HOME

The Anatomy of Explosion

by A.C. Sturt

Summary

The dynamics of explosions are analysed in terms of the forces which cause acceleration of the particles of exploding material rather than the usual bulk properties of pressure, temperature concentration etc. The initial step of chemical explosions is the formation of mutually repulsive like negative charges, and for nuclear fission explosions, like positive charges. Nuclear fusion is initiated by very high temperatures and pressures. However, after the initiation step all three types of explosion are propagated by the mutual repulsion of the negative charges of electrons orbiting atoms.

The methodology is applied to the initial explosion postulated by the theory of the expanding Universe. This raises doubts about fundamental particles present at initiation of the 'big bang', and the interpretation of cosmic redshift and cosmic microwave background radiation. Observations are much more readily compatible with the steady-state Universe model of regeneration and redistribution.

A. The role of particles in explosions

An explosion is an instantaneous separation of particles of mass in all directions from a spatial origin at high velocity. Explosions may be conveniently described in bulk terms: concentrations, explosive limits, pressures, energy changes, emissions of electromagnetic radiation, the generation of heat and even as waves, which all essentially summarise properties in bulk. But they must be particulate phenomena because all matter is ultimately particulate in the form of molecules, atoms or atomic nuclei. They must therefore be explicable in terms of what happens to individual particles, and what interactions occur between them.

The forces which accelerate particles away from the centre of explosion must act on individual particles, whether the bulk is solid, liquid or gas. The fundamental questions are: what exactly are these forces; what causes them; and how are they transmitted from particle to particle? Interaction is implicit in the phenomenon itself, because all particles which are concentrated at the origin of an explosion are subject to these forces in the same short space of time.

This argument is in effect the distinction between a whole system and its parts, of which heat is an example. Heat is the vibration in the orbits of electrons around atomic nuclei. In principle each atom or molecule has its independent orbiting electrons, and so its own quantity of heat. But heat is conducted through a material by its electrons. When the atoms or molecules of the material come into contact, any vibration of the electronic orbits of one is transmitted in part to the orbits of the other, and so on eventually throughout the material. Interaction of the orbits of electrons around individual atoms is the fundamental mechanism which underlies the bulk property of heat.

The same reasoning applies to other bulk properties such as magnetism and weight. Magnetic forces are generated at the particle level i.e. the electronic properties of individual atoms and the particles of which they are composed, even if the result is a magnetic field for the whole mass. Weight depends on electronic orbits, which distinguishes it from mass. The force of gravitational attraction pulls a weight down onto the surface of the Earth. Since an atom is composed of a few very small particles in a large volume of free space, there is no obvious reason why the atoms should not slip through each other, so that a mass should simply dissolve into the surface of the Earth. The reason why it does not dissolve is that the electrons of the atoms of which both mass and the Earth are composed are contained in orbits which repel each other. The gravitational attraction between the two masses pulls them together, but this is counteracted by distortion of their electronic orbits, squeezed towards their nuclei on the side at which they come into contact, but extended on the opposite side. Just how far the distortion proceeds depends on the attraction between electrons and the nuclei around which they orbit. Distortion is reversed when the mass is removed from the surface i.e. it is elastic, because the atomic nuclei pull their electrons back into their ‘default’ orbits. All this is implicit in the bulk properties of gravitational attraction, and tension, compression and elastic recovery of materials, but they summarise the interactions which are happening at the fundamental particle level.

There are two particle levels at which explosion may occur: the chemical level, which involves only orbital electrons; and the nuclear level, which involves both nuclei and electrons.

First, in chemical explosions the chemical reaction of components essentially causes the rearrangement of orbital electrons of reactant atoms and molecules into more stable orbits around the molecules produced. The term ‘more stable’ means that the orbits of electrons around the product are more difficult to force into combination than those around the original atoms/molecules or around intermediates formed during the process. Thus molecules of hydrogen and oxygen combine explosively to form water molecules. An initiator is required to start the reaction, which in effect means disturbing the orbits of electrons around a hydrogen and an oxygen molecule to the point that orbits break and recombine eventually around a water molecule. The energy required to break the orbits of electrons in the reactants is the activation energy of the reaction. If there were no barrier to reaction, the mixture of reactants would not be stable enough to form an explosive mixture in the first place.

