in the Committee due to his position and statute in the region's business community but also due to his commitment to maintaining and strengthening the links to the research community (he holds a PhD in Physics from the University of Crete). The Center finalized (in October 2014), as described in DoW, the contract and administrative aspects related to the procurement of the services supplied by the Science and Technology Park of Crete (STEP-C), an expert in technology transfer and IPR, and IP Strategy. STEP-C provided (to the Center) training and IP skills development for all researchers and personnel involved in research and management of technology; and enhancement of an innovation and innovation exploitation culture and support toward the identification of IP (protectable project research outcomes) in collaboration with CCQCN researchers. The contract to STEP-C signed in October 2014 and IP training seminars began in November 2014 and concluded in Spring 2015. Deliverable D6.1 "Guide to IPRs and Patents" has been prepared, submitted and accepted by the Project Officer. Deliverable D6.2 "Guide to Spin-off company formation" has been prepared, submitted and accepted by the Project Officer. CCQCN researchers have worked with STEP-C to discuss and to explore commercialization aspects of their work. Researchers P. Navez, V. Binas, G. Neofotistos, and CCQCN members professors G. Kiriakidis, E. Iliopoulos, I. Kominis have worked with STEP-C on IPR and commercialization potential of their research work. A University of Crete spin-off company (in which the University of Crete owns 5% of equity with the rest vested in CCQCN members) has already been formed.

At the same time, start-up Tribe-Wearables (http://tribewearables.com), a VC-backed startup based in Komotini, Greece, which is developing a cutting edge muscle activity tracker embedded into sport apparel, is in discussions with CCQCN researchers toward the development of inks (with

nanoparticles) to be painted on the sport apparel in order to function as sensors and conducting lines to monitoring muscle activity of the person wearing the apparel.

Regarding the regional development role of CCQCN, the Center has started collaborating with the Region of Crete in the recent (March 2016) initiative of the Region of Crete to launch the Crete Center for Energy Technologies (KETEK) in order to focus on modern energy technologies. This Crete Center for Energy Technologies is part of the Region of Crete Smart Strategic Specialization (S3) policy. Energy efficiency is of primary importance to the Region of Crete. The island of Crete becomes the top Greek tourist destination every summer, with an immense need for energy generation and steady-state distribution. CCQCN participates in this regional initiative by providing its METROPOLIS Supercomputing Facility for advanced scientific projects. In this "energy" line of regional activity, CCQCN presented its research infrastructure to participants in the "Crete has Energy" workshop (Heraklion, March 22-23) on innovative energy technologies; the workshop was organized by the Foundation for Research and Technology Hellas (FORTH), the Heraklion Chamber of Commerce and Industry, STEP-C, the Technological Educational Institute of Crete, and the University of Crete, and was supported by the Greek German Assembly (DGV), the Friedrich-Ebert Foundation in Athens, the State Development Corporation of Thuringia, the Association of Medium-Sized Enterprises – pro South Thuringia, the Green Chiller – European Association for Sorption Cooling, and the CCQCN.

It should be pointed that Greece's recent economic condition has resulted in a substantial delay of implementing Structural Funds in the country (due to country's problems, although these funds have been agreed by EU authorities the processes/procedures have not been developed and implemented yet). 2016 was the year for the start of a substantial implementation of the Structural Funds framework in Greece (the Region of Crete has been earmarked for funds of over 300 million Euros). Extending CCQCN's activity in the second half of 2016 (M37-M39), and establishing contacts with officials in the Region of Crete (at the level of Governor and Vice-Governors of the Region of Crete) has helped the build-up of synergies between Structural Funds and the Research Framework Programme, enhancing the CCQCN's competitiveness and excellence in research, and directly contributing to a regional, national and European sustainable economic development.

In October 2016, CCQCN was included in the Region of Crete funding initiative to strengthen the 3 Higher Education Institutions (HEIs) of the Crete Region, namely the University of Crete, the Technical University of Crete, and the ATEI-Crete.

CCQCN supported the Greek State's S&T Funding Authority (GGET-Greek Ministry of Education and Research) to European project QUANTERA and attends the European initiative on QUANTUM TECHNOLOGIES (which is planned to lead to the third EU Flagship Programme on Quantum Technologies).

The address of the project's public website (CCQCN website)

The website of the CCQCN (http://qcn.physics.uoc.gr) has been operational from the very first day, continuously, facilitating both the informational needs of the Center's members as well as the outreach and dissemination effort.

APPENDIX I

TABLE: CCQCN's (Overall) Research Production
(throughout the lifetime of the project)
Working Papers; Papers submitted to refereed journals; published Papers.

