EXTERNAL ASSESSMENT

DOCTORAL THESIS CONFERRING THE TITLE OF "INTERNATIONAL DOCTOR"

A	THESIS

Author (Name and surname)
 Noel Alberto García Martínez

Title of thesis
  Functionalized Bilayer Graphene For Quantum Technologies

B	EXPERT

Name and Surname
 Claudia Maria Pereira Cardoso

University or Research Centre	Department
Istituto Nanoscienze, Consiglio Nazionale delle Riicerche	S3 Center, Modena, Italy

C	REPORT

The PhD candidate **Noel Alberto García Martínez**, in his thesis with the title **Functionalized Bilayer Graphene For Quantum Technologies** studies the physical properties of sp^3 functionalization of graphene and bilayer graphene. The thesis is written in a clear and precise way and presents relevant and novel results concerning sp^3 defects in graphene based systems, part of them already published in international peer review journals.

The study of single defects in infinite graphene, i.e in the absence of the translational symmetry, was performed using different methods: Green's functions, and the Dyson equation, within an embedding technique, a mean field Hubbard model and the kernel polynomial method. The study shows consistent results for the different methods and, among other results, an anomalous magnetic response that differs from Curie Law and a non-linear magnetic susceptibility, with non quantized local moments induced by the defects.

The study, extended to large islands of bilayer graphene, shows that the electric field can be used as a parameter connecting or isolating the zero- modes from the rest of the spectrum.

The effect of the electric field on the in-gap state is their spatial confinement with a length of 50 Angstrom .

In the thesis, the idea of using H adatoms on bilayer graphene as spin based qubits following Kane's proposal was also explored. As well as the fabrication of a quantum simulator through an array of sp^3 defects, using the possibility of confining in-gap states from large length scales to tenths of Angstroms as means of controling the interactions. These ideas were supported by the derivation of the effective Hamiltonian describing the interactions between two in-gap states which results in several effective terms with clear physical interpretations such as an exchange term, a pairing term, effective hoppings or a renormalized Hubbard repulsion.

Has passed the reading of the thesis: **YES**

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D	SIGNATURE
	Claudia Nauz Pereira Cardoso
Date:	16th July 2021