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EL HOTEL CUÁNTICO

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Resumen

El modelo mecánico cuántico resulta sumamente útil para explicar las propiedades químicas de los elementos, pero su alta complejidad dificulta notablemente su enseñanza en los niveles ESB o polimodal.

Utilizando simples analogías se ha desarrollado un “modelo del modelo” que facilita su comprensión y utilización en los primeros niveles de enseñanza media. El modelo se basa fundamentalmente en comparar la estructura de cada átomo con la de un edificio muy particular poblado por electrones “huéspedes”.

THE QUANTUM HOTEL

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Abstract :

Chemistry teachers know how difficult is to explain the quantum mechanical model to university students. It is much more difficult in secondary schools. Generally, these students learn rules by heart and soon forget about the topic. We know that it is possible to work deeper in chemistry handling the electronic configuration of the element. But this is only possible if we teach the basics of the quantum mechanical model. The key is how to do it

The level of abstract thought between twelve and thirteen years old is very limited. In mathematic classes students start working with lineal equation in x but they still ignore ondulatory phenomena. How could they understand that the wave equation has several solutions?

After trying strategies provided by texts for secondary school, I decided to build my own model, based on a simple analogy: comparing atomic structure with a Hotel .

Key words : High School / Introductory Chemistry -Physical Chemistry- Analogies / Transfer- Atomic Properties / Structure- Quantum Chemistry Didactic model – Quantum numbers

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The aim is to provide a strategy that facilitates the teaching of the quantum mechanical model to secondary students.

I will try to simulate a model of electron distribution in different elements. To do it, we should first imagine that the element is a building whose basement is the nucleus. As an ordinary building, it has floors, apartments, rooms. But its architecture has some particular features:

It has seven floors, but the height or distance between floors decreases as we go up. The base is narrow and it widens as we climb, so, in the upper floors there are more apartments than in the lower ones (fig. 1).

The apartments receive a letter or a number according to the number of rooms:

s or 0 if they have one room
p or 1 if they have three rooms

d or 2 if they have five rooms
f or 3 if they have seven rooms

All the rooms are furnished with bunk beds, i.e. upper bed and lower bed, therefore there can be two guests per room at most. (fig. 2)

Not all the apartments belonging to the same floor are at the same level, but at different sublevels within the same floor. So, whenever there are apartments belonging to different categories, the s will be at the lower sublevel, p a little higher, after that d and finally f.

This architectonic detail is a problem because the floors tend to gather in the upper floors. Due to this, in some upper floors apartments d or f overlap the lower apartments of the superior floors. Therefore, apartment 3d is practically at the same level or higher than apartment 4 s. The same happens for example with all the apartments d starting at the 3rd floor and also with apartments f. (fig 1)

This makes harder to remember what apartment is above or below which; but there is a mnemonics, called diagonal rule, which lets us go through the building from bottom to top in complete order.

Once the building described, we must know the

Occupation Rules of the Quantum Hotel

In order to avoid wasting energy, guests must be located following arrival order, starting at the lower floors and sublevels and following with the higher ones.

Guests will be distributed in each apartment as comfortably as possible: at first, one in each room in the lower bed and the upper bunks will only be occupied if there are more guests for that apartment. In order to locate each guest more easily, rooms were numbered according to the numerical straight line, taking the central room as 0, as in fig 3.

In order to know if the guest is in the lower bunk (alone in the room) this bed is called $+ \frac{1}{2}$. If there is a second guest who will therefore occupy the upper bunk, it is called $- \frac{1}{2}$

For example, if we want to locate a guest who arrived third at the apartment p on the fourth floor, it will be enough to tell the concierge four numbers: floor, apartment, room and guest bed: $(4,1,1, + \frac{1}{2})$. These four numbers identify perfectly well the location of an only guest.

Schrödinger in the Quantum Hotel

In the atomic model designed by Schrödinger, the “floors” are energetic levels and they represent nuclear distance. The apartments are sublevel, that indicate the shape of the region of space occupied by the electron, the rooms are the orbital orientation and the bunks are the spin of the electron.

Summarizing :

According to Schrödinger		In our Quantum building
LEVEL	(n)	FLOOR
SUBLEVEL	(l)	APARTMENT
ORBITAL	(m)	ROOM
SPIN	(s)	BED

According to Schrödinger model, the Quantum Hotel could be useful even if scientist discover new elements. It means that if we need to place more electrons we could extend the building by adding more floors at the top of the building.

Conclusion:

We know that it is possible to work deeper in chemistry handling the electronic configuration of the element. This is only possible if we teach the basics of the quantum mechanical model. The key is how to do it

I have been using this strategy for five years and I have observed that the time of learning is remarkably reduced as well as the persistence of the model in the memory is increased. Besides, the students find it funny, very easy to learn and to use to solve exercises.

Those students who make progress in the field of chemistry will have the opportunity of knowing the quantum mechanical model in all its depth and of understanding its real scope. They will surely laugh remembering the “Quantum Hotel”. But our duty is to find the best strategies to make students understand chemistry and be enthusiastic about it. If we do not succeed, they will not even be able of laughing at this model.

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