

Marcus Chown

The incredible exploding mosquito



Some time ago I was sitting at my PC idly looking at the power cord snaking its way from the wall socket to the back of the machine. I wondered: how is it that something invisible can come down a wire into my home and power my PC? And not just my PC but my washing machine and my toaster and my electric lights? And not just my electrical appliances but the appliances of billions of other people all over the world?

After a bit of thought I realised that it is all due to nature's electric force, which holds together the atoms in your body and pretty much everything else in the world. All of us are familiar with the gravitational force. It appears to be pretty strong in our everyday world. After all, it is hard to jump more than a metre in the air before being pulled back down again and, if we fall from any height, we are liable to break our bones. The electric force, however, is stronger than the gravitational force. Not by a factor of 10. Or a factor of 100. Or even a million. No, the electric force is stronger than the force of gravity by a factor of 10,000 billion billion billion billion.

How can such a mind-bogglingly powerful force operate in the world around us without us noticing? It is all down to the fact that matter comes in two distinct types. Call them Type I and Type II, or A and B, or positive and negative. It really does not matter. Physicists have plumped for calling the two types positively and negatively "charged". The important thing to know is that like charges repel each other with the electric force while unlike charges attract each other with the electric force (contrast this with the case of gravity, where matter comes in only one type, which always attracts). And, in all everyday matter, there is a precisely equal quantity of negative and positive charge, so the electric force is perfectly cancelled out. This means that, even though there is a super force 10,000 billion billion billion billion times stronger than gravity operating in your body, you can walk past someone on the street without either of you feeling even the slightest force of attraction or repulsion.

But say a body did not contain an equal quantity of negative and positive charge. Imagine a mosquito. The mosquito is made of atoms, like you and me. And an atom, if you remember from school, is like a miniature Solar Sys-

tem, with a compact "nucleus" at the centre, like the Sun, around which tiny electrons orbit like planets. The nucleus has a positive charge and the electrons a balancing negative charge. And it is the attractive force between these unlike charges that glues an atom together.

Now say, by some wizardry, it was possible to magically remove all the electrons from the mosquito. This would leave only the nuclei. Being all positively charged, they would repel each other. Consequently, the mosquito would explode. The question is: with how much energy would the mosquito explode? Would it explode with...

- The energy of a sparkler?
- The energy of a stick of dynamite?
- The energy of a 1-megatonne H-Bomb?
- The energy of a global mass extinction?

Perhaps you think the answer is b) a stick of dynamite, or maybe c) a 1-megatonne H-Bomb? If you think c), you are at least on the right track. A hydrogen bomb is a useful comparison. But not a single hydrogen bomb. A million billion 1-megatonne H-Bombs. Because the answer is d). The mosquito would explode with the energy of a global mass extinction – that is, an energy equivalent to the city-sized asteroid that slammed into the Earth and wiped out the dinosaurs 65 million years ago.

Each and every mosquito on Earth would be a potential world-destroyer – were it not for the fact that the mind-bogglingly huge electric force is in all normal circumstances utterly nullified. (Will you ever look at a mosquito in the same way again?)

Now perhaps it is possible to appreciate the potential of the electric force for energising the world. Removing all the electrons from a mosquito – if it were possible – would create a dramatic charge imbalance and unleash a truly extraordinary amount of electrical energy. It follows that creating even a modest charge imbalance might unleash a significant amount of electrical energy. Such a charge imbalance occurs in a thunderstorm and is unleashed as a bolt of lightning 10 times hotter than the surface of the Sun. Such a charge imbalance is also created in a power station. And that, in a nutshell, is the secret of how electricity powers the world. ●