Interactions in many-body systems and the concept of chain-formation

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Abstract:

It is proposed that force is finite and remains completely used at any given instant. So, distance between bodies is not arbitrary, and the interactions in many-body systems can be interpreted in a simple way by taking that force exists between immediate neighbours only, forming chains. The nature of interactions and force-constants in different types of many-body systems are explained in this paper. This has much significance in condensed matter physics, which deals with many-body systems made up of atoms.

Key words: Balance of forces, Centre-filled and centre-vacant systems, Chain-formation, Pulsating system, Condensed matter physics, Superconductivity, Hydrogen fusion, Plasma state, Casimir effect, Super-fluidity

1. Introduction:

The Newtonian approach towards force (gravity) is that bodies simply attract one another. Here, the distance 'd' between bodies can be arbitrary, only that force decreases with d^2. That is, force has no direct role in deciding the distance between bodies. An alternate approach[1] proposed in my previous papers is that "*motion at speed 'c' is the fundamental property of matter and force is reaction to motion*." This makes force finite, and bodies remain in such a way that force is completely used. So distance between bodies cannot be arbitrary; that is, force has a direct role in deciding the distance.

The finite force gets divided[1] equally as gravity and electromagnetic force at the level of electrons/positrons. Atoms are made up of electron-positron pairs, and all large-scale structures are made up of atoms. So this division of force is final, and these are the only forces of nature[1]. The force-constants vary depending on the system, and G of a body is directly proportional to the square of the speed. The concept of finite force makes the interpretation of interactions in many-body systems easier.

2. Many-body systems:

A many-body system will contain two or more bodies held together by attractive forces. Because of the attractive forces, the system will tend to be symmetrical, and a sufficiently large number of bodies will give rise to a nearly spherical structure. Energy acts as repulsive force, and together with other repulsive forces (electrostatic and magnetic), acts against the attractive forces. The *balance* between these gives stability to the system.

The concept of finite force implies that force can be partly or completely used. If the force is used partly, the system is open and can interact further. If completely used, the system is closed. In the absence of any repulsive force, the bodies come as close as possible that they may physically touch and get packed closely. In such a situation, we can assume that the force is completely used except that of the central body.

In symmetrical packing, there will be no net force on the central body, or the central body will not exert any force on the rest. Its force will remain unused. So *central filled systems* will be open systems, and all closed systems will be *centre-vacant*. Closed systems cannot interact, and so remains isolated. Open systems can exist only as part of a closed system. So in any system we come across, force remains fully used, partly for internal interactions and the rest for external interactions.

3. Chain-formation:

It is the attractive interactions that create many-body systems. Though a body interacts with the rest of the bodies in the system, the net effect of attractive interactions can be viewed as *chain-formation*, forming bonds. If all the bodies are identical, an un-branched chain is formed and each body interacts with only two neighbours. If the bodies are of different sizes, a branched chain is formed, and the body interacts with all the immediate neighbours. As force remains completely used, the distance between bodies is not arbitrary, and so for calculating the force between two neighbouring bodies in a chain, we can ignore the presence of others. By Newtons third law, the force exerted by A on B is equal to the force exerted by B on A, and so it can be assumed that each body contributes half the force required for the bond. If any of the force (gravity, electrostatic or magnetic) is completely used in forming a certain chain, that chain is closed; if not, that chain is open, and the process of chain formation continues.

4. Types of many-body systems:

Many-body systems present in nature can be classified as given below.

(i). Close-packed systems of bodies
(ii). Orbiting systems of bodies
(iii). Close-packed systems of orbiting systems
(iv). Orbiting systems of orbiting systems
(v). Pulsating system of orbiting systems

These may be the only possible many-body systems that can be formed, if we take that matter and space are always three-dimensional. 'Close-packed system of bodies' and 'Pulsating system of orbiting systems' are introduced for the first time in my papers. The rest are already familiar. The complex interactions in these systems can be interpreted by visualizing chain-formation and balance of forces. The interpretation becomes simple (i). if the bodies involved are identical (ii). if gravity is the only force involved (because gravity is always attractive).

5. Close-packed systems of bodies:

Here, all bodies physically touch each other. As proposed in a previous paper, electrons and positrons[2] are close-packed systems of shells made up of fundamental particles. These have centre-filled structures. The force of the central shell remain unused. The rest form a closed un-branched chain; each uses its whole force for two interactions with the two neighbours in the chain.

Neutron[2] is a close-packed system containing electron-positron pairs. Electrons and positrons form a closed un-branched chain with alternate bonds of gravity and electrostatic force, and the centre remains vacant. The force is completely used, and so neutron is a closed system that cannot interact with other bodies.

