**Communicating particle physics**

A few ideas about how you might go about communicating particle physics:

**Atoms**

Atoms are unimaginably small. About 10 million atoms would fit into 1mm! However, the nucleus of an atom is even smaller, about 100,000 times smaller!

To make a scale model of an atom is difficult:

You can give people participating in your activity small balls (like those found in children’s ball pools or similar) to represent the protons, neutrons and electrons then you can simply change which atom you make depending on how many people you have.

Ask the people who are your protons and neutrons to stand in a group close together in the centre of the space you are using. Hopefully, the group will fit into a circle of around 1m diameter. Then ask the people who are electrons to position themselves where they think they should be. Once they have done this tell them that actually the position they need to be in is outside the room/space you are using. In fact, on this scale, they would need to be around 100km from where you are (choose a town/city around this distance from where you are to illustrate the point).

To make a smaller scale model you can use a small marble (around 1cm in diameter) to represent the nucleus (with all the protons and neutrons in it). You can ask once again how far away the electrons should be. On this scale the answer is still 1 km. If you wanted your atom to fit into a room (so say it had a diameter of 1m) then the nucleus would only be one hundredth of a millimetre wide – so small you couldn’t see it!

**Particle accelerators**

The salad bowl particle accelerator is great for talking about this! The handbook describes how it works.

Particle accelerators use magnetic fields to steer the particles (rather than the side of a salad bowl which is what is happening here!). These magnetic fields have to be very strong to give a big enough force to steer the particles enough. To get a strong magnetic field you have to cool down your magnet until it becomes superconducting – that means electricity can pass through it with no resistance. Other strange effects happen when particles become superconducting. You can demonstrate Strong Levitation (instructions are in the kit) with the Superconducting Magnet Kit. You will need Liquid Nitrogen for this demonstration. You will also need to use a camera to ensure all your audience can see what happens.

Remember it is only a small fraction of particle accelerators which are used for particle physics. Most are used for medical applications and large facilities like Diamond and ISIS have huge variety of uses.

**Cloud chamber**

The cloud chamber is a great way of proving the existence of some of the small particles which are invisible to us. You can see both alpha particles (two protons and two neutrons stuck together – a helium nucleus) and beta particles (electrons) with this. Full instructions on how to use this are in the handbook.

**Uses of particle accelerators**

Particle accelerators like Diamond produce something called synchrotron radiation. This is a type of light. The following section (taken from the family science show script) shows different ways you can show properties of synchrotron radiation:

Shine the white light source on a wall across the stage to show that the spot size is quite large. Shine a laser pen across the stage in the same way to show a small spot size. Synchrotron radiation is like the laser; it is highly collimated and has a very small spot size. This means that it can be used to carry out far more accurate experiments than white light.

Now shine the white light source through a prism to show a rainbow. Shine the laser pen through the prism and show that you don’t get a rainbow (be careful that the laser beam doesn’t get bent and end up going in someone’s eyes). Synchrotron radiation is like the white light source; it is made up of many colours including things outside of the visible spectrum, such as infra-red, ultra-violet and X-rays.

So how do researchers use synchrotron radiation? In broad terms, they shine it through materials and look at the patterns the light makes. These patterns tell them about the structure of the material.

Take the diffraction grating and shine the laser pen through one set of slits so that the resulting pattern shows up on a wall (again take care that the laser beam doesn’t hit anyone). Compare this pattern with the other sets of slits. You should see that spacing of the laser beams varies with the spacing of the slits in the diffraction grating. Scientists look at the spacing of the beam after it has passed through a material and use this spacing to work out the spacing of the atoms or molecules in a material (the material acts like a diffraction grating because the atoms and molecules have a regular spacing).

You can show the properties of both ultraviolet light and infrared light (both of which are produced in synchrotron radiation sources) using the infrared camera and the UV diodes.

**Guess who**

The project team are developing agues who game for particle physics. You will need a standard guess who game. Particle physics inserts and particle properties will be provided. This will allow people to learn about the most fundamental particles in the universe.

If anyone has any questions about particle accelerators or particle physics I am always happy to help.