The kinetic paths of the reaction are such that it then proceeds rapidly and violently, which is an explosion. No energy is lost from the system; it is expressed in new forms i.e. the translational kinetic energy of water molecules, the vibration of the structure of these water molecules and electromagnetic radiation caused by the acceleration of particles. Water molecules can withstand much greater structural vibration than oxygen or hydrogen molecules because the orbitals of electrons around them are more resistant to destructive disruption. None of this affects the nuclei of the atoms involved except to jostle them in response to the rapid movement of electrons.

The other level at which explosions may occur is the nuclei themselves. Unstable nuclei are smashed by bombardment with missiles to form two new, more stable nuclei, which is a fission reaction. Nuclei are far more stable than atoms and more difficult to reach through the negatively charged protective shells of orbiting electrons. The missiles used are therefore neutral particles which are not deflected by electric charges i.e. neutrons. The unstable nucleus was by definition highly positively charged with the number of positive charges equal to the number of orbital electrons in the neutral atom. It follows that the two new nuclei must also be highly positively charged. Freed from the forces that bound the original nucleus into a single entity, they repel each other strongly and so begin to fly apart. They are rapidly surrounded by their own orbital electrons drawn from surrounding material, since this process takes place not in collections of nuclei but in fissile materials in the form of atoms and molecules. Electrons move much faster than nuclei because of their small mass. These new orbiting electrons pick up the vibration of the new nuclei, and spread it to each other and so on throughout the mass of material. Thus vibrational energy of positive electric charges on the nuclei are transmitted by vibrations of orbits of electrons to the rest of the material, which manifests itself as heat. This is the same process which produces heat at the centre of the Earth. The thermodynamic summary of such a reaction is that input material is transformed into an output, accompanied by the release of a quantity of energy which subsumes all the rearrangements that individual particles undergo.

This process does not fall within the definition of an explosion, but if bombardment of the unstable nucleus produces another neutron as well as new nuclei, the process can continue as long as there are unstable nuclei to strike which is a chain reaction. However, if bombardment produces more than one neutron for every neutron used as a missile, the chain reaction is potentially explosive as the process accelerates. Orbiting electrons cannot conduct the heat away fast enough from the mass, and the temperature rises fast. Since the process takes place in a body of material, there is always the possibility of losing neutrons from the process, so that the point of extreme temperature rise may not be reached, but a suitably designed body of material may retain enough neutrons to reach temperatures which blow it apart explosively. This is the critical mass required to produce nuclear fission explosion in this particular system, but the transformation into heat and its explosive transmission throughout the material is performed by orbiting electrons. They are the link between the bulk property of the fissile material and the particle mechanisms which give rise to it. The acceleration of individual particles during the process also gives rise to what may be shown in an equation as the bulk property of electromagnetic radiation.

There is the further example of thermonuclear fusion reactions which are essentially a hybrid system in terms of explosion. Atoms with light nuclei e.g. hydrogen and deuterium are forced together at such high temperatures and pressures that they eventually fuse to form new, larger nuclei e.g. those of helium. These nuclei are not in isolation, any more than the nuclei in fissile material are in isolation. They come with their complement of electrons, and so propagation of the energy which is released in the form of vibration of nuclei is in fact similar to chemical explosion i.e. interaction of the orbital electrons which move to surround them. By contrast the electrons in fissile material are needed at least initially to hold the nuclei still for neutrons to strike i.e. for engineering purposes.

In summary, all the processes of explosion as they affect particles are driven by electric charge and propagated by orbital electrons.

B. Sequence of events in explosion

This framework of analysis allows the elements of the two types of explosive mechanism to be set out as follows:

1. Explosion at the chemical level

    a. Explosion is initiated at a single particle, say A.
    b. Initiation is by an exogenous source e.g. a match, in which mechanical input causes a small explosion at the match head; or a hot wire in which moving electrons cause the disturbance; or electromagnetic radiation which causes electronic disturbance where it strikes.
    c. Whatever the initiator, the result is to increase the irregularity of the orbit of electrons around the single particle A to the point that it exceeds the activation energy of its reaction with a particle of the second species B which comprises the explosive mixture.
    d. Chemical combination of particles A and B takes place to form the more stable molecule AB with their electrons combined into a new, more stable orbit.
    e. Most of the energy difference between A and B and the product AB is realised as increased vibration of the electronic orbits, making it effectively a ‘high temperature’ molecule. Some is emitted as electromagnetic radiation which is caused by the acceleration of particles.
    f. Some of the vibration of AB is transmitted to other particles A and B, if it collides with them i.e. if the concentration is sufficient.
    g. These particles A and B react to form AB, and so on in a chain.
    h. If particle AB causes the reaction of more than one new pair of particles A and B, it becomes a potentially explosive chain reaction.
    i. Molecules AB tend to fly apart in their ‘cooler’ form when collision occurs because of the repulsion of their electronic orbits vibrating in their new configuration, i.e. it is mutual repulsion by negative electric charges.
    j. This is effectively bulk heat with molecules AB colliding and their separation tending to increase.
    k. Rapid reaction of A with B results in explosion.

