Optical signal modelling and characterization for QKD security analysis (QuNEST Doctoral Candidate 5)

Research Programme Description

"QuNEST- Quantum Enhanced Optical Communication Network Security Doctoral Training" is hiring 11 Doctorate Candidates" to be funded by the Marie Skłodowska-Curie Actions (MSCA) Doctoral Networks. QuNEST is a highly interdisciplinary and intersectoral Doctoral Network composed of leading academic and industrial partners. The consortium consists of six academic institutions, namely: Eindhoven University of Technology, Technical University of Denmark, Karlsruhe Institute of Technology, University of L'Aquila, University of Warsaw and University of Geneva as well as the companies: ADVA Network Security, Exatel, IDQuantique, Infinera Germany, KEEQuant (SME), NKT Photonics, Nokia Bell Labs France, Telecom Italia Mobile, Quantum Optical Technologies (SME), Quantum Telecommunications Italy and VPIphotonics and involves seven different European countries. The diverse consortium provides a unique and timely opportunity to train students in quantum physics and optical communications.

The driving force for QuNEST - is to provide high-level and highly collaborative training to 11 highly achieving Doctoral Candidates. This Doctoral Network is a highly multi-disciplinary, spanning areas of quantum physics, simulations, photonics, optical transmission, Quantum Key Distribution (QKD) protocols, implementation security, error correction algorithms, digital signal processing, networks and control, requiring cross-disciplinary and intersectoral training targeted at creating experts in this emerging multidisciplinary field. The QuNEST Doctoral Candidates will be trained by doing research, in which they will demonstrate the potential of combining quantum and classical optical data signals in a single fiber with the aim to develop ground-breaking and commercially attractive, short-to-medium term solutions targeting European industry leadership in this highly challenging sector. QuNEST will train much-needed future scientists and engineers who will design, build, deploy and operate the next generation quantum secured optical communications infrastructure.

The Doctoral Network program is designed to follow technical, scientific, and transferable skills, enabling the next generation of young researchers/engineers with excellent skills in understanding the challenges of quantum secure optical communications. All Doctoral Candidates will carry out secondments and placements with industrial partners at the earliest possible opportunity. Transferable skills and technical workshops from industrial partners will be central to the training of the Doctoral Candidates.

About the host institution:

Founded in 1816, The University of Warsaw offers studies in several dozen of fields of arts and sciences at 1 and 2 cycle programmes, as well as at the integrated Master programmes, for postgraduate students and PhD students. The total number of students exceeds 53 thousand. University of Warsaw recognizes doctoral studies as one of its priority activities and it pursues the aim of providing PhD students with the training of high quality and expanding its pool of PhD studies programmes offered in English resulting in single or joint doctorates in partnership with European or non-European higher education establishments. University of Warsaw hosts the Centre for Quantum Optical Technologies, established in 2018 by the University of Warsaw in partnership with the University of Oxford under the International Research Agenda Programme operated by the Foundation for Polish Science. The Centr aims to explore quantum phenomena, such as superpositions and entanglement, in optical and optically controlled systems, with the long-term prospects of their practical utilisation. At present the Centre comprises of five laboratories pursuing research into quantum communication, sensing, imaging, as well as experimental development of quantum memories and fundamental aspects of quantum resources.

Job Description

- o **Project title:** Optical signal modelling and characterization for QKD security analysis
- Host institution: University of Warsaw
- o **PhD enrolment:** University of Warsaw
- Supervisors: Konrad Banaszek (University of Warsaw). Co-supervisor: R Thew (University of Geneva)
 Mentor: G. Boso (IDQuantique)

- Research Objectives: DC5 will investigate effects of noise and impact on security of QKD protocols. Current security analysis for QKD has been carried out using models based on single modes carrying the signal. On the other hand, modulation, propagation, and demodulation of optical signals propagating in communication systems is interlinked with a plethora of intrinsically multimode noise effects and distortions for which an effective description is required to provide a bridge to new fibers. DC5 will work to maximise information throughput in a channel with QKD signals
- Expected Results: 1) Effective models for QKD links incorporating noise and imperfections, resulting
 e.g. from interchange crosstalk and distortion introduced by the modulator/detector transfer
 functions, 2) Practical methods to quantify the security of QKD links based on accessible
 characteristics of the optical signals.
- Secondments: The doctoral candidate secondments periods are planned at VPIphotonics, ADVA Network Security, IDQuantique

Job Requirements

We are looking for candidates who meet the following requirements:

- You are creative, ambitious, hard-working, and persistent.
- You have an MSc degree in electrical engineering, applied physics, mathematics or any other relevant program.
- You have theoretical and applied knowledge of Quantum communications or Photonics
- You have hands-on experimental experience in Quantum communications or Optical Communications lab based setups
- You have good communicative skills, and the attitude to collaborate successfully in the work of a research team.
- o You have a good command of the English language (Spoken and Written).

