Scattering

04 March 2020 09:30

If you want to find out about the structure of something you often have to break it to look inside.... The same is true in particle physics where high energy particles are fired at other particles to see what happens when they collide.

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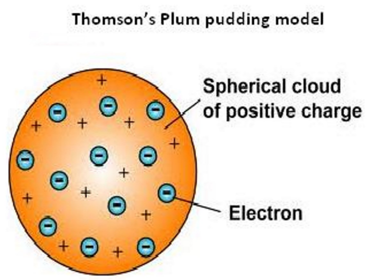
<td>
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<td>Late 1800s Thompson proposed the "plum pudding" model of the atom.

In 1909 Rutherford (or more correctly, his students) carried out</td>
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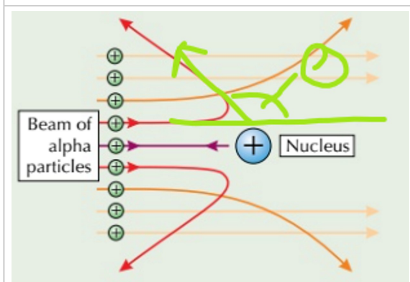
<td>
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<td>High energy alpha particles were fired into a very thin gold foil. Geiger and Marsden spent days and days recording the angles at which the alpha particles come out of the foil by looking for tiny flashes of light. Mostly the α particles went through, with some deflection. Very occasionally though a few came back at angles greater than 90 degrees (in green)</td>
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1. Most α went straight through - so atom mostly empty
2. Some α were deflected through large angles - so there must be a large positive charge there
3. A very few α deflected at greater than 90^{O} - so nucleus must be tiny
4. Fast α were deflected - most of the mass must be in the nucleus

This work led to a reworking of the model - so plum pudding went out of fashion (except at Christmas) to be replaced by a tiny positve nucleus with negative electrons in shells.

Scattering Leads to Structure

If you know a particles initial kinetic energy you can work out the charge on the nucleus

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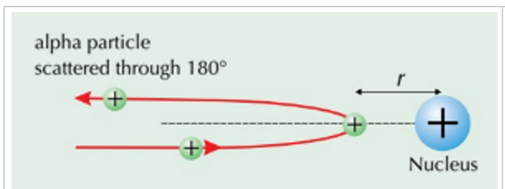
<td>
</td>
<td>This diagram is slightly confusing - the α is meant to be travelling in along the dotted line connecting the two centres of positive charge. Therefore said α should reflect back along the same dotted line. Its just really hard to show that.

As the α approaches the nucleus it loses KE and gains PE. The closest approach, r, is when all the KE has turned into PE. So the electric potential energy at closest approach is equal to the kinetic energy at a 'great' distance.</td>
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<td>$KE = \frac{kqq}{r} \qquad k = \frac{1}{4\pi\varepsilon_0}$</td>
<td>The two q s are the charges on the nucleus and on the alpha and the nucleus. So you can work out the closest approach distance.</td>
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