Unhappiness of Newton with Lorentz and triangular coil experiment

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In real world, all objects obey Newton's thirds law. A coil with current flowing within produces magnetic field that exerts force on the current of the coil itself. If the coil is not round, this force tends to make the coil round. But the total force on the coil is zero and the coil does not move as a whole. However, when this force is computed using the Lorentz force law, the total force is not zero. So, Newton is unhappy with Lorentz. In the following, we take the isosceles triangle coil ABC shown in Figure 1 and compute the total force numerically.

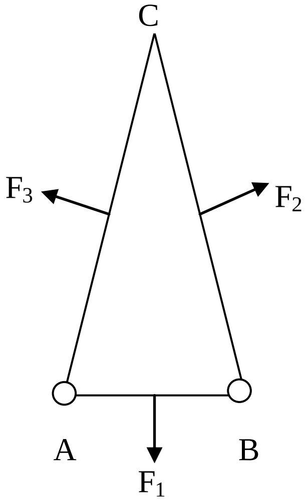

Figure 1

1. Numerical values

I have computed for 3 triangular coils. The bases of the 3 triangles are 1, and the height of each is 1, 2 and 3. The shapes of the 3 triangles and the discretization are shown in Figure 2, the numerical result in Table 1.

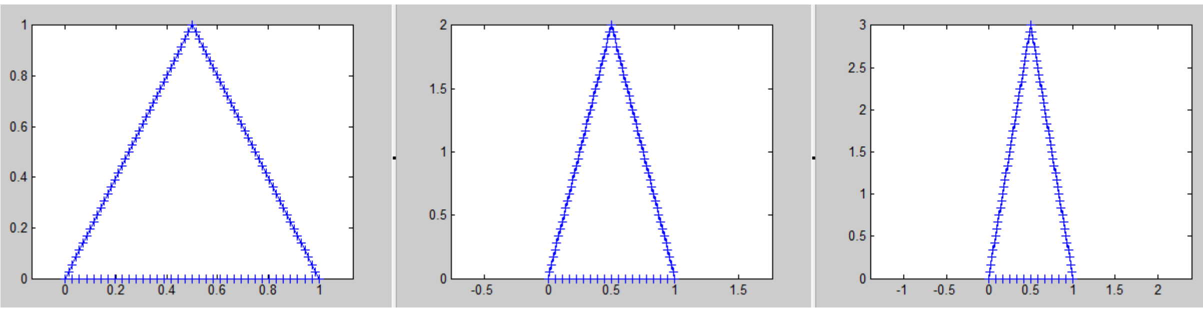

Figure 2

In Table 1 are the values of magnetic forces on the base AB, on the upper part BCA and the total force on the coil. These values are for current of 1 ampere. They are computed using 2 laws, the Lorentz force law and the corrected magnetic force law given in "Unknown properties of magnetic force and Lorentz force law"
http://pengkuanem.blogspot.com/2013/04/unknown-properties-of-magnetic-force.html
The forces obtained by the latter are named Ampere's force in Table 1.

Heights	Segments numbers	Vertical Lorentz Force 10^{-7} Newton			Vertical Ampere's force 10^{-7} Newton		
		BCA	AB	Total	BCA	AB	Total
1	108	15.1814	-14.1017	1.0798	6.1329	-6.1329	-0.0000
2	90	15.4973	-9.4070	6.0903	2.2789	-2.2789	0.0000
3	84	18.8047	-7.6636	11.1411	1.2943	-1.2943	0.0000

Table 1

We see that the total force obtained by the Lorentz force law is not zero, the forces on the base AB and the upper part BCA have different magnitudes. This result illustrates well my theoretical demonstration given in
http://pengkuanem.blogspot.fr/2012/04/analyze-of-lorentz-forces-internal-to.html

In the contrary, the total force obtained by the corrected magnetic force law is zero, the forces on the base AB and the upper part BCA have the same magnitude and opposed sign, showing that they are action and reaction forces and respect Newton's third law.