2. Explosion at the level of the nucleus

a. Explosion is initiated at a single particle, the nucleus.
b. Initiation is by an exogenous source i.e. by a neutron.
c. The target nucleus is unstable. Its instability is frozen in as a result of natural forces in the distant past, and has not had time to resolve itself through decay.
d. When the neutron strikes the unstable nucleus, it splits into two or more parts which are more stable.
e. The new nuclear structures vibrate and emit electromagnetic radiation which has a very high frequency, and may therefore be difficult to detect.
f. The new nuclei resulting from fission are new, highly positively charged nuclei, and so they repel each other strongly, which is an explosion on the smallest scale.
g. As the new nuclei move apart, orbital electrons rapidly move into place around them.
h. This movement of particles generates orbital disturbances which propagate through interaction to the orbital electrons of adjacent atoms, and similarly throughout the bulk i.e. the bulk material becomes heated.
i. The acceleration of electrons into new orbits during the rearrangement causes emission of electromagnetic radiation.
j. If the fission of the unstable nucleus produces another neutron, the process begins again in a chain reaction.
k. If the fission of the unstable neutron produces more than one neutron, the process becomes a potentially explosive chain reaction.
l. If the fission reactions produce enough heat i.e. the orbits of the electrons of the mass are sufficiently distorted and vibrated, and if production of heat is fast enough, the mass becomes so hot and vibrates so much that it flies apart, which is the bulk explosion.
m. Acceleration of particles as they fly apart produces electromagnetic radiation.

C. Conclusions and the Theory of the Expanding Universe

The acceleration of particles in explosions can be attributed to the repulsive force of like pairs of electric charges on particles produced at initiation. The high velocity particles, the heat and the radiation can all be ascribed initially to electric charge. There is no need to postulate other, unknown forces.

The mechanism is that mutually repulsive charges are produced at initiation of an explosion, and the resulting forces cause particles to accelerate away from each other. This follows from the law of action and reaction. Another way of describing it is that repulsion of electric charges is a two-way force. Disturbance of electron shells around atoms is transmitted from particle to particle, which sends them off in all directions by mutual, negative repulsion. Vibration of electron shells is what we perceive as heat. Acceleration of particles produces electromagnetic radiation of a frequency which is related to their velocity at the instant of acceleration.

Chemical explosions start with destructive distortion of electron shells, and so the explosion is driven by negative electric charge throughout. What are called nuclear explosions begin with fission of a nucleus, but acceleration cannot be transmitted from positive charge to positive charge, because positive nuclei in materials are always surrounded by electrons which are lighter and more nimble. Transmission of acceleration from negatively charged particle to negatively charged particle can occur, because clouds of electrons all repelling each other are known; this is what happens at the interface between molecules of a gas. Propagation from nucleus to nucleus directly would require an environment composed entirely of positive nuclei with no electrons present. Such environments are not observed to exist. The mechanism immediately switches, therefore, from mutually repulsive positive charges to mutually repulsive negative charges in the form of electrons.

Particles of mass cannot travel faster than the speed of light, and so at any point distant from the origin of the explosion, light arrives before particles.

Explosions are not the only source of high velocity particles. The sudden escape of gas trapped under pressure creates a sort of explosion as its volume increases rapidly. This is the phenomenon which occurs, for instance, in volcanoes. It is not caused directly by chemical reaction, but it does involve repulsion by disturbed electronic orbits around molecules. There are also conditions in space such as vortices of charged particles which may act as particle accelerators. However, these are different in kind from explosion as defined above.

The Lyell principle of geology says that geological structures which we see today were produced in the past by the same processes as those which we observe in operation today. This seems a reasonable hypothesis in astronomy too. Thus, if the mechanism is correct, it must also apply to explosions which can be seen to have occurred around the Universe. It is not likely that many explosions can be chemical in origin, because this relies on the separate formation of bulk quantities of reactive materials. Such reactions would probably proceed continuously as the components occurred. It may be that Earth is a special place for chemical explosions, because of the store of oxygen in its atmosphere which was made by living organisms.

