A Theoretical Explanation of the Anomalous Magnetic Crane-Monstein Effect Using the Idea of a Dipole Gas

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We consider the problem of how to obtain the formula for the (constant) magnetization M vector field in the case of a large volume of a uniformly and permanently magnetized magnetic material that is everywhere magnetized parallel to a fixed vector (we take the fixed vector [0, 0, 1] here for convenience sake) in terms of the (constant) dipole density of a hypothetical space of uniformly distributed electron dipoles with each dipole vector parallel to this vector [0, 0, 1] and pointing upward. We also assume this space of dipoles is of (uniform) magnetization M. This means that we are considering the case where ALL (lined up) dipoles are of the same type (i.e. spinning electrons) and all dipole moments are parallel to this unit vector. Of course, it is believed to be true that nuclei also have spin and dipole moments (in addition to electrons), but they are believed to be small and so we ignore them herein. Further, we do NOT accept the idea that electrons orbit the nuclei of atoms since, if they did, they would have then to radiate all their energy. Copenhagen quantum mechanics postulates that this radiation cannot occur, but this sounds suspicious to us; and so we follow Dr. Charles (Bill) Lucas, Jr. here ... who shows in his excellent recent book, "The Universal Force Volume 1," that this postulate is both unnecessary and unfortunate.

Now that this space of dipoles has uniform magnetization M then means that at any point P inside this space, if we consider a small sphere with center at P and the vector sum of the dipole fields inside this sphere divided by this sphere's volume, then in the limit when this sphere has its radius go to zero but still having center at P.

We begin by assuming that we have a "dipole gas" instead of such a space of electron dipoles described above. This means that we consider a space of infinitesimally small bits of dipole material that all have the same infinitesimal dipole moment vector dm = ([0, 0, 1] dmm), where dmm = ABS(dm) is the infinitesimal (scalar) dipole moment of of any such bit of dipole material. This dipole gas has uniform dipole density λ > 0 by assumption (where this density takes into account this infinitisimal dipole moment also, and so is not just a number that is dimensionless). This means that dmm = lim((λ dV) / dV) as dV --> 0 and this limit is evidently λ, where dV is a volumn element containing the point P at which the bit corresponding to dmm is located.

The classical formula for the A vector field inside magnetic field at point having position vector r2 [where the H field is assumed to vanish everywhere inside the magnet] is:

A(r2) = (mu0 / (4 π))((m cross r2) / rr2^3), where rr2 = ABS(r2) is the scalar magnitude of the position vector r2 and where the origin of our coordinate system is very near the dipole center. [In our dipole gas case, we take (in effect) the origin AT the bit of dipole gas in question.] Here, we have M = ((1 / mu0) curl(A)) inside the magnet. We use only mu0 here, NOT more generally mu, simply because we are assuming that we only consider a space of lined-up electrons and ignore nuclei entirely in our present magnetic modeling.

We assume this formula to govern the magnetization field A according to our remarks above concerning the derivation of A in terms of this our diplole gas, where we will (in view of our dipole gas having been assumed to be of constant density λ and each bit's diplole field being everywhere parallel to the vector [0, 0, 1]) assume that our origin having coordinates [xpr, ypr, zpr] and we will consider all the dipole gas contained in the cylinderical magnet (vith vertex at this origin) and of cylinder length Lt > 0 along the x-axis. Further, we will integrate this diplole gas over this cylinder's interior to obtain A at a typical magnet point [xpr, ypr, zpr] in the cylinderical magnet.

Then our formula becomes:

A(xpr, ypr, zpr) = the volumn integral of (λ mu0 / (4 π)) (CROSS(dmm [0, 0, 1], -[x - xpr, y - ypr, z - zpr] / (ABS(-[x - xpr, y - ypr, z - zpr]))^3

where (again) dmm = λ dV. Here we use the minus position vector as we want it to be from the dipole (scalar) element dmm in question to our typical cylindrical magnet point [xpr, ypr, zpr] for a best approximation. (See page 164 of Reitz and Milford.)