2. Unbalance of Lorentz force

Why the total Lorentz force is not zero? Look at the magnetic fields on the 3 sides of the triangle in Figure 1, these sides are AB, BC and CA. On AB, the average magnetic field from BC is denoted as $\mathbf{B}^{BC}$, that on CA is denoted as $\mathbf{B}^{CA}$ and the total average magnetic field is $\mathbf{B}^{BC} + \mathbf{B}^{CA}$. On BC the magnetic field is $\mathbf{B}^{AB} + \mathbf{B}^{CA}$ and on CA $\mathbf{B}^{BC} + \mathbf{B}^{AB}$.

The Lorentz force on AB, BC and CA are:

$$F_1 = I \cdot AB \times \left(\mathbf{B}^{BC} + \mathbf{B}^{CA}\right),\ F_2 = I \cdot BC \times \left(\mathbf{B}^{AB} + \mathbf{B}^{CA}\right),\ F_3 = I \cdot CA \times \left(\mathbf{B}^{BC} + \mathbf{B}^{AB}\right) \qquad (1)$$

So, on the base AB are exerted 2 forces,

$$F_{1,BC} = I \cdot AB \times \mathbf{B}^{BC} \text{ from BC and } F_{1,CA} = I \cdot AB \times \mathbf{B}^{CA} \text{ from CA.}$$

On BC there are 2 forces, $F_{2,AB}$ from AB and $F_{2,CA}$ from CA. On CA there are 2 forces, $F_{3,AB}$ from AB and $F_{3,BC}$ from BC. The total force on the coil is then:

$$F_1+F_2+F_3 = F_{1,BC} + F_{1,CA} + F_{2,AB} + F_{2,CA} + F_{3,AB} + F_{3,BC} \qquad (2)$$

Let us cut the triangle into 2 parts: the base AB and the upper part BCA. On AB the force is:

$$F_1 = F_{1,BC} + F_{1,CA} \qquad (3)$$

On BCA the force is:

$$F_{BCA}=F_2+F_3 = F_{2,AB} + F_{2,CA} + F_{3,AB} + F_{3,BC} \qquad (4)$$

Is the force on BCA really this? F_{BCA} can be split into 2 parts:

$$F_{BCA}= (F_{2,AB} + F_{3,AB}) + (F_{2,CA} + F_{3,BC}) \qquad (5)$$

The second part is from BC and CA which constitute BCA. In Newtonian mechanics, we consider the 3 sides AB, BC and CA as 3 bodies. Each exerts a magnetic force on the others. If we bind the bodies BC and CA together, they become one body and the force that BC and CA exerts on each other cancel. The force on the composed body is from AB only. So, the total force on BCA must exclude $F_{2,CA}$ and $F_{3,BC}$ that are forces internal to BCA as a unique body.

However, Lorentz force is perpendicular to current. $F_{2,CA}$ is perpendicular to BC and $F_{3,BC}$ is perpendicular to CA, they do not cancel and add an amount of force to F_{BCA} making it greater than the force on the base AB. This is how the flaw of the Lorentz force law creates a wrong force unbalance on these triangular coils.

So, for computing the force on BCA, the magnetic force should not include that from BC and CA. The force on BCA should be:

$$F_{BCA} = F_{2,AB} + F_{3,AB} \tag{6}$$

3. Non isosceles triangle

If we compute the Lorentz force on BCA from AB only, will the force be balanced? I have computed the force on BCA by excluding the forces internal to BCA ($F_{2,CA}$ and $F_{3,BC}$) and then, F_{BCA} and F_1 (AB) balance for isosceles triangles. However, for non isosceles triangle, the horizontal components of Lorentz forces do not balance. Figure 3 shows 3 right triangle coils, the horizontal Lorentz forces are shown in Table 2. The resulting F_{BCA} has a horizontal component. But on AB there is not, since the Lorentz force is perpendicular to AB. Then, the Lorentz force is still unbalanced for these coils.

