The Concept of

AMANE'S LAW OF HALF SYNCHRONISATION (AHS)

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Content

(Note: this a continuation of ALS, so the item numbering starts from 2.)

I. Background

ASR was first discovered in October 2004, during a laboratory experiment. From the research, I found that some physical ideas on magnetism and electromagnism till today are yet to be fully uncovered. I have managed to come out some with more complete and precise ones over them. I have also discovered a new kind of electromagnet: Half Magnet (HM). For a better understanding of HM in AHS, it is advicable to read through Amane's Law of Synchronisation (ALS).

There are two laws under ASR: Amane's Law of Synchronisation (ALS) and Amane's Law of Half Synchronisation (AHS).
ALS − complete explanation of Fleming's Left Hand Rule and Right Hand Rule, and proves that there is no difference between them. ALS also demonstrates a more accurate explanation on Magnetic Induction.
AHS − discovery of Half Field (HF) as well as Half Magnet (HM). Under certain condition for HMs, magnetic same poles attract one another and repel one another for different poles; these effects are termed as **Amane's Effects** (found in 24 March 2005).

AHS is believed to be a newly discovered concept, so the content is restricted to a short one.

Though there might have some errors, inaccuracies in this theory, I believe the ideas brought out here have some little advancement on further basic understanding on magnetism as well as electromagnetism.

II. AHS terms translation (English, Chinese, Japanese)

Amane's Law of Half Synchronisation (AHS)	亚玛子变向同步法则	**アマネ変向連動法則**
Half Field (HF)	变向磁场	**変向磁場**
Vo	斡(wo4)	**ヴォ**
Half Magnet (HM)	变向磁铁	**変向磁石**
Amane's Effect	亚玛子效应	**アマネ効き目**

2. Amane's Law of Half Synchronisation (AHS)

2.1 Half Field

ALS is explaining about magnetic field synchronisation between straight CC wires, a straight wire (CC wire) and a magnet; AHS will be explaining magnetic field behavior at a deflected angle.

2.1.1 Coil of CC wire

The simple formula on solenoid magnetic field from Ampere's Law shows:

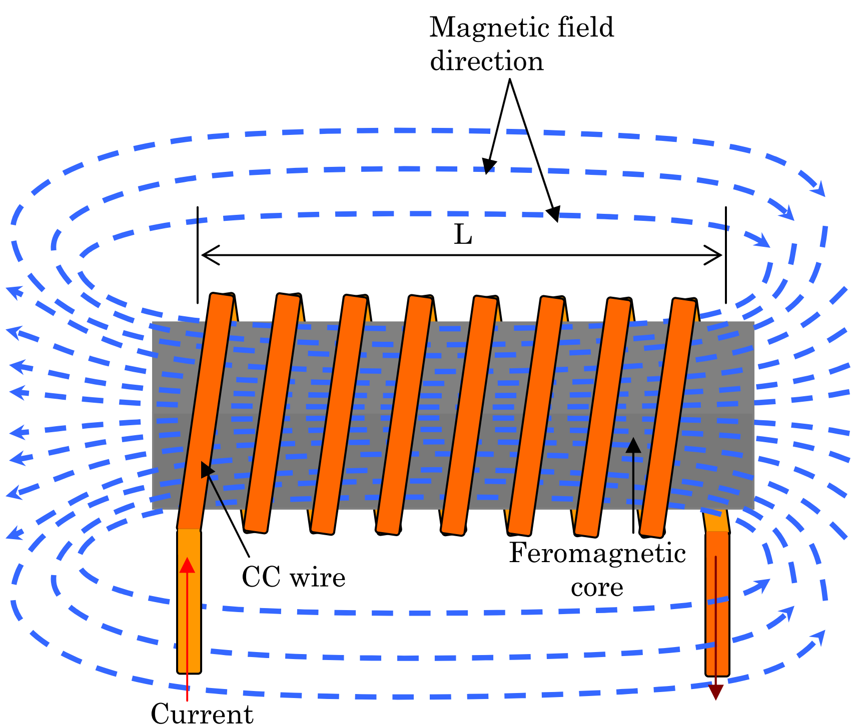
$$BL = \mu NI$$

$$B = \mu \frac{N}{L} I$$

$$B = \mu nI$$

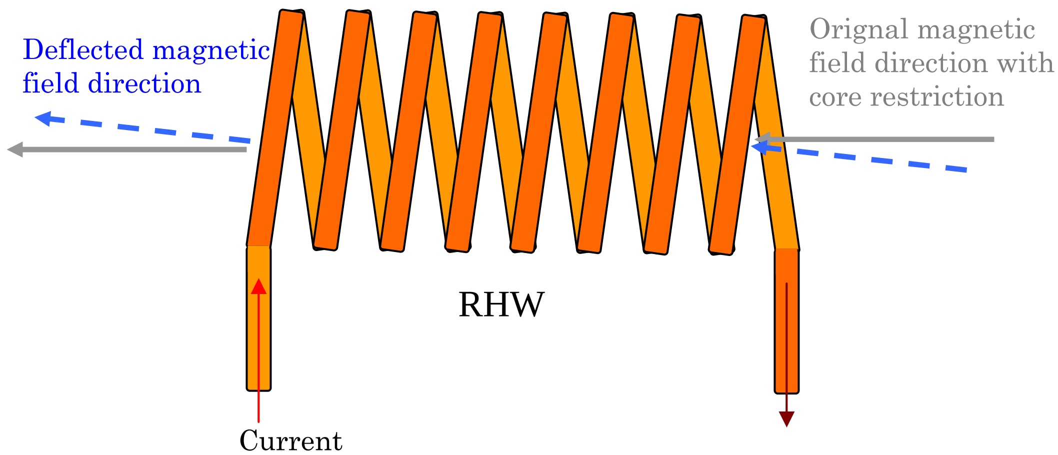
where
B = magnetic field strength
μ = permeabuility of the core;
I = ampere;
n = N/L, number of turns divided by effective length of the solenoid

One point has to be noted here is that the core has a definite shape (i.e. cylinder shape), so the direction of the magnetic field within the core is almost parallel to the length of its cylinder shape. In another words, the direction of the magnetic field within a core of definite shape is being restricted/controlled by the shape of the core medium.

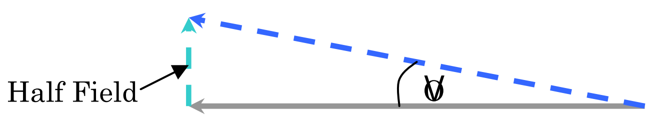


2.1.2 Deflected Magnetic Field

For a core media without a definite shape like air core will not restrict/control the direction of the magnetic field produced by the CC wire. As according to the Right Thumb Rule (1.1.2), it is know that magnetic field ciculates around the CC wire perpendicularly to the length of the CC wire. There are basically two types of winding diection for a solenoid: Right Hand Winding (RHW) and Left Hand Winding (LHW). Over here, RHW will be used for explanation.



It is obvious that the produced magnetic field is deflected at a small angle of θ (Vo). This is also the (average) deflecting angle of the coils from vertical position. The formula for magnetic field (grey color) parallel to the solenoid can be written as:



$$B_f = \cos\theta \, \mu nI$$

From the trigonomical figure above the magnetic field (cyan color) that causes the deflected can be defined as:

$$B_h = \sin\theta \, \mu nI$$

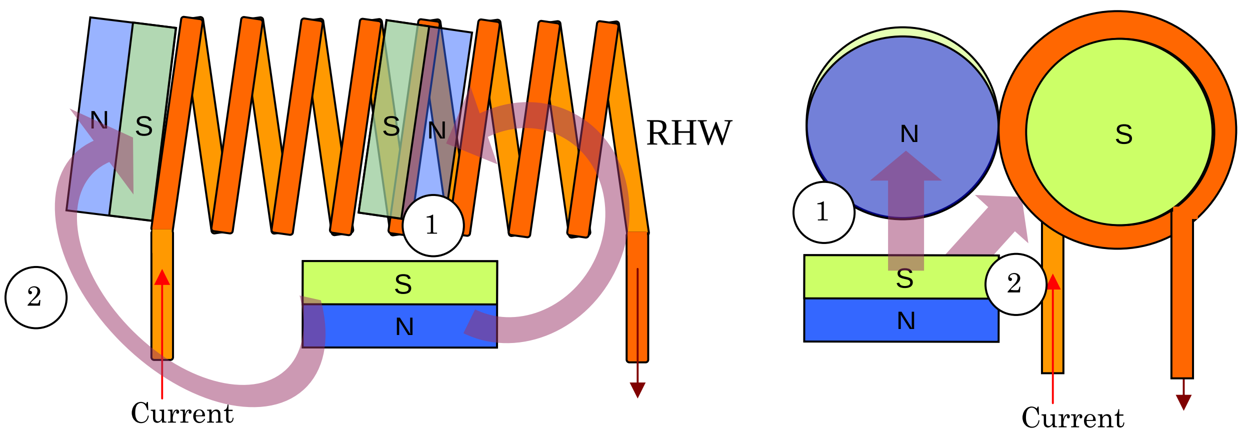
where
B_f = magnetic field with fluid core
B_h = magnetic half field with fluid core

And this magnetic field is termed as Half Field (HF). The concept of Half Field is a bit hard to be understood without a three-dimensional visualization. The picture below shows a simple behavior of a coin shape magnet towards the magnetic field.