All research papers can be accessed at the CCQCN's website
http://qcn.physics.uoc.gr/content/journals (published papers)
and
http://qcn.physics.uoc.gr/content/preprints (working papers)

#	CCQCN Code	Title	Authors
1	CCQCN-2013-1	Analytical and numerical study of diffusion-controlled drug release from composite spherical matrices	Amalia Hadjitheodorou, George Kalosakas
2	CCQCN-2013-2	Transforming graphene nanoribbons into nanotubes by use of point defects	A. Sgouros, M. M. Sigalas, K. Papagelis and G. Kalosakas
3	CCQCN-2013-3	Nonlinear Localization in Metamaterials	N. Lazarides and G. P. Tsironis
4	CCQCN-2013-4	PT -symmetric nonlinear metamaterials and zero-dimensional systems	G.P. Tsironis · N. Lazarides
5	CCQCN-2013-5	T-matrix formalism for one space dimension systems with different spatial asymptotics and symmetry relations for ferromagnetic Josephson junctions	I. Margaris, V. Paltoglou and N. Flytzanis
6	CCQCN-2013-6	A holographic model for QCD in the Veneziano limit at finite temperature and density	T. Alho M.Jarvinen K. Kajantie E. Kiritsis K. Tuominen
7	CCQCN-2013-7	The confining trailing string	Elias Kiritsis, Liuba Mazzanti and Francesco Nitti
8	CCQCN-2013-9	Extreme Events in Nonlinear Lattices	G. P. Tsironis, N. Lazarides, A Maluckov and Lj. Hadžievski
9	CCQCN-2013-10	Enhanced surface plasmon polariton propagation induced by active dielectrics	C. Athanasopoulos, M. Mattheakis and G.P.Tsironis
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174	CCQCN-2016-178	Causality Implies Inflationary Back-Reaction	S. Basu, N. C. Tsamis and R. P. Woodard
175	CCQCN-2016-179	Higher derivative corrections to incoherent metallic transport in holography	Matteo Baggioli, Blaise Gouteraux, Elias Kiritsis and Wei-Jia Li
176	CCQCN-2016-180	Large acoustic polaron states and bifurcation in three coupled parallel molecular chains	Dalibor Cevizovic, Zoran Ivic, Dragan Toprek, Željko Pržulj, Darko Kapor
177	CCQCN-2016-181	Graphene based Polymer Nanostructured Materials through Molecular Simulations	Petra Bacova, Anastassia N. Rissanou, Albert John Power, Vagelis Harmandaris
178	CCQCN-2016-182	Properties of Nanographene in Polymer Nanocomposites through All-atom Simulations	Anastassia N. Rissanou, Petra Bacova, Vagelis Harmandaris
179	CCQCN-2016-183	Atomistic Simulation of Graphene-Based Polymer Nanocomposites	Anastassia N. Rissanou, Petra Bacova, Vagelis Harmandaris

180	CCQCN-2017-184	Multi-mode Waveguides with Tailored Dispersion - a Way for Coherent and Dispersion-Free Propagation of Classical and Quantum Optical Signals	C. A. Valagiannopoulos, A. Mandilara, S. A. Moiseev and V. M. Akulin
181	CCQCN-2017-185	Turbulent chimeras in large semiconductor laser arrays	J. Shena, J. Hizanidis, V. Kovanis and G. P. Tsironis
182	CCQCN-2017-186	Electrically and Magnetically Resonant dc SQUID Metamaterials	O.V. Shramkova, N. Lazarides, G.P. Tsironis, A.V. Ustinov
183	CCQCN-2017-187	Nonparaxial abruptly autofocusing beams	Raluca-Sorina Penciu, Konstantinos G. Makris, Nikolaos K. Efremidis
184	CCQCN-2017-188	Constant intensity supermodes in non-Hermitian lattices	K.G. Makris, Z. H. Musslimani, D.N. Christodoulides, and S. Rotter
185	CCQCN-2017-189	PT-symmetry breaking in the steady state of microscopic gain-loss systems	Kosmas V. Kepesidis, Thomas J. Milburn, Julian Huber, Konstantinos G. Makris, Stefan Rotter, Peter Rabl
186	CCQCN-2017-190	Modulational instability in a PTPT-symmetric vector nonlinear Schrödinger system	J. Cole, K.G. Makris, Z. Musslimani, D. N. Christodoulides, and S. Rotter
187	CCQCN-2017-191	Invariant superoscillatory electromagnetic fields in 3D-space	K.G. Makris, D. G. Papazoglou, and S. Tzortzakis
188	CCQCN-2017-192	Wave propagation through disordered media without backscattering and intensity variations	K.G. Makris, A. Brandstotter, P. Ambichl, Z. Musslimani, and S. Rotter

In total, CCQCN researchers have produced 188 research papers (of which 138 are already published papers in peer-reviewed high-caliber journals, 30 are working papers and papers submitted to refereed journals, 4 are published book chapters, and 16 are papers already published in conference proceedings). The published papers (138 in peer-reviewed journals, 4 in book chapters, and 16 in conference proceedings) have been uploaded in 4.2 Use and dissemination of foreground - Section A (public), in Template A1 (List of all scientific (peer reviewed) publications relating to the foreground of the project).