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## **The Interaction of Mechanical Force and Electric Charge in Physical Systems**

**by A C Sturt**

Comments made in response to two previous papers (1,2) highlight a need to clarify the relationship between mechanics and the characteristics of fundamental particles in practical systems.

Systems are the essence of processes at the abstract level. The components of systems fall into two basic categories: those which are homogeneous through time, and those which are non-homogeneous through time (3). This paper concerns systems with components which are homogeneous through time. These are essentially the processes of the physical world in which the components are ultimately species of fundamental particles that are identical throughout time and space i.e. homogeneous through time.

Processes in the physical world are concerned with the effects of mechanical forces on bodies composed of fundamental particles, which in turn generate effects in the form of forces of restitution. The reasoning which follows points spells out the electronic basis of this force of restitution. In effect this is the transition from bulk properties of materials to the characteristics of fundamental particles of which they are composed.

### A. The mechanical level

1. All processes require energy to make them function. Alternatively, energy is what drives systems. This is in effect a definition of energy, and it applies to all systems whether homogeneous through time or non-homogeneous through time; nothing changes without the application of energy.
2. Energy is a scalar quantity i.e. it is additive.
3. Energy is defined in physical terms as *force x distance* (Newton).
4. Thus all processes require the use of forces in some form.
5. The definition of force is *mass x acceleration* (Newton).
6. Therefore all forces require equal forces in some form to oppose them, or there would be an “excess” of force which would result in perpetual acceleration.
7. Thus for every action there is an equal and opposite reaction, where action means the application of a force (Newton).
8. These equal and opposite forces may take various forms depending on the nature of the receptors: solid, liquid or gas.

9. For a body this force is called the force of restitution.
10. When two bodies collide, which is how force is applied, momentum is transferred between them, which is a transfer of energy, the energy of collision.
11. This energy takes the form of *force x distance*, where the distance embodies the extent of deformation.
12. Deformation may be plastic or elastic.
13. Plastic deformation occurs if the body is permanently deformed. It means that the particles of which the body is composed have slipped past each other in an uncontrolled way, from which it is difficult to generalise. The remainder of the argument therefore refers to elastic deformation.
14. Elastic deformation occurs if the body recovers its shape completely when the force is removed.
15. During elastic deformation of a body the particles of which it is composed remain in the same configuration with respect to each other.
16. Elastic deformation which occurs in a body must therefore apply to the shape of the particles of which it is composed.
17. When the force is removed, the elastically deformed body returns to the shape which it had before the application of force. Elastic deformation is therefore temporary.
18. The origin of the force of restitution therefore lies within the particles. It is the same force which gave rise to and maintained their shape.
19. What defines and maintains the shape of particles at the atomic level is their shell.
20. The application of force to an atom therefore deforms its shell.
21. This deformation is likely to be from a sphere to an ellipsoid.
22. When the force is removed, the atom returns to its former shape, which is full recovery by the definition of elastic deformation.
23. Thus the shell undergoes temporary displacements during the application and removal of the force, which might be called a vibration.

24. Under a sustained compressive force, the shell will be distorted for as long as the compression lasts. This is the normal condition of bodies subjected to gravitational attraction on the surface of a larger mass i.e. having weight.

B. Subatomic particles.

The analysis according to the principles of Newtonian mechanics needs to be reconciled with the characteristics of subatomic particles, masses at a level of which he was completely unaware. The shell of an atom is composed of orbiting electrons circling around a nucleus. Do these subatomic particles have a shape? Can you squeeze an electron or proton into a different shape, at least temporarily? If this were possible, what would cause the force of restitution? This would imply a structure within the particle, which would mean that they were not so fundamental after all. This is an argument which you can pursue down to as fundamental a particle as you like. Do electrons and protons then come in a range of different shapes? They certainly have a measurable dimensions as well as a mass. Probability distributions of charge are no answer, because they simply describe where the charge is likely to be rather than what it looks like if you manage to grab hold of one.

In fact the assumption is that all these questions are irrelevant and misguided. So what provides the forces of restitution of structures of which these particle are part, which comprises all atomic and molecular structures? The answer must lie in their unique and distinctive property: their electric charge.