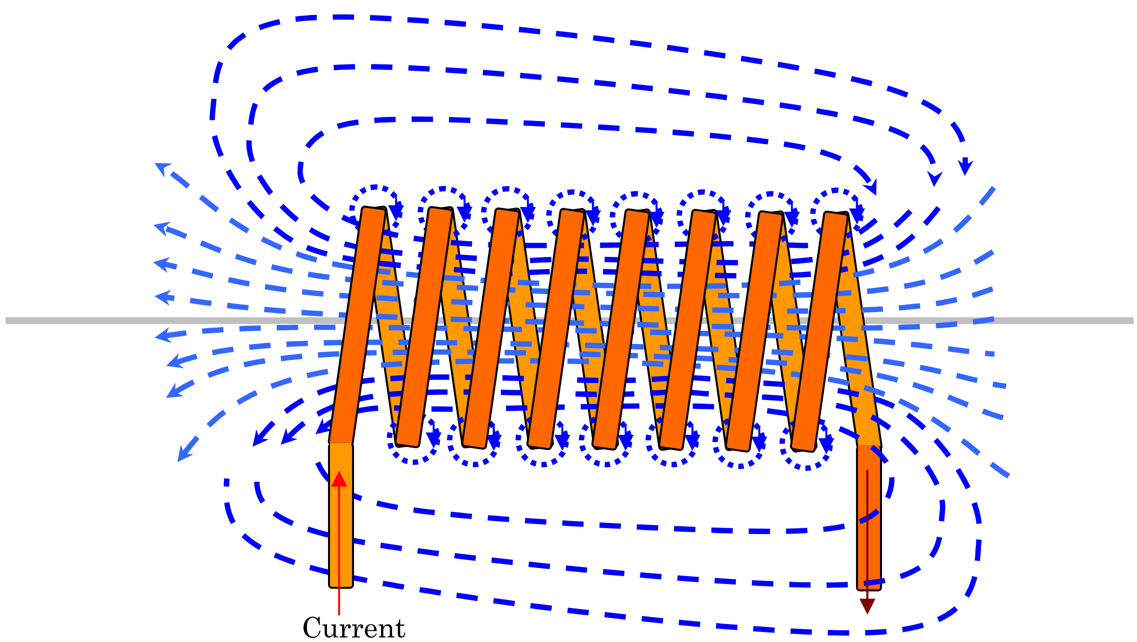
If the coin magnet (cross-section) is placed freely near the solenoid, there are two possibilities how the magnet moves towards the CC solenoid:

1) According to ALS the coin magnet will synchronise with one of the turns of the solenoid at an angle of θ.
2) The coin magnet will move to the left side of the solenoid.

Both of the above behaviors are very similar to the behaviors of two pieces of magnets except for the magnet deflects at an angle of θ.
There is a third action of the coin magnet reacts to the Half Field, this is shown in 2.2.1.



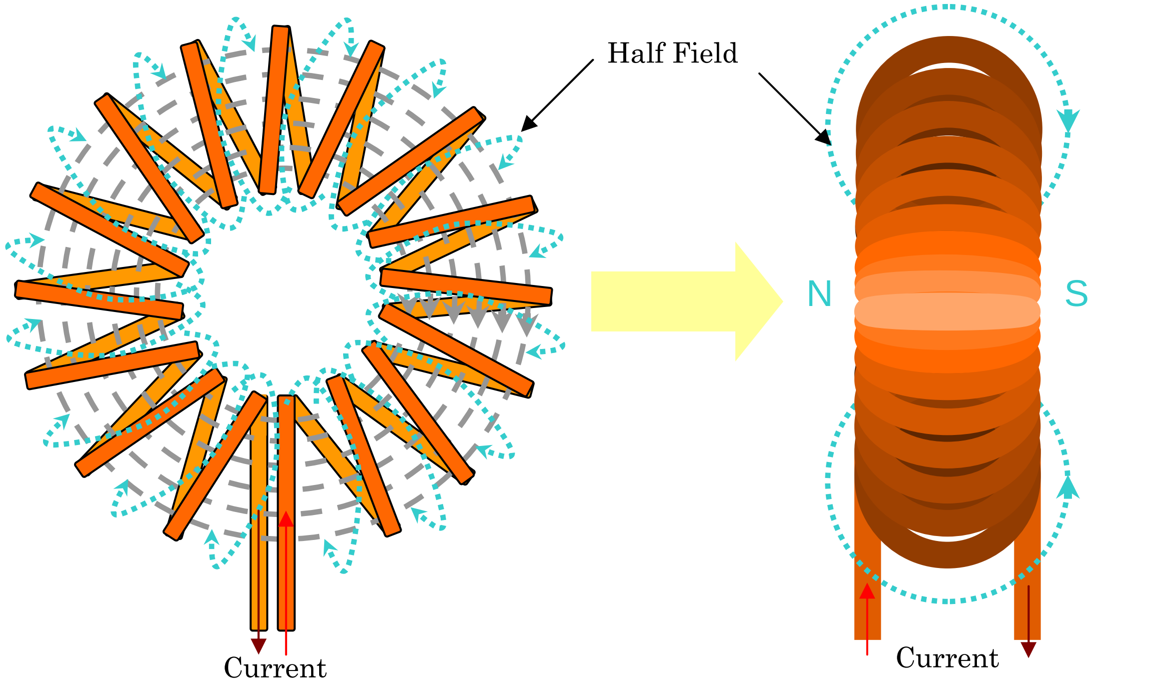
The piture below shows the simple shape of the magnetic field behavior of a CC solenoid.