Protons and atomic-nuclei[2] are close-packed systems containing electron-positron pairs and unpaired positrons. The electron-positron pairs form a closed chain as in the case of neutron. The unpaired positrons are symmetrically distributed inside the nucleus. The gravitational attraction between them is exactly equal[3] to the electrostatic repulsion and so, no net force exists between them, and thus the whole force of the unpaired positrons is available for the nucleus.

6. Orbiting systems:

Atoms are orbiting systems of particles. The gravitational interaction inside an atom is between the nucleus and each electron. The electrostatic interaction is between the 'positrons as a whole' and each electron. Thus branched chains are formed. The nucleus shares its force among the orbiting electrons, and each electron contributes half the required force. The moving electrons create magnetic force at the expense of electrostatic force. The paired electrons spin in the same direction, but their direction of motion is opposite (relatively), and so there is attractive magnetic interaction. The relevant force constants are given below (Z, the atomic number of atom).

Gravitational: Nucleus ↔ Electron = G of electron = G_e = $2.7782\text{x}10^{32}$ m^3/kgs^2. [3]
Electrostatic: Positrons (in nuleus) ↔ Electron = E/Z = $(1/4\pi\varepsilon_0)/Z$
Magnetic: Between bonded electrons = E

The anti-gravity energy of each electron is $8\text{x}10^{-15}$J [4], and it remains constant. This repulsive energy is balanced by the attractive forces, mainly gravity and electrostatic. As there are three independent[1] forces, the equilibrium is static, and the orbits are fixed. The average distance of electrons from the nucleus is approximately $(A/Z)a_0$, where A ia the mass number and Z, the atomic number. In the case of paired electrons, the magnetic force created is fully used, or it is closed chain. But unpaired electrons have unused magnetic force. The other two forces are only partly used inside the atom, and so the chains are open. Atoms are thus open systems.

7. Close-packing of orbiting systems:

In bodies like Earth, atoms are packed in such a way that the orbits of electrons just touch or overlap; that is, the orbiting systems remain closely-packed. Two types of gravitational interactions[4] exist in such bodies: '*bonding*' between atoms and '*confining*' towards a common centre. The electrostatic interaction is between particles in different atoms, and magnetic interaction is between unpaired electrons in different atoms.

Constants for interactions (Z, atomic number of atom):
Bonding gravity : Between hydrogen atoms = $2.432\text{x}10^{29}$ m^3/kgs^2. [4]
Between atoms of same element = $2.432\text{x}10^{29}/Z$.
Between atoms of different elements = Geometric mean of their constants
Confining gravity : for bodies on Earth = G of Earth = $6.674\text{x}10^{-11}$ m^3/kgs^2. [4]
Electrostatic: Electron↔ Electron of nearby atom = E
Nucleus ↔ Electron of nearby atom (mass used) = G_e/Z
Magnetic: Between bonded electrons in different atoms = E
Between free electrons = E/c^2 (for unit speed)

It may be noted that 'mass' and 'G of electron' are to be used to calculate electrostatic force involving nucleus[3]. So the force required for nucleus–nucleus repulsion is very high compared to available force, and so that interaction has no real role in deciding the position of atoms. The positions of atoms are such the electrostatic force of electrons remains fully used for attractive and repulsive interactions. The open electrostatic chains (inside different atoms) together form closed chains, and the force remains completely used. Molecules are formed solely due to magnetic interactions, and so all chemical bonds are magnetic; internal energy of atoms is unaffected during chemical reactions.

The atoms form gravitational chains (with branching inside each atom) and each atom is attached to the centre of Earth with a gravitational bond. A group of atoms, when taken separately, will have a closed electrostatic chain; each atom gets gravitationally attached to the centre of gravity of the group, and the centre gets attached to the centre of Earth. Gravity is not completely used in the system (the gravitational chain is still open) and so bodies like Earth can interact gravitationally.

Though there are three independent forces in the system, the repulsive energy of atoms (unlike that of electrons) changes with temperature. At any given temperature (energy), the equilibrium is static and the neighboring atoms remain at their relative positions, but the positions change with temperature. However, at any position, the electrostatic force of electrons should remain fully used for attraction and repulsion, and so the number of possible ways the given atoms can be packed is limited. Thus knowing the temperature and the respective constants, the positions of atoms can be estimated.

8. Orbiting systems of orbiting systems:

A galaxy-cluster is an orbiting system made up of smaller orbiting systems. This is a hierarchical system: the satellite revolves around the planet, planet revolves around the star, the star revolves around the galactic centre, and the galaxy revolves around the intergalactic centre. Gravity is the only force involved. The interactions inside a cluster can be interpreted in an easy way using the concept of chain-formation: we can take that each body attaches itself to the parent-body using the whole available force.