More likely are nuclear reactions. Certainly there are widespread decompositions of unstable nuclei in the Universe which are generating heat. Some of the unstable nuclei also reach Earth as radioactive elements. They do not produce explosions on a scale that would register in the Universal scheme of things, because of the considerable pressures of bodies which are usually much more massive than we experience on Earth. The most likely nuclear explosions are fusion reactions of the sort that produce the light and heat in stars.

What applies to parts of the Universe ought to have obtained at the very beginning, if we believe the theory of the expanding Universe and the kernel from which all time, space and particles originated. There are two corollaries of the preceding analysis which are relevant to this theory. First, fundamental particles which were formed at the initiation of the first explosion must have been electrically charged to accelerate apart. It is not clear where or whether electric charges fit into the current cosmological analysis. Secondly, if the electron is a fundamental particle and it has the standard negative charge, it implies that the positive particles in each paired particle separation must have been identical as well as opposite.

This raises a fundamental problem. The only particle known to have a positive charge equal to that of the electron is the proton. Either the first positively charged particles were protons, or they were composed of more fundamental particles which had an exact fraction of the proton's positive charge. If they were not an exact fraction, there would always be a little left over, however they were combined, which means a charged initial kernel. What (on Earth!) would that mean? If on the other hand it was the proton which was the antithetic particle of the electron, it would imply that no other fundamental particles were required; the electron and the proton would suffice. The numbers could of course be doubled up to two varieties by giving them opposite spins which manifest themselves under particular circumstances i.e. electron, proton, anti-electron and anti-proton. However, that would mean that all other particles were either electromagnetic radiation or some association of these four with electromagnetic radiation, which is far from current theory.

Alternatively, the electron may not be as fundamental as thought. The electron may be made up from matching subparticles in same way as suggested for the proton. But what causes subparticles to stick together, and in exactly reproducible numbers?

There is the further complication that light must have preceded mass in the first explosion, unless the restriction on mass travelling faster than the speed of light is lifted for the occasion. If light preceded mass, then time and space were created by the propagation of light not by the explosion of mass. It might be asked: where does that leave cosmic redshift, and the cosmic microwave background radiation?

The Einstein equation for apparent equivalence of mass and energy is invoked at various stages to account for problems with the expansion model, but even if this relationship is accepted, the problem is how the bulk property of energy becomes differentiated into specific particles of mass. Indeed there is an argument that energy is in fact simply the acceleration of particles of mass, not their being in existence. Then there is the problem of the presence of the electron and its standard negative charge in the beginning. Not far behind is the assignment of mass to photons of electromagnetic radiation, and vice versa.

In the expanded Universe which we see today 'dark matter' is invoked to explain apparent deviations from the predictions of Newtonian mechanics. However, it seems perverse to ignore mass as the origin of 'dark matter' since gravitational attraction was Newton's definition of mass in the first place (baryon means heavy!), just as it seems similarly perverse to ignore the known repulsive effects of like electric charges.

Much simpler is the theory of a steady-state Universe which is infinite in time and space, regenerated stochastically, part by part, by being pulled together into masses by kinetic energy, remixed by gravitational attraction down to particle level and redistributed by explosion (1). In this model the energy of explosions at any time must exactly equal the energy of gravitational accretion and fusion over the Universe as a whole. They are the Universal opposing action and reaction. Matter is conserved; none disappears into any other form. Energy is also conserved as the acceleration of particles of matter.

The steady-state model fits well with the neutron analysis and new atomic model (2) proposed in recent papers, and central to the model is the repulsion of electric charges as the basis of explosion proposed in this model.

There are two remaining points. None of this analysis leaves us any nearer to knowing what the nature of electric charge is, either positive or negative. We observe its effects, but we do not know what it is. This just has to be accepted as given.

And finally, the conservation of energy is implicit in the analysis of explosions throughout the analysis, but nuclear transitions may produce electromagnetic radiation which is difficult to detect because of its high frequency. It has to be detected by another nucleus, which is not practicable at present. This could spoil deductions from equations based on conservation of energy using on current methods of observation.