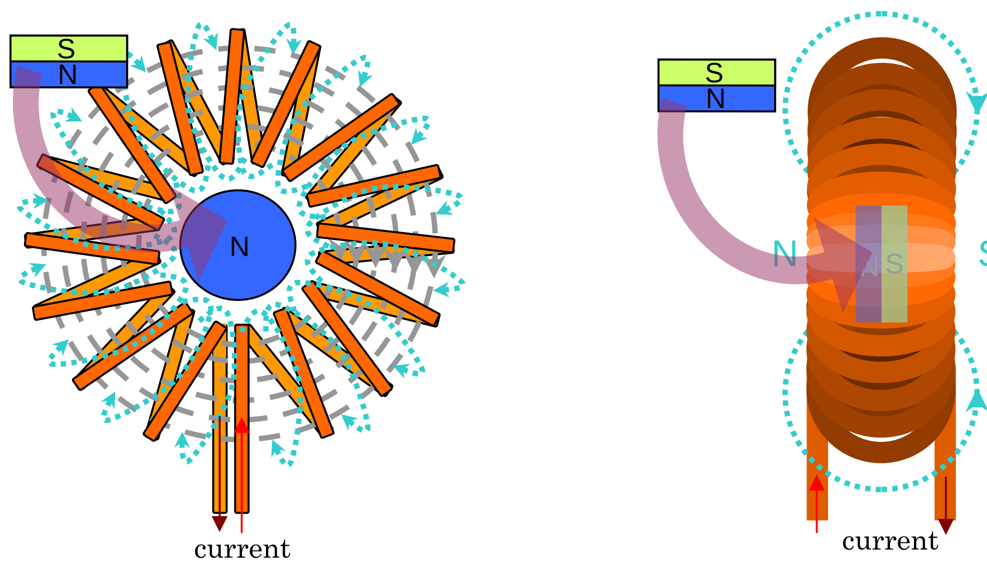
2.2 Half Magnet

2.2.1 The Magnet

When the majoy magnetic field (grey color) is eliminated, what left over is the Half Field. To eliminate this major field, just twist the solenoid into a round toroidal coil. With such, the major magnetic field will form into a circular loop, and hence the left over magnetic field (cyan color) is the half field. This half field is still able to circulate around the toroidal coil with a complete loop. There is one side of the toroidal coil behave similar to as a North Pole and so to the other side. A CC toroidal coil/solenoid with a fluid core (eg. air, liquid or vaccum) is termed as **Half Magnet**.



How to show/determine a half magnet's polarity… there is a very simple way: just hang a small coin magnet freely near the centre location of the CC coreless toroidal solenoid and it will show the polarity of the half magnet.



