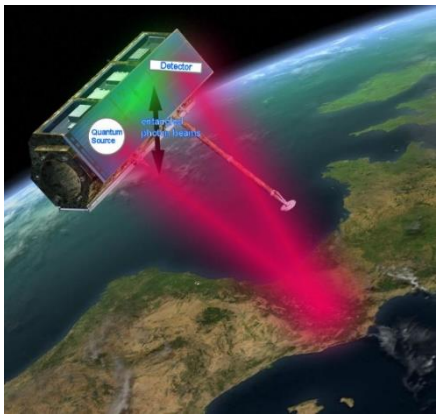
DAAD Doctoral Fellow

German Aerospace Center (DLR)
Microwaves and Radar Institute

Topic	**Potentials of Synthetic Aperture Quantum Radars**	Date of announcement **December 03, 2020**

Description

The Microwaves and Radar Institute of the German Aerospace Center (DLR) contributes to the advancement of spaceborne remote sensing through the execution of long-term research programs. The research work of the Institute encompasses the conception and development of new synthetic aperture radar (SAR) techniques and systems, as well as the retrieval of information from SAR data for several science applications.



In the past decade, a new technological research field in the frame of quantum physics has emerged. So-called quantum illuminators – specific hardware realizations of quantum emitters – are able to generate, for instance, entangled photons, which allow improving the detection probability of objects with low radar cross section. These quantum optical technologies are being heavily investigated with the goal of making the transition from laboratory experiments to real world applications, even in the microwave regime. One such application is Earth observation employing synthetic aperture radars. A major research goal is to investigate the potentials of this kind of imaging radars using quantum principles in order to improve, for instance, the sensitivity of such systems.

A further research area, which exploits the principles of quantum physics, is quantum computing. Quantum computers are expected to have an exponential advantage in processing speed compared to their classical counter parts. Since imaging radars produce large amounts of data which require processing before the data can be interpreted by humans, there is a natural connection between quantum radars and the subsequent quantum radar signal processing.

This research topic is situated at the interface of imaging quantum radars and the processing of radar data on quantum computers. The following tasks shall be addressed in the frame of the research activity:

- Assert the state-of-the-art of quantum radars via a literature study and familiarize with the underlying theory and concepts.
- Establish a theoretical description (signal model) of the entire radar transmission and reception chain including the scatterer on ground, using the usual quantum optical formalism. Derive performance metrics which allow, for example, a comparison of the sensitivity of a quantum enhanced radar with a classical radar.
- Assess principal limitations of quantum radars, using low- to medium-number microwave photon illuminators, in terms of their detection range.
- Investigate how the quantum radar principle can be developed towards an imaging quantum radar, where several radar pulses have to be combined coherently. This research topic encompasses fundamental questions like the information content of a quantum radar image.
- Investigate whether quantum mechanical effects can be used to improve the synchronization accuracy of the clocks (oscillators) on distributed radar satellites.

The candidate will be engaged in cooperation with other national and international research institutions.
Output of this research activity should be a report including all research results, accompanied by journal and/or conference publications.
This research is to be understood as a first step towards establishing a new research field at the Microwaves and Radar Institute with a much broader scope including quantum radar signal processing.

Please send your complete application (cover letter including preferred starting date, curriculum vitae, current enrollment and, if applicable, current transcript of records from your University).

Please see also Fellowship No. 472
DLR Current offers - DAAD

Starting Date	January, 2021

Application Deadline	Until position filled
Required Skills	University diploma or master in mathematics, physics or electrical engineering with a knowledge in quantum mechanics and/or quantum field theory (quantum optics). Analytical skills and programming experience in Python or equivalent. Applicants should have good interpersonal and communication skills and should be able to work in an international and interdisciplinary environment, both independently and as part of a team. Knowledge in radar theory (quantum/classical) as well as quantum computing. Helpful is also an understanding of the principles of synthetic aperture radar and signal processing. The communication and working language is English. English skill level for reading and writing research articles and reports is required.
Benefits	Look forward to a fulfilling job with an employer who appreciates your commitment and supports your personal and professional development. Our unique infrastructure offers you a working environment in which you have unparalled scope to develop your creative ideas and accomplish your professional objectives. We are striving to increase the proportion of female employees and therefore particularly welcome applications from women. Disabled applicants with equivalent qualifications will be given preferential treatment.
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