

TAP 539-1: Probing arrangements

Trajectories show structure

Probing unknown regions of space by tracking probes can show what lies in the volume of space. If a charged probe is used then expect to be able to tell where the charged particles are in that space (or perhaps were – the nature of the interactions will depend on the mass of the target charges, as well as the probes). A further potential difficulty is that the charges within the probed volume may not themselves be stationary, even before the probe arrives. And often you can usually only see where the probes enter and leave the volume, not track them through the volume. However, there are usually few alternatives available. Highly inferential knowledge gained in precisely this way forms a major part of what is known about the subatomic world.

Here the north-seeking poles of magnets are used, to model repulsive interactions.

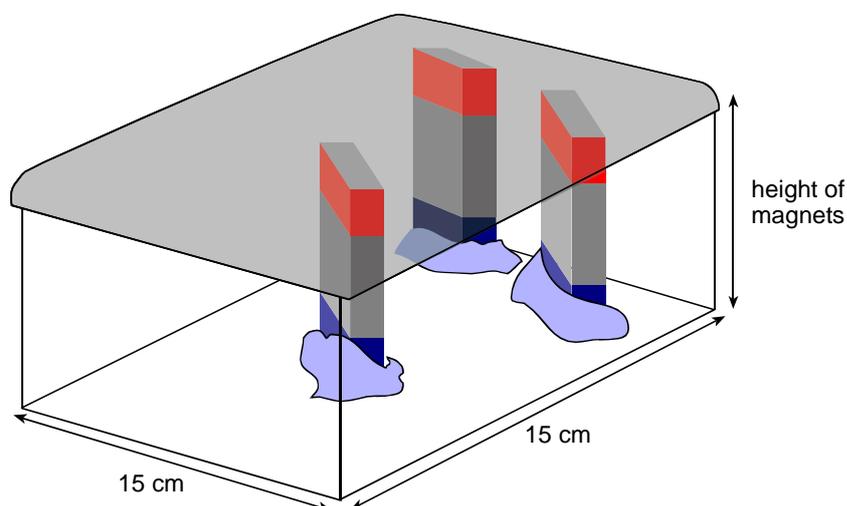
You will need:

- ✓ target box
- ✓ three bar magnets
- ✓ cylindrical magnet mounted on 1 m of dowel
- ✓ retort stand, boss and clamp

A model of high-energy collisions

Set up the probe to swing freely.

Set up a number of magnets in the target volume of space:



Then challenge a partner to discern what is in that space – using the probe! Keep it to fairly simple distributions.

Suspend the probe so that the centre of the swing is over the centre of the box. Place the aiming card over the centre of the box. Then probe. Make a good model – don't cheat!

In probing you might try:

1. Altering the initial kinetic energy of the probe.
2. Altering the aiming error of the probe.

Suggest reasons for your choice of what is under the box. Change roles and try again.

You have

1. Used a model of high-energy probing of a volume of space.
2. Seen the effect of probe energy on the ability to resolve what is in the space.
3. Found some of the difficulties in interpreting trajectories to infer the existence of particles.

Practical advice

The apparatus is simple enough, and variations may suit local conditions. The box will need to be of a suitable inside height to allow the magnets to stand inside the box, just reaching to the top.

External reference

This activity is taken from Advancing Physics chapter 17, 70E