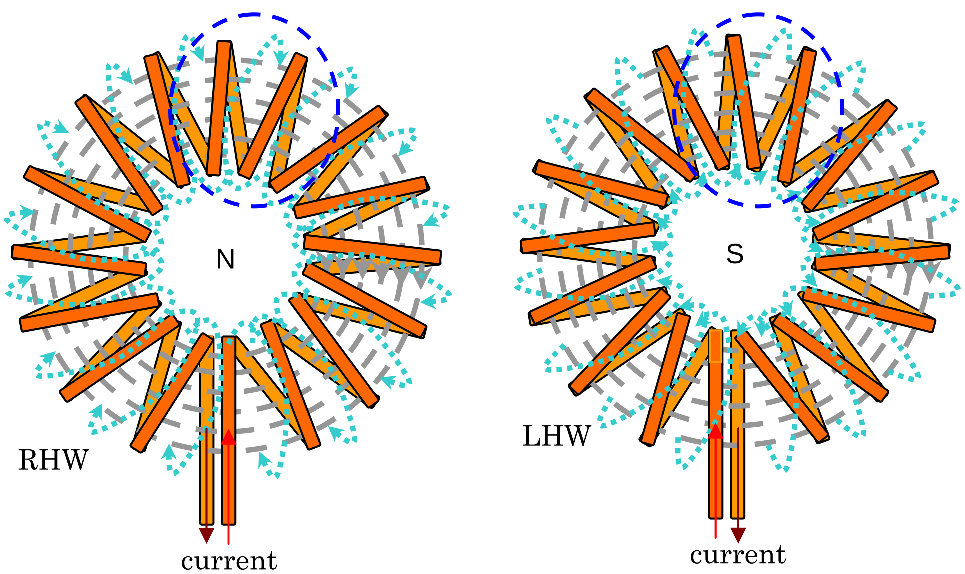
2.2.2 Special Effects of Half Magnets

Normal magnet behaviors are of we have been knowing for centuries, but as for Half Magnets, they have some special effects depending very much on their hand winding directions; that is LHW and RHW.

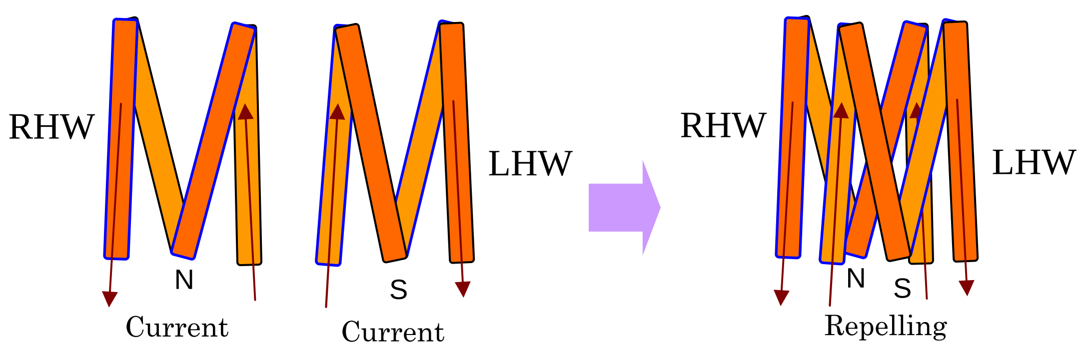
2.2.2.1 Different Hand Windings

Placing two Half Magnets of different hand windings (one RHW and LHW on the other), since for a toriodal solenoid, there is no different on viewing its winding direction between from the front and from the behind, so there is no different on the effect casued by direction of the current.

The picture below shows the two CC coreless solenoid of different HW, assuming they are having the same ∀̸ in average (= same number of turnings). Let's take look on a single turn of coil of each solenoid.



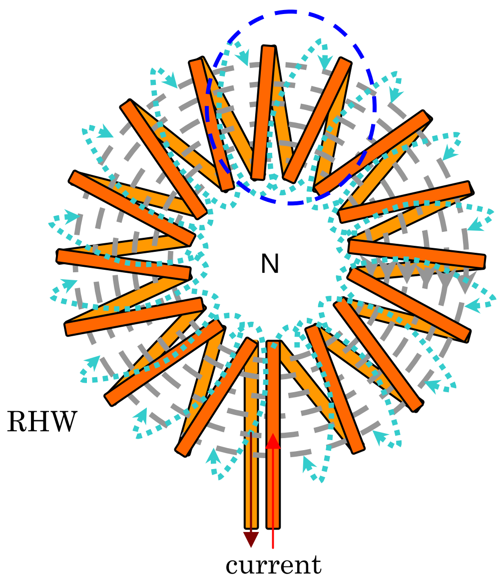
For easy understading, let's just concentrate on only one to two windings (blue circles) of each solenoid from the above solenoids (refer to picture below). Let's say, the coil of LHW is going to be placed right above RHW. It is obvious that at the wire portion with blue borderlines, they are of exactly ∀̸ (same direction of deflection). The current direction within these portions of wire are opposite so they repel each other.

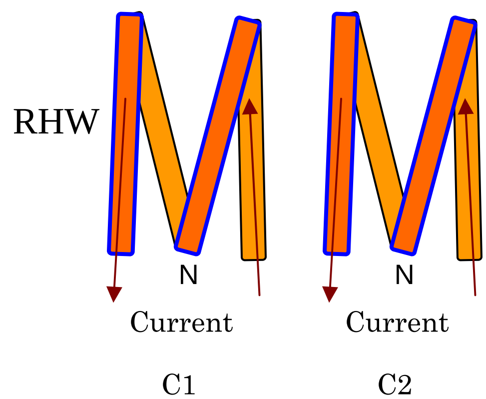


The magnetic poles shown in the picture are from viewer's viewing direction. So the magnetic pole on the behind of the solenoid LHW is north, this shows that replling takes place. On the other hand, if one of the solenoids changes the direction of the current flow (or turn one of the solenoids around of half a turn), the solenoids attract towards each other as synchronisation takes place on current direction on the wire portions of blue borderlines. These behaviors are the same as normal magnets.
Just remember one thing: toroidal coils of different HW putting together are just like a mirror image of each other.

