ESPCI PARIS
EDUCATION SCIENCE INNOVATION

Postdoctoral Position in Experimental Physics

Topic: High-frequency parametric amplification with High-Tc Josephson junctions

Laboratory: Laboratory of Physics and Material studies (LPEM), ESPCI Paris - CNRS - Université PSL - Sorbonne Université http://www.lpem.espci.fr

Address : 10 Rue Vauquelin, 75005 PARIS (France)

Description:

Parametric amplifiers exploit a non-linear response of a medium to transfer the power of a high-amplitude pump tone to the signal to be amplified. The physical properties of the non-linear medium are parametrically modulated by the pump, which serves as the energy source for the amplification. In the microwave domain, parametric amplification can be realized with one or a set of superconducting Josephson junctions whose non-linearity allows the mixing of the waves [1]. The junctions can operate in an almost non-dissipative regime, which in theory allows the amplifier to reach the quantum limit at very low temperature [2].

The present project aims at fabricating Josephson traveling wave parametric amplifiers TWJPA made of a high critical temperature superconductor ($YBa_2Cu_3O_7$) that can operate at a temperature between 30K and 50K. The design will be adapted from recent works on conventional low-Tc superconducting materials [3] and the devices will be fabricated using the ion-irradiated Josephson junction technology developed for several years within the ESPCI-C2N partnership [4-6]. The high frequency operation of these junctions has already been demonstrated in the past with the realization of Josephson heterodyne mixers operating up to 400 GHz [7,8]. A first demonstrator operating below 10 GHz will allow the potential of the technology for parametric amplification to be assessed. The main objective is to fabricate a high-Tc TWJPA in the Ka band (26.5-40 GHz), which corresponds to one of the atmospheric transmission windows. Such devices could in particular be useful for satellite communications.

The postdoctoral candidate will join the PHASME team at ESPCI Paris (https://phasme.lpem.espci.fr/spip.php?rubrique1) and work under the supervision of E. Maréchal and N. Bergeal. He/she will be in charge of designing and measuring the properties of the parametric amplifiers (gain, bandwidth, noise...) and will also participate to their fabrication in collaboration with the C2N lab. The project involves collaborations with groups at the Néel Institute, C2N lab and Thales TRT lab within the ARPEJ ANR grant Proposal. The position should start in the fall 2022 (october-december). The contract is concluded for one year and is renewable for one year by agreement (salary : 2500-2800€/month depending on the candidate experience)

[1] Review article by J. Aumentado, IEEE Microwave magazine 21, 8 (2020). [2] N. Bergeal *et al.* Nature 465, 64 (2010). [3] L. Planat *et al.* Phys. Rev. X 10, 021021 (2020). [4] N. Bergeal *et al.* Appl. Phys. Lett. 87, 102502 (2005). [5] N. Bergeal *et al.* Appl. Phys. Lett. 89, 112515 (2006). [6] F. Couëdo *et al.* Appl. Phys. Lett. 114, 192602 (2019). [7] M. Malnou *et al.*. Appl. Phys. Lett. 101, 233505 (2012). [8] M. Malnou *et al.* J Appl Phys 116, 074505 (2014).

Pre-requisites: a PhD in experimental physics is a necessary pre-requisite to apply. Experience in the following domains will be favorably considered: superconductivity, cryogenic transport measurements, microwave measurements, high-frequency circuits, microwave simulation softwares.

How to apply: Send a cv including a list of publications and conferences, and (at least) one recommendation letter. Contact : etienne.marechal@espci.fr and nicolas.bergeal@espci.fr