For example, Moon uses its whole available gravity to attach itself to Earth, Earth uses its whole available gravity to attach itself to Sun, and so on, thus forming a branched chain. Thus the force of the parent-body remains unused. If there is no parent body, we can take that each body uses only half the force to remain in the system and contributes half the force and half the mass towards the centre of the system, and thus the force of that 'assumed parent body' remains unused – the logic is that the interaction with the parent body is missing. All orbiting systems are thus open systems, and so cannot have independent existence.

The G of a cluster is proportional to the square of its speed. G for unit speed is 7.7929×10^{-20} m^3/kgs^2 for a cluster having normal energy[4]. A cluster having shortage of energy has a higher G for unit speed, and the one having excess energy has a lower G for unit speed. The distribution of energy between clusters is such that at any given time, all clusters have a 'common G', though they have different speeds. Thus each cluster has a 'relative G' for unit speed, which is valid for all its subsystems.

In orbiting systems, the kinetic energy of the orbiting body is balanced by gravity. As there are only two forces, the equilibrium is not static. That is, the orbits are not static as perceived by Newton. The orbital plane, distance, apsis, etc. need not remain stationary; the only condition is that $GMm/2d = mv^2/2$, where G is the 'relative constant' valid for that system. The average distance of orbiting members from the centre of the system depends upon the 'available gravity' and the 'common G'. These two depend on the state of the universe; the theoretical deduction of these will be given in a separate paper dealing with the mathematical model of pulsating universe.

9. Pulsating system of orbiting systems:

The universe is a pulsating system made up of orbiting systems, the galaxy clusters. The clusters do not orbit around a common centre, but move away from the common centre and return back along helical paths in a synchronized manner, resembling the expansion and contraction of a spherical structure which is always uniform. The centre of the spherical structure is vacant and the clusters form a closed gravitational chain, which branches out into each clusters, then to each galaxies, then step by step to each bodies, and finally to each atoms. The universe is thus a closed system and any change that happens to it is transferred to the level of atoms through the gravitational chain. Local changes spread out along the gravitational chain and gradually fizzle out. The distance between clusters also depend on the 'available gravity' and the 'common G'.

10. Condensed matter physics:

Condensed matter physics deals with many-body systems made up of atoms. The interactions in such systems are very complex because there are more than 120 different atoms, each having a separate constant. The energy possessed by atoms has a direct role in deciding the distance between atoms. So depending on the temperature and the elements present, materials can exhibit strange properties. Some such properties are explained on the basis of the new concepts.

If in a given material, electrostatic force is used equally for attractive and repulsive interactions, it will provide a resistance-free path for electrons and will show *super-conductivity*. In the case of electrons at rest, gravitational attraction and electrostatic repulsion are equal[3] and there is no net force. When electrons move, magnetic force is created at the expense of electrostatic force, and if the electrons have opposite spins, there is attractive interaction. The created magnetic force is fully used if the distance between electrons is $2r_e$. That is, *Cooper pairs* are formed due to magnetic interaction, and the pair has no net magnetic field.

In *plasma state*, hydrogen shows superconductivity. So electrostatic force is used equally for attraction and repulsion, and the repulsive energy is balanced solely by gravity. Based on the constants proposed, it can be shown that such a spatial arrangement of hydrogen atoms is possible, if the atoms remain oscillating between positions. This is a highly unstable state. A slight increase in gravity can induce a collapse leading to *fusion*.

If a linear/planar packing is possible when the forces remain balanced, there will be no electrostatic bonds between strands/layers, and the material will show *super-fluidity*. The individual strands can creep on the the walls of the container due to the strong *bonding gravity,* and will fall off the outer bottom of the container.

When two uncharged parallel plates are far apart, the interaction is due to confining gravity and the constant is very low. But when brought sufficiently closer for atoms to interact, bonding interaction between atoms takes place. The G for this very high, and so the force is strong. Thus the *Casimir effect* can be due to *bonding gravity*.

Thus the exotic properties can be explained based on the known three forces; no 'exotic explanations' are required. Atoms cannot be packed in an arbitrary manner to suit our requirements. However, based on the information provided by the proposed concepts, the probable ways in which atoms can be packed can be ascertained, and we can select the most suitable one. Thus the proposed concepts can have great significance in the field of condensed matter physics.

11. Conclusion:

Thus in this paper, the concept of chain formation is put forth to explain the interactions in different types of many-body systems – all structures in nature are covered. The constants to be used in each system and how the distance between bodies (except for the large-scale structures) can be calculated are also explained (to calculate the distance between large-scale structures, the model of the universe need to be explained). The proposed estimation of the distance between atoms in materials, if found experimentally correct, can have far reaching consequences in the field of condensed matter physics.

Reference:

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