

# Halbach Array Kit

**Warning:** We have made these kits to be as simple to assemble as possible. It is much easier/stronger than gluing magnets together. But assembly still requires a person with good dexterity. Be careful as the magnets are strong and can pinch the skin or fly away from one another. These magnets are also quite brittle. Keep away from computer components and anything magnetic or electrically sensitive. Keep away from pacemakers. Do not let young children handle them.

## This kit includes:

Aluminium magnet case (8mm x 37.5mm x 12mm)  
5 very strong rare earth magnets (cube shaped)  
5 grub screws to hold magnets in place (in some cases a spare maybe provided)  
Allen key to tighten grub screws  
Magnetic field viewer card  
These Instructions

## What is a Halbach array?

A Halbach array is a special arrangement of permanent magnets which increases the magnetic field on one side of the device while cancelling the field to near zero on the other side. It is the closest you can get to a one-pole/monopole magnet. In the diagram below, the magnetic field is enhanced on the bottom side and cancelled on the top side (a one-sided flux).

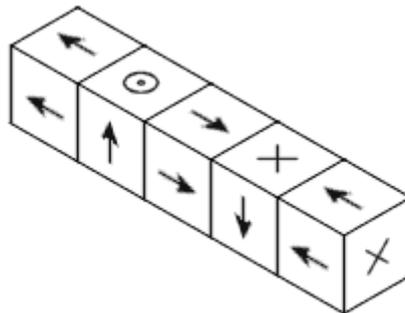
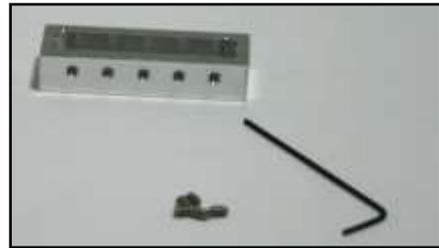


Diagram1 : the Alignment of the magnets

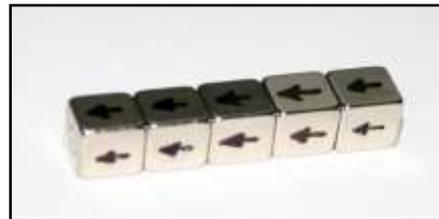
The pattern (on the front face; left, up, right, down) of permanent magnets can be continued indefinitely and have the same effect. It is roughly similar to many horseshoe magnets placed adjacent to each other, with alternating polarity. The effect was discovered by Mallinson in 1973, and these 'one-sided flux' structures were initially described by him as a 'curiosity', although he recognised at the time the potential for significant improvements in magnetic tape technology. In the 1980s, the late Klaus Halbach, a physicist at Lawrence Berkeley National Laboratory, invented the Halbach array to focus accelerator particle beams.

## How to construct the Halbach array

- 1) Take the aluminium case and screw in the grub screws using the provided Allen key. To achieve this you may find it is easier to put the grub screws onto the Allen key first, before attempting to 'locate' it into the hole. Do this for all five screws but make sure they are not protruding out of the back (and hence stopping the magnets from going in). Some kits may come with a spare grub screw.



- 2) Mark the orientation of the magnets. The easiest way to do this is to allow the magnets to naturally align. Make a note of their alignment or mark them with a permanent marker (as shown in picture). Then split them up but making sure they are not too close together.



- 3) Place the case so the screws are facing you and the space for the magnets above. Start putting in the magnets from left to right making sure the orientation is correct as show in diagram 1. As you put each magnet in, tighten the corresponding grub screw. The first 3 magnets should be quite easy to fit. The last 2 I found much harder to put into place correctly. NOTE: make sure the magnet does not flip over and have change orientation as you are putting it in place.



- 4) If the last two magnets are troublesome, try putting in the 5<sup>th</sup> one (far right) before the 4<sup>th</sup>. Don't forgot to first tighten each grub screw as you put in the magnet. Be very careful with the last magnet as it will require a lot of pressure to go in. Make sure you tighten the magnet grub screw while securely holding the magnet in place.



**Tip from a customer:** by wrapping the surface of a broad rubber band partly around the 4th magnet you can get a firm grip on it that will enable you to slowly position it over the remaining space, in the correct orientation, and firmly push it into the case.