How does the Graphene think? (part 2)

Graphene inspired Quantum Machine Learning

Why Graphene? Well, let's say that a particular feeling binds me to the Graphene. I don't know why … I don't know how … but it's a common idea that the real potential of graphene isn't exploded yet. I mean, it's a totally new material and all we are doing right now is to explore its features to solve problem that in a way or another we have already solved. As far as I can tell, what Graphene can do is something that we haven't thought yet: a totally new world is waiting for us to be discovered.

The most emotional thing about Graphene is that it has been always there for us. Since the very start of human history, the man has learned to discover and shape new materials that have allowed his evolution beetween ages: from the stone age, to the bronze age, the iron age and so on until to reach our modern society. The Graphene has always been there … we just have spent a lot of time to realize its existence.

Since its discovery, and even before when Graphene was only theorized, it has inspired the most controversial dreams of scientist. One of all, the possibility of a space elevator that could bring us into the space without any kind of fuel.

All that to say that Graphene has taken its own space among our imagination. It is a kind of wonder-material born form our dreams to make our dreams come true.

Let's take a step back to visualize this scenario and return to the first question … why Graphene?

Its well known honey-comb structure confers to Graphene many exciting properties. But something really magic happens when we consider this structure as the result of two equivalent triangular sublattices.

The first aspect I want you to consider is how these sublattices interact: this kind of separation isn't only visual, but has a real physical meaning. That's clear if we focus on the way Hydrogen can change the magnetic property of Graphene. Manipulating on the atomic scale the position of an Hydrogen over a layer of Graphene is possible to underline how the Hydrogen induces a magnetic moment on the layer. This magnetic moment is canceled if we put a second Hydrogen nearby the first but on a different sublattice. At the same way we can enhance the magnetic moment if we put the second Hydrogen on the same sublattice of the first atom. To visualize this charateristic I suggest you to watch this video:

https://www.youtube.com/watch?v=NmPAAo7_xY0

Now that we have taken confidence with this aspect of the layer, will be more clear the importance of the following research you can reach by clicking here:

https://www.researchgate.net/publication/45094572_Quantum_dots_and_spin_qubits_in_graphene

Of course it's not easy to understand everything on a first approach: it requires knowledge of some fundamental principles of quantum mechanics, but what really matters is the incredible and natural way that Graphene fits these principles.

In this interesting article is prospected a system which can serve as the fundamental building block for scalable and fault-tolerant quantum computing. It is all based on the development of the Dirac's equation where the parameters are setted considering the subdivision of the layer of Graphene in two sublattices.

To be more specific the Dirac's equation describes how particles like electrons behave when they travel close to the speed of light. We are interested in the orbital structure of the wave function. It allows the

existence of spin qubits due to the small and highly symmetric band gap, which is not known to exist for other semiconducting materials. It's a unique feature of Graphene.

All that should answer to our question: why Graphene?

More over, now we have routed our journey towards a significant direction.