Conditions of employment

- o The successful candidates should receive an estimated expected gross salary of € 2378 (an additional annual premium could be paid), in accordance with the Marie Skłodowska-Curie Actions (MSCA) regulations for Doctoral Candidate researchers (the mobility allowance is included in the previous value). The salary values may change slightly due to the individual situation of the candidate. According to the MSCA regulation, if the recruited doctoral candidate has or acquires family obligations during the action duration, a family allowance will be added to the previous value, in case of eligibility.
- The period of employment is 36 months. In addition to their individual scientific projects, all fellows
 will benefit from further continuing education, which includes secondments, a variety of training
 modules as well as transferable skills courses and attractive participation in conferences.
- The Doctoral Candidates are expected to travel to network partners under three secondments for a typical duration of 2-6 months. Additionally, the Doctoral Candidates are expected to participate in outreach activities including, but not limited to, YouTube videos, social media updates, participation in public events and campaigns, as well as dissemination to popular press.

Eligibility and mobility criteria (mandatory requirements EU rules)

- The recruited researchers must be doctoral candidates, i.e. not already in possession of a doctoral degree at the date of the recruitment.
- The recruited researchers must be employed full-time, unless the granting authority has approved a part-time employment for personal or family reasons
- o The recruited researchers must be working exclusively for the project
- Recruited researchers can be of any nationality and must comply with the following mobility rule: they must **not have resided or carried out their main activity** (work, studies, etc.) in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before the

recruitment date - unless as part of a compulsory national service or a procedure for obtaining refugee status under the Geneva Convention¹

Application Procedure

Documents requested:

- Complete CV (Europass format obligatory):
 https://europass.cedefop.europa.eu/documents/curriculum-vitae

 The candidates are allowed to pursue a maximum of three positions in the QuNEST programme. If more than one position is pursued, please clearly indicate all the positions that are pursued with priorities on the first page of the CV
- o Motivation letter (maximum 1 page per position applied) should state why the applicant wishes to pursue the specific research and why the applicant thinks to be an ideal candidate for the position.
- Scan of certificates showing BSc, MSc and other courses followed, with grades and if it is possible a ranking.
- Up to three recommendation letters and/or contact e-mail addresses with a brief professional description (title, position, relationship with applicant) of the referring person.
- o Up to two written scientific reports in English (e.g. MSc thesis, traineeship report or scientific paper)
- Eligibility Statement: for verifying the MSCA requirements, the candidates clearly indicate the country or countries of the main activity (work, studies, etc) and country or countries of residence in the last 5 years with the exact dates.
- Signed information on the personal data processing;

Selection Process:

The selection process of invited candidates contains two phases:

In the first phase, a wide range of selection practices will be used (including expert assessment, face-to-face interviews, etc.) to evaluate the potential candidates. The selection committee for each doctoral candidate will be composed of three members: the main supervisor from the hosting institution, a QuNEST representative from another beneficiary and the future secondment manager of the doctoral candidate.

In the second phase, the selected candidate will be evaluated by QuNEST's Recruitment, Equality, Diversity & Inclusion Committee. The committee addresses gender balance and diversity issues within the entire Doctoral Network and needs to approve the selected candidate.

QuNEST deals with a recruitment process based on the European principles of openness, fairness and transparency that guarantee a selection of candidates in respect of merit and gender balance. All institutions have clear equal opportunities policies ensuring equal and fair recruitment and employment of men and women.

Please note that all submitted applications will be checked against the defined eligibility and mobility criteria. Applications that do not follow these criteria will not be considered.

Deadline for online application: 31/12/2023

o Targeted Starting date: 01/02/2024

For more information about the project and any informal enquiries, please contact k.banaszek@cent.uw.edu.pl

How to apply:

Please send the required documents as attachments to a single e-mail to qot-jobs@cent.uw.edu.pl

¹ 1951 Refugee Convention and the 1967 Protocol.