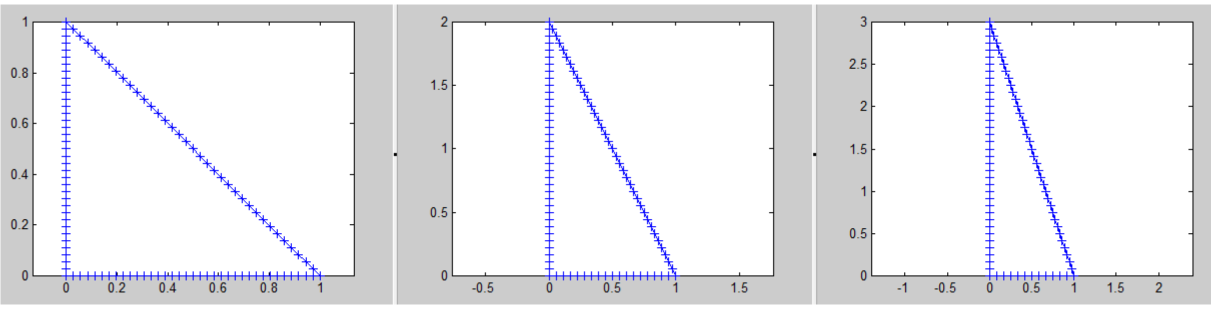

Figure 3

4. Experiment

It will be interesting to measure the actual forces on AB and BCA of a triangular coil. This experiment will use a triangular coil whose corners A and B are elastic (see Figure 1). This way, one can fix the base AB and measure the movement of BCA to determine the force F_{BCA} and respectively, fix BCA and measure the movement of AB to determine the force F_1.

Heights	Horizontal Lorentz Force 10^{-7} Newton		
	BCA	AB	Total
1	3.1113	0	3.1113
2	1.6301	0	1.6301
3	0.9994	0	0.9994

Table 2

As the Lorentz force law gives unbalanced forces, it will not fit experimental result.

5. Comment

The above computation and analyze show that the Lorentz force law is really flawed. The correction of the magnetic force law is a great work. In addition to theoretical research, confirmation by experiments is vital. By carrying out the experiments I propose, you can participate and associate your name to this great work. The experiments are easy to perform, cheap to realize. My theoretical and experimental work indicates that they have high probability of success. This is a dream opportunity for young physicists to become renowned.

If you have obtained good result, it is preferable to announce it through press conference, because physical journals are all reluctant to publish papers that question such an established theory. Only after a large number of experimental confirmations are known, they would accept to publish this theory.

6. Programs

Below are the programs of computation (executable in Matlab) of magnetic force on triangular coils. The mathematics of computation is the same than “Numerical computation of the Lorentz force internal to an asymmetric coil”
http://pengkuanem.blogspot.com/2013/04/numerical-computation-of-lorentz-force.html