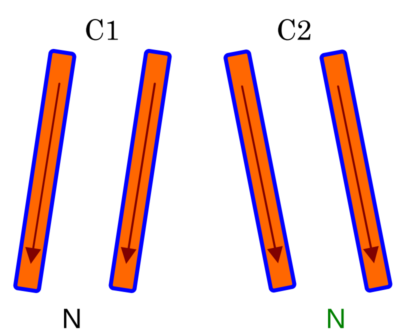
2.2.2.2 Same Hand Windings, Amane's Effects

For magnetic behaviors between CC toroidal solenoid of same HW, very strange results occur with certain control on Ʊ. But let's don't define Ʊ first. Just take the assumsion solenoid of RHW for demonstration and, a current direction as shown in the picture below. Now using two same CC coreless solenoids of same HW, try to put them together with the same the pole of half magnet, what happen?
With respect to the basic concept of normal magnetic behavior, the two solenoids will repel away. But now, the current in both wire portions with blue borderlines show that they are in similar directions. According to ALS, if synchronisation strength is stronger than that of anti-synchromization, then the two solenoids attract to each other, which means that half magnets of same poles attract each other. On the other hand, this also means that half magnets of different poles will repel each other (this has been already practically proven successfully on 24 March 2005)!!

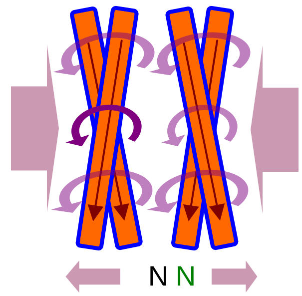


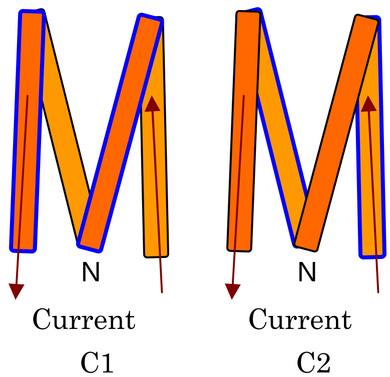


Let's look into this in a little bit more detail. Take a look at the picture on the right. For easy understanding, it shows only the wire portion of the blue borders. The pair of CC wires on the left hand side represents the blue portion of coil C1 of the above picture; the pair of CC wires on the right hand side represents the portion of coil C2 of the above picture flipping over, so from viewing into



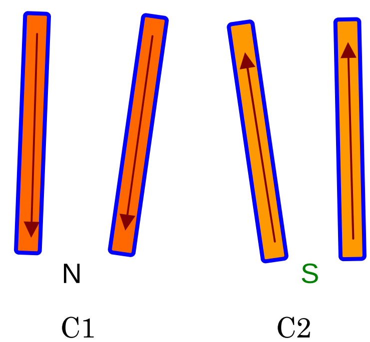
the paper its bottom pole is North (top is South). When C2 is put on top of C1, the bottom pole of C2 goes against C1's North pole is North; North against North. It is understood that repelling takes place on North against North. But here, from the directions of current flow it is known both pairs of wires are in partial synchronisation and hence attraction takes place. If the partial synchronisation strength is stronger than repelling strength of similar poles, the two coils of toroidal solenoids attract each other in spite of their poles.

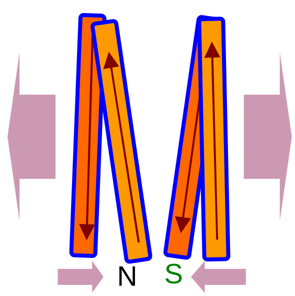




Now, let's look onto the effect on different pole to different pole. Look at the exact same portion of the half magnet on the picture on the right.

Again concentrate on the blue portion (bottom portion on the coil of the right hand side). The bottom of the coil portion on right hand side is South (looking into paper). What happen when put C2 over C1?





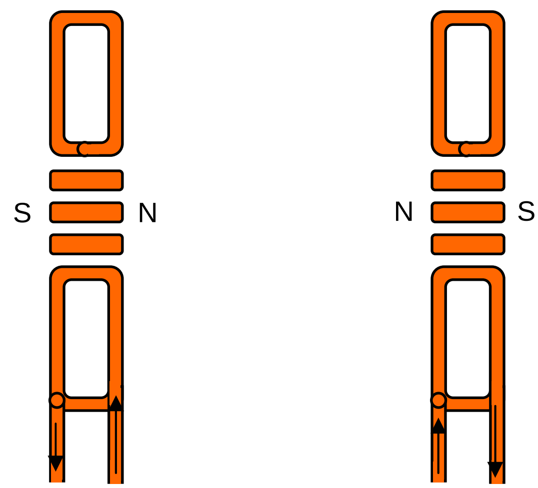
North against South; it is understaood that different poles attracts. But over here, look at the current direction on the two pairs coil portions: one up, the other down. This is anti-synchronisation. In other words, if this partial anti-synchronisation strength is stronger than normal magnet effect, the two coils repel each other. The two effects explained are termed as **Amane's Effects**.

