The story of a density.

The density is a very peculiar property of the real world. We know from our experience some pots are heavier then other pots. Of course with the same volume. The piece of a gold is heavier then the same piece of a steel and so on. The volume of a water is lighter then the same volume of a mercury. The fact is the density. What the density exactly is? The density ρ is a ratio of a mass m to the volume V – *see the formula* $\rho = \frac{m}{V}$

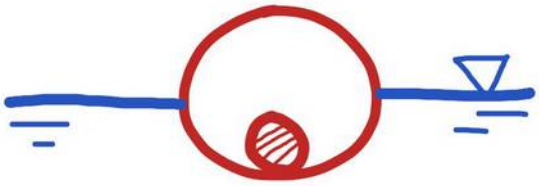

Fig. 1 – the big ball with a small one inside it in the water

Imagine - we have a ball in the empty room with some volume. What is the density of the room? And what about if we go down with the volume of the room. The density go up then. Is it correct to use such thinking? It seems quite crazy. Let´s have a look at the next problem.

We have a big ball with a small ball inside it. The big ball is made from polypropylene and the small ball is made from a lead. Put such balls into the water – Fig.1. We know the balls will be flowing. The density of two balls together with the air inside it is smaller then the density of the water.

See russian dolls - every piece of a space has its own density. It depends how far away we are. Yes, the point of a view. From the position of atom the density has another value then from the position of the nucleus or from the position of a proton or a neutron or from a position of molecules. Which space we are looking for? Always a probability space. We know the electron in hydrogen has a probabilistic occurence in orbit around the nucleus. We don´t know where the electron is and what is its form (particle, wave). The space is always probabilistic one.

Fig. 2 – the rough structure of the atom helia with two protons, neutrons and electrons (in the real world – particles as electrons are not balls, they are hidden at a probabilistic space around the nucleus)

I would like to give another example - how to solve the density of the atom. Imagine the atom as a room with balls . The „room" is the space of electron orbits and the „balls" are particles (protons, neutrons, electrons). But these particles could not be compress closely to each other. Especially for the behavior of electrons (Pauli exclusion principle). If the atom has heavy nucleus made from protons and neutrons then the same atom has bigger volume of the outer space for the reason of the behaviour of electron orbits. We could solve density of different atoms from hydrogen to bismuht. After that don´t forget molecules are made from atoms which are put together with a binding energy. We know if the temperature go up then the molecules trembling so much in a larger space. It´s clear the density go down.

Go on then. We want to solve the density of the atom nucleus. What shall we do then? Of course we know the volume and the weight of the protons and the neutrons which are tightly pressed to each other for the reason of a strong nuclear interaction among them.

We found out the density needs some space. In the same way as the mass. **If there were no Pauli´exclusion principle to make a space then the universe couldn´t exist in our form.**

The Pauli exclusion principle supports the finite density. No two non distinguish fermions cannot be in the same quantum state. At the basic structure such fermions are distinguished from each other by the spin. The limit of such princip is the Fermi pressure. To see a white dwarf or a neutron star. There is change of electrons to neutrons, where the Fermi pressure is bigger. Every black hole overcomes every biggest Fermi pressure. But the energy of such blackhole mast rapid grow up. This is the

problem - the increasing of the energy or the mass. Go on with the density. We know thera are a lot of combinations of atoms with Pauli principle. How many are there combinations – see a periodic table. These combinations are called atoms. After that, see the combinations of hydorcarbons. There are plenty combination of hydrocarbons especially with next two atoms as Nitrogenium and Oxygenium. After that there are plenty combinations among flowers or animals or people, every „subject" is different from each other. How many are there combinations at all?

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