From The PowerGlide Lab

Cue Mr Bumble

How can a bumblebee stop an express train? If you want to know what the answer to that question has to do with the science behind the design of equipment for snooker, billiards, and pool, keep reading!

So cue Mr Bumble (a bee, not the Dickens character), who is unwittingly flying directly along a railway track at 5mph when he encounters the front of the 3.15 from Euston to Little Dorrit coming the other way at 90. The argument between the two is understandably short-lived and Mr Bumble continues his now posthumous journey stuck to the front of the train, in exactly the opposite direction to his previous course.

In rapidly going from slow forward to fast reverse, for one instant Mr Bumble must have been stationary. But at that instant he was in contact with the train, so that must have been stationary too. Hence a bee can, albeit very briefly, stop an express train.

So what's wrong with that argument? Where is the logical flaw, as there always is in those supposed "proofs" that 2 equals 1? Well, the possibly surprising answer is that, in one sense, there's no flaw and Mr Bumble really did stop the train. The catch is that he didn't stop all of it, only the bottom of the microscopic dent he made in the front, which then elastically rebounded back to its previous position.

Incidentally (inci-dent-ally?), had Mr Bumble been a bee made out of tungsten (although nature is way too smart to try that), it's likely that the elastic limit of the train front material would have been exceeded and the dent would have stayed there.

Why is it some folk find that bee and train paradox hard to explain? Perhaps half-remembered basic school physics has to take some of the blame by introducing the phrase "rigid body problem" and then applying it to situations like a snooker cue ball hitting an object ball. No need to mention elasticity, that can be sneakily hidden away in a parameter called "the coefficient of restitution", then a bit of conservation of momentum and Newton's your uncle, the answer drops out.

OK, but what about when a cue ball hits an object ball which is on contact with another? If everything is perfectly linear and the balls are of equal size and mass, the first object ball will not move, only the second will. The same sort of thing happens when shunting coins into each other on a table, or, speaking of old Isaac, when the suspended metal balls in a Newton's cradle start swinging.

The reason this all happens is because, in the real world, there's no such thing as a rigid body. The snooker balls, like the front of Mr Bumble's train, coins, and Isaac's metal spheres, are all elastically compressible and a compression wave travelling through the material transmits the collision forces.

For cue sports, this consideration doesn't just apply to collisions between balls, it also applies to collisions between a cue and a cue ball. So the compressibility of the cue and tip materials are key factors in how the cue will play, as is the speed the compression wave travels, which is effectively the speed of sound in the material.

In some shots the compression wave may not have time to travel far very down the cue before the cue ball has left the tip, which means the characteristics of that small part of the cue alone will do much to determine the nature of ball's motion.

This is, of course, just dipping a toe into the ocean of science behind cue design, but hopefully Mr Bumble has helped to show that there's a lot more to it than basic school physics!