2.2.2.2.1 The angle, Vo (Ꮩ)

For Amane's Effects to be realized, the angle of Ꮩ stands the primary weight of it. Ꮩ also indicates the number of truns in the half magnet as Ꮩ is inversely propotional to number of turns:

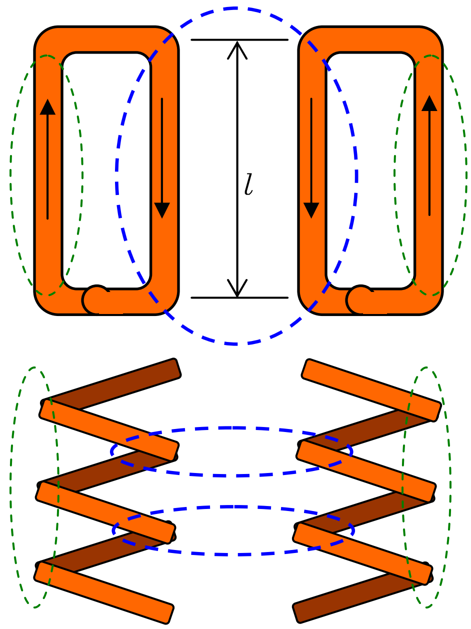
$$Ꮩ = \frac{360^\circ}{n}$$

First of all in order to make the calculation simplest, the shape of solenoid must be simplified first; circular shape → rectangular shape. Hence when two half magnets are put together, they can behave normally with the shape of normal magnets. Next we shall consider only same current level is applied to both solenoids.



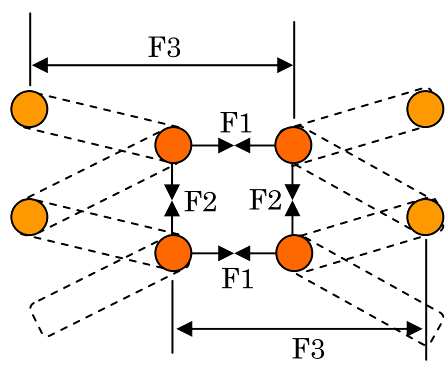
Simple cross-sectional view of two identical same HW rectangular half magnets.

There are quite a number of factors to be considered here. The pictures below show two view directions of two identical solenoids of same HW: cross-sectional view, top view and top view of showing the wire portions in blue dotted circles and green circles. The blue dotted circles are the region where attraction (synchronisation) takes place.



Cross-sectional view

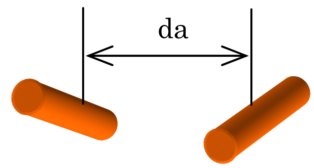
Top view



Top view showing the wire portions of blue circles and green circles

Over here, only the major factors are taken into consideration for the synchronisation: F1, F2 and F3. F1 is the attracting force for synchronisation, for Amane's Effects. F2 is the second attracing force for synchronisation but, this sttracting force is between the coils of a solenoid itself, hence it weakens the attracting force F1. F3 is the repelling force of the two half magnets; anti-synchronisation. Here we only want F1, but with constant current level flowing throughout the solenoid, there is not way we can eliminate the effect of F2 and F3. What we can do here is to reduce the effect of these two forces to minimum. F3 is relatively small compare to F1. As for F2, it has a stronger effect if has the same coil-coil distance with F1 this is due to the coils of F2 are parallel to one another wherea the coils of F1 are not. l is the length for synchronisation.

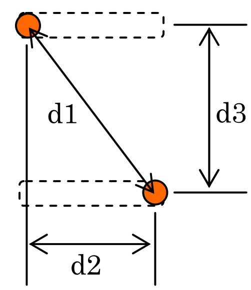
The picture below shows the structural distance of two portions of coils of F1. da is the average distance between them.



da is the average distance of d1 and d3:

$$d1 = \sqrt{d3^2 + d2^2}$$

$$da = \frac{d1 + d3}{2}$$



Where

d1 = max distance between similar points of a pair of coils,

d2 & d3 = perpendicular distances between a pair of coils.