Program for computing the total internal forces with all magnetic fields

```
% Total internal force of a triangular coil
a=1;
na=3;xdisp=zeros(na,7);
for ia=1:na
crn=[[0;0],[1;0],[1/2;ia],[0;0]];k=1;%triangle corners
 mp=36; np=mp/ia;% mp =x
tif=0:1/mp:1;%i:indice y, f:fix
tjf=0:1/np:1;%i:indice x, f:fix

s=tjf;s1=crn(:,k+1)*s-crn(:,k)*(s-1);k=k+1;ns1=length(s1);%
s=tif;s2=crn(:,k+1)*s-crn(:,k)*(s-1);k=k+1;%
s=tif;s3=crn(:,k+1)*s-crn(:,k)*(s-1);k=1;%
lc=[s1,s2(:,2:length(s2)),s3(:,2:length(s3))];%Triangle segmentation
m=length(lc)-1;
x1=(lc(:,2:m+1)+lc(:,1:m))/2;dI1=lc(:,2:m+1)-lc(:,1:m);%
n=m;x2=x1;dI2=dI1;

ddfamp=zeros(2,m,n);ddffic=ddfamp;
dfamp=zeros(2,n);dffic=dfamp;dcplamp=dfamp;dcplfic=dfamp;
%Differential force
for j=1:n
for i=1:m
    if i==j;
    ddfamp(:,i,j)=0; ddffic(:,i,j)=0;
    else
    r12=x2(:,j)-x1(:,i);vr=r12/norm(r12)^3; %radius coefficient
    ddfamp(:,i,j)=-dot(dI2(:,j),dI1(:,i))*vr; %diff force ampere
    ddffic(:,i,j)=dot(dI2(:,j),vr)*dI1(:,i); %diff force fictive
    end
end
end
% First integral
for j=1:n
trp=[ddfamp(:,:,j),ddfamp(:,1,j)];dfamp(:,j)=trapz(trp,2);
trp=[ddffic(:,:,j),ddffic(:,1,j)];dffic(:,j)=trapz(trp,2);
end
% Second integral
trp=[dfamp,dfamp(:,1)];famp=trapz(trp,2)*a; %force ampere
trp=[dffic,dffic(:,1)];ffic=trapz(trp,2)*a; %force fictive
florentz=famp+ffic; %force  lorentz
famficlor_t=[famp,ffic,florentz];
figure,plot(lc(1,:),lc(2,:),'-+');axis equal;
trp=[dfamp(:,1:ns1)];famp1=trapz(trp,2)*a; %force ampere part 1
trp=[dffic(:,1:ns1)];ffic1=trapz(trp,2)*a; %force fictive part 1
florentz1=famp1+ffic1; %force lorentz part 1
xdisp(ia,1:5)=[mp*2+np,florentz(1),famp(1),florentz(2),famp(2)];
end
xdisp,
```

```
return
```

Program for computing the Lorentz forces on BCA with magnetic field from AB only

```
% Lorentz force on BCA from AB
a=1;
na=3;xdisp=zeros(na,7);
for ia=1:na
crn=[[0;0],[1;0],[0;ia],[0;0]];k=1;%triangle corners
 mp=36; np=mp/ia;% mp =x
tif=0:1/mp:1;%i:indice y, f:fix
tjf=0:1/np:1;%i:indice x, f:fix

s=tjf;s1=crn(:,k+1)*s-crn(:,k)*(s-1);k=k+1;ns1=length(s1)-1;%
s=tif;s2=crn(:,k+1)*s-crn(:,k)*(s-1);k=k+1;% BCA segmentation
s=tif;s3=crn(:,k+1)*s-crn(:,k)*(s-1);k=1;%
lc=s1;%AB segmentation
m=length(lc)-1;
x1=(lc(:,2:m+1)+lc(:,1:m))/2;dI1=lc(:,2:m+1)-lc(:,1:m);%
lc=[s2,s3(:,2:length(s3))];%BCA segmentation
n=length(lc)-1;
x2=(lc(:,2:n+1)+lc(:,1:n))/2;dI2=lc(:,2:n+1)-lc(:,1:n);%

ddfamp=zeros(2,m,n);ddffic=ddfamp;
dfamp=zeros(2,n);dffic=dfamp;dcplamp=dfamp;dcplfic=dfamp;
%Differential force
for j=1:n
for i=1:m
    r12=x2(:,j)-x1(:,i);vr=r12/norm(r12)^3; %radius coefficient
    ddfamp(:,i,j)=-dot(dI2(:,j),dI1(:,i))*vr; %diff force ampere
    ddffic(:,i,j)=dot(dI2(:,j),vr)*dI1(:,i); %diff force fictive
end
end
% First integral
for j=1:n
trp=ddfamp(:,:,j);dfamp(:,j)=trapz(trp,2);
trp=ddffic(:,:,j);dffic(:,j)=trapz(trp,2);
end
% Second integral
trp=dfamp;famp=trapz(trp,2)*a; %force ampere
trp=dffic;ffic=trapz(trp,2)*a; %force fictive
florentz=famp+ffic; %force  lorentz
figure,plot(lc(1,:),lc(2,:),'-+');axis equal;
xdisp(ia,1:5)=[mp*2+np,florentz(1),famp(1),florentz(2),famp(2)];
end
xdisp,
return
```