A.C. Sturt

9 July 2007

References

1. The Timeless Universe I. A Model of Stochastic Regeneration and Redistribution, A.C.Sturt 22 September 2001 www.churingapublishing.com/timeless_1.html.
2. Neutrons in the Structure of Atomic Nuclei, A.C. Sturt 29 November 2006 www.churingapublishing.com/neutronp1.html.

Appendix

Questions and answers

Questions

A number of points were raised about the validity of some of the statements in the paper. These are set out below.

1. “Heat is the vibration in the orbits of electrons around atomic nuclei”. (Objection: the main contribution in most materials is the motion of atoms; orbits don’t vibrate.)

2. “Weight depends on electronic orbits, which distinguishes it from mass”. (Individual neutrons have weight, as does light; so for that matter does nuclear binding energy.)

3. “Since an atom is composed of a very few small particles in a large volume of free space, there is no obvious reason why the atoms should not slip through each other”. (While electrical repulsion cited by the author is one factor, the most important contributor is the Pauli exclusion principle).

4. “The only particle known to have a positive charge equal to that of the electron is the proton”. (This is about 75 years out of date.)

5. Where are the quantitative predictions and explanations of observations?

My Reply

The objections of the commentator depend entirely on the Theory of Relativity and on quantum theory. While these undoubtedly have their applications, they are just models of physical phenomena, and the equations which follow from them are generalisations of the model. Other models, which I believe to be more realistic, lead to other equations. The measurements which I have proposed in the papers on my personal website, as in the references of the paper, use new technological developments, including in space.

My specific points are:

- Heat is the motion of atoms **in bulk**. An ion flying through space at whatever velocity does not contribute to heat until it hits something and shakes its atoms. In fluids this is the equivalent of Brownian motion. In solids the atoms do not move bodily, and so they simply vibrate and bump against each other on the spot. Atoms like all bodies must deform in order to produce the forces of reaction, just as a wall deforms when you lean against it, or it could not push back and support your weight. Simple mechanics! I assume we are not suspending Newton’s laws, not at these velocities. The question then is what in an atom deforms on impact. It is the electrons shells which collide (it certainly isn’t the nuclei), and so they must be displaced into more eccentric orbits with the nucleus as the focus. The nucleus accelerates much more slowly than the electron shell is displaced, because its mass is 2000 times greater. It follows their changes; a bit like the Solar System in fact. It is these processes which I described as “vibration of orbits”; they shift with each collision.

I suspect the commentator has in mind the quantum theory in which orbits can change only in steps. Smaller changes are not allowed, but this is a problem for the theory, not for the mechanics, which seem simple enough. There are other explanations for the electromagnetic emissions which gave rise to Bohr’s quantised atom in the first place.

- Mass is a concept invented by Newton as a constant of proportionality to make his theory of gravitation possible. See the very first paragraphs of the *Principia*! A weightless body still has mass. A body has weight when it rests on another body, and the point of contact is their electron shells. These must be deformed to produce reaction, as described above. (The term g force is a convenient way of describing changes of angular momentum, which depend on mass not weight). I am sure that neutrons have weight as well as mass, say when they rest on the surface of a body, but I have suggested that a neutron too is an electron in close orbit around a proton, a sort of mini hydrogen atom. I doubt whether electromagnetic radiation has weight, though it may be influenced by the electric/magnetic properties of bodies which have mass. Nuclear binding energy is a calculation rather than a direct measurement, and so it depends on a lot of other things.

- Pauli's exclusion principle states that no two electrons in an atom may be described by the same quantum numbers. One does not need quantum numbers to differentiate between the roles of electrons in an atom at any instant. It is enough to agree that electrons come as individual, identical particles. Back to the interaction of particles in numbers! Pauli's exclusion principle never launched any rockets.

- I stick by my assertion that the proton is the only positive particle with a charge equal and opposite to that of the electron. Presumably the commentator is referring to the positron, but that is simply an electron with the opposite spin, is it not? The electron is the fundamental particle. The proton by contrast is different from the electron in mass.

- Finally, measurement is quantitative. When quantitative measurements are used in mathematical equations, they are no more valid than the model which the equation describes. To coin a phrase, not everything that counts can be counted, and not everything that can be counted counts. I could not have put it better myself!

See paper in the reference for a quantitative materials science experiment to measure the distortion of electronic orbits around nuclei which quantum theory denies!

Alan Sturt
29 July 2007

Reference:
Further thoughts after replying to comments on The Anatomy of Explosion, an experiment in material science.
http://www.churingapublishing.com/explosion_moreadd.pdf