F1 effect weakens as d2 increases; for a constant d3, d2 increases and d1 also increases. θ is being controlled by d2 and l**:**

$$\text{Sin}\,\theta = \frac{d2}{l}$$

If distance of F2 = d3, Amane's Effects will never happen as da is bigger than distance of F2 and effect F3 enhances this. Hence for Amane's Effects to realize, the following formula is crucial (applies to both attracting and repelling):

F1 >> F2 + F3

Using the formula of Ampere's Law in 2.1.1,

$$\mathbf{F1} = \frac{\mu_0 l \mathbf{I}^2}{\mathbf{2\pi da}} \qquad \mathbf{F2} = \frac{\mu_0 l \mathbf{I}^2}{\mathbf{2\pi d_{F2}}} \qquad \mathbf{F3} = \frac{\mu_0 l \mathbf{I}^2}{\mathbf{2\pi d_{F3}}}$$

Where

$\mathbf{d_{F2}}$ = distance between parallel coils of a solenoid

$\mathbf{d_{F3}}$ = distance between parallel coils of two solenoids, since they are parallel and far apart, so a simple straight forward distance is considered here compare to da (which is not parallel).

F3 is having an opposite effect to F1, so it is negative (ie. F1-F3>>F2).

Hence,

$$\frac{\mu_0 l \mathbf{I}^2}{2\pi \mathbf{da}} \gg \frac{\mu_0 l \mathbf{I}^2}{2\pi \mathbf{d_{F2}}} + \frac{\mu_0 l \mathbf{I}^2}{2\pi \mathbf{d_{F3}}}$$

Simplify,

$$\Rightarrow \quad \frac{1}{\mathbf{da}} \gg \frac{1}{\mathbf{d_{F2}}} + \frac{1}{\mathbf{d_{F3}}}$$

$$\Rightarrow \quad \mathbf{da} \ll \frac{\mathbf{d_{F2}d_{F3}}}{\mathbf{d_{F3} + d_{F2}}}$$

With substitute $\sin\theta = \frac{d2}{l}$ into $\mathbf{d1} = \sqrt{d3^2 + d2^2}$ and further substitute into $\mathbf{da} = \frac{\mathbf{d1 + d3}}{\mathbf{2}}$, we get

$$\Rightarrow \quad \theta \ll \sin^{-1}\left(\frac{\sqrt{\left(\frac{2d_{F2}d_{F3}}{d_{F3}+d_{F2}}\right)^2 - \frac{4d_{F2}d_{F3}d3}{d_{F3}+d_{F2}}}}{l} \right)$$

It may seem that θ is best at 0^0, but at 0^0 the effect of Half Magnet is gone, and this is impossible for a solenoid. So at a small d3 will allow θ to have a little bigger angle. Hence,

$$\Rightarrow \quad 0^0 < \theta \ll \sin^{-1}\left(\frac{\sqrt{\left(\frac{2d_{F2}d_{F3}}{d_{F3}+d_{F2}}\right)^2 - \frac{4d_{F2}d_{F3}d3}{d_{F3}+d_{F2}}}}{l} \right)$$

Above is just a calculation of perfect condition; excluding gravity, hardness of the wire used to hold the Half Magnets (due to Amane's Effect is very weak, a wire of soft type with high current carring capability will have the best result). In real world, the most important criteria are:

1. the softness of wire
2. in spite of θ angle size, as long as its Half Magnet property holds (θ can be as large as 90^0 or even 120^0, which means that only 3 to 4 turns per same HW solenoid!)
3. high current for obvious result
4. weight of solenoids

It may be thought that the formula has excluded current after simplification and why high current is still needed. Simple, this is to enhance the result against gravity as well as the hardness of the wires.

For different poles repelling, just turn around one of the Half Magnets.

2.3 Summary of Simple AHS concept

- AHS means the synchronisation of partial magnetic fields, with the primary concept of ALS, delfects away from their normal directions that parallel to their solenoids.
- These minor magnetic fields are termed as **Half Fields (HF)**.
- Magnetic Half Field with fluid core is defined as:

$B_h = \sin$ Ꮙ $\mu\, nI$

- A current-carrying toroidal coil/solenoid with a fliud core (eg. air or liquid) is termed as **Half Magnet (HM)**.
- The behaviors between Half Magnets of different Hand-Winding are just like normal magnets.
- The behaviors between Half Magnets of same Hand-Winding can be just like normal magnets; however, with a control of angle Vo, Ꮙ, on the basic conceptal formula of

F1 >> F2 + F3

incredible effects happen:
Similar poles attract each other;
Different poles repel each other.
These effects are termed as **Amane's Effects**.

- Short-terms and symbol Used:
AHS: Amane's Law of Half Synchronisation
HF: Half Field
HM: Half Magnet
HW: Hand-Winding
Ꮙ : Vo

Bibiography

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