It must be more complicated than simply opposite electric charges. Electrons are not thought to stick to the surface of protons, as electric charge might lead us to expect, but continue in a sort of perpetual motion. In the case of the hydrogen atom, reasoning suggests that the electron has three possibilities as follows:

1. The electron is drawn towards the proton by its positive charge, though not in a straight line, because the proton itself is moving. Thus there is little chance of the electron making a "direct hit" and landing on the surface of a proton. If it did, how would we detect it? Presumably it would not fuse, and some event might shake it free again, depending on the force of electric attraction at zero distance. This force cannot vary according to the inverse square law relationship, which would predict a force of infinite magnitude between electron and proton, because such an irreversible process would mean that by now in the life of the Universe all electrons would be stuck for ever to protons, which clearly they are not.
2. More likely is that the electron closes on the proton very fast, but its momentum causes it to swing off into space in a hyperbolic orbit from which it never returns, so that the encounter might never be detected.
3. Alternatively the electron approaches at the angle and velocity which allows it to go into close, very fast orbit around the proton to form what is called a neutron. A

free neutron is an unstable particle which does not long survive the encounter with any other particle (10 minutes?). In space where other particles are seldom encountered, the neutron might last almost indefinitely. A wandering neutron would be invisible because it is detected only by momentum when it is “fired” at a target structure and causes detectable damage.

4. When the electron falls out of its close orbit around the proton, it remains associated in the form of a hydrogen atom, but this is not a stable arrangement, and hydrogen atoms combine under suitable conditions to form hydrogen molecules, the gas we make in the laboratory.
5. When the nucleus is larger than that of hydrogen it contains more than one proton, bound together in suitable configurations by intranuclear electrons, according to my new theory of the atom (4). In this case the problems of approach for an electron are therefore compounded by the presence of the much faster electrons in the nucleus, which repel boarders with their negative charge faster than protons can attract them with their positive charges.
6. In addition the presence of more than one extranuclear electron means that each repels the other, and may have the consequence of propelling both into symmetrical orbits of much slower velocity than the intranuclear electrons.

### C. Conclusions

These are the forces which define and maintain the shape of the atom. Such forces must depend on the distances between subatomic particles, because there is no reason to think that the magnitude of charges varies. Thus the force of restitution is the force of resistance generated by disturbance of the structural forces which originate from electric charge. Though electric charge is the simplest term to use in describing the process, moving electric charges create their own magnetic forces which also serve to reinforce the structure of the atom.

During deformation it is the orbital electron shells of atoms which are first affected by applied force, because they are on the outside. This is also a simplification because electron shells serve both to keep the atoms as discrete units and to give coherence to the body by holding them together. However, the simple model serves to illustrate the concepts. The nuclei must also adjust their position inside the atoms in relation to the shape of the shells because of the forces of electric attraction between them, but more slowly owing to their greater mass. When the force which distorts the body is removed, all the internal structural forces of the atom pull them back into shape again.

Thus in practice there is no possibility that an the atom could maintain some immutable shape for ever, nor that the adjustment of shape described above could take place other than smoothly, like the orbits of satellites. How would the variable and continuous three dimensions of deformed atoms all simultaneously adjust in quantum leaps, let alone in quanta of time?

The presence of electrons in nuclei could in principle be tested experimentally by stripping orbital electrons off heavy nuclei and causing them to disintegrate into subatomic particles in a collider. The product should contain electrons from decomposed neutrons plus protons in the stoichiometric proportions i.e. one per neutron. This presents a challenge of detection, not least because the electrons would rapidly combine with protons to form hydrogen atoms and then molecules.

The technique of deforming a body and measuring its force of restitution could in principle be used to explore the form of the function which relates the force between charges in the atom and their distance from the nucleus. This function cannot be the classical inverse square law, because as pointed out above, such a law predicts infinite force if there is no distance between the charges, which is not possible. In usual practice the measurements are made by comparative methods i.e. half the separation, four times the force. Near the atomic level there is always the consolation that bringing bodies together still leaves a gap between the charges below. However, between electron and nucleus this cannot work, because they are fundamental particles and their charges can actually come into contact and produce infinite attraction, at least in principle.

Alternatively, if the magnitude of electric charges and the forces between them were known, the shape of a deformed atom under applied mechanical force could in principle be calculated.

It is not clear whether fundamental particles below the level of the proton i.e. the quarks could play any part in the above processes, packed into protons, because applied mechanical forces are soaked up by the electron/proton interaction, and so they need electric charge to influence the shell. Gravitational attraction might have an effect, but this seems unlikely because of the much smaller mass of the electrons.

It also seems likely that free neutrons could play a much bigger role in the cosmos than that for which they are currently given credit. Neutrons have been generally considered to be a sort of make-weight in nuclei, useful as missiles and pumping up the mass of stars and leading ultimately to high density neutron stars. But neutrons are predicted rather than observed directly, because this requires electromagnetic emissions which are generated and detected by shifts in the orbits of extranuclear electrons. Neutrons basically have only mass and hence gravitational attraction to betray their presence, but they might account for some very large scale bulk phenomena indeed. Hence the suggestion that dark matter might consist of clouds of neutrons.

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15 October 2007

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*The Interaction of Mechanical Force in Physical Systems*

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