Finally, we use the value R = (3.87056242 10^-13) since this value does NOT involve the Copenhagen quantum theory factor of root3 that Beiser mentions, but only the angular spin of hbar/2, not (root3 hbar / 2) that is in Beiser. (This latter fails to result in a working electron model of our ring type.) This is because the only component of the spin vector that will not cancel in the lattice of ring electrons is the component along [0, 0, 1], that is, along the magnet B = curl(A) field, and this non-vanishing component is obtained by using this value of R as the ring magnetic moment is (e v R / 2), where e is the magnitude of the electron charge and v is the velocity of the electron charge circuling the electron center. (In our modeling, the free electron in the ground state, v = c, the velocity of light in a vacuum.) For more information concerning Bergman-Allen ring electron modeling, see David Bergman's web site.

#1: CaseMode := Sensitive

#2: InputMode := Word

We can then write:

#3:
$$\frac{\frac{\mu 0}{4\cdot\pi}\cdot \mathrm{CROSS}(dmm\cdot[0,\ 0,\ 1],\ -\ [x - xpr,\ y - ypr,\ z - zpr])}{\left|[x - xpr,\ y - ypr,\ z - zpr]\right|^{3}}$$

Simplifying:

#4:
$$\left[\frac{dmm\cdot\mu 0\cdot(y - ypr)}{4\cdot\pi\cdot(x^{2} - 2\cdot xpr\cdot x + y^{2} - 2\cdot ypr\cdot y + z^{2} - 2\cdot zpr\cdot z + xpr^{2} + ypr^{2} + zpr^{2})^{3/2}},\ \frac{dmm\cdot\mu 0\cdot(xpr - x)}{4\cdot\pi\cdot(x^{2} - 2\cdot xpr\cdot x + y^{2} - 2\cdot ypr\cdot y + z^{2} - 2\cdot zpr\cdot z + xpr^{2} + ypr^{2} + zpr^{2})^{3/2}},\ 0\right]$$

This just above is our A field at [xpr, ypr, zpr] due to the dipole gas at [x, y, z]. We need to volume integrate over the cylinderical magnet with respect to x, y and z to obtain the A value at [xpr, ypr, zpr] in the magnet.

But first we must simplify as this integral is too complicated. We can begin simplifying by assuming that the magnet is doubly infinite in the z direction since the pole strength of a cylindrical magnet is its dipole moment divided by the length "Lt", and the dipole moment is just M multiplied by the pole area that is (π Rt^2), where Rt is the cylinder radius. Then we have that we may assume that zpr = 0 as the cylinder is assumed doubly infinite and using z-axis symmetry. We integrate from z = -z to z = z to pick up the whole cylinder volume:

#5:
$$\int_{-z}^{z}$$

$$\left[\frac{dmm\cdot\mu0\cdot(y - ypr)}{4\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + z^2 - 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)^{3/2}},\right.$$

$$\left.\frac{dmm\cdot\mu0\cdot(xpr - x)}{4\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + z^2 - 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)^{3/2}}, 0\right] dz$$

Simplifying:

#6:
$$\left[\frac{dmm\cdot\mu0\cdot(y - ypr)\cdot(\sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + z^2 - 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)}\cdot(z + zpr) + \sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + z^2 + \ldots}}{4\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + xpr^2 + ypr^2)\cdot\sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 \ldots 2\cdot ypr\cdot y + z^2 + 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)}\cdot\sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 - \ldots}\right.$$

$$\frac{\ldots 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)\cdot(z - zpr))}{\ldots\cdot ypr\cdot y + z^2 - 2\cdot zpr\cdot z + xpr^2 + ypr^2 + zpr^2)},$$

$$\frac{dmm\cdot\mu0\cdot(xpr - x)\cdot(\sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + z^2 - 2\cdot zpr\cdot z \ldots}}{4\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + xpr^2 + ypr^2)\cdot\sqrt{(x^2 - 2\cdot xpr\cdot x + y^2 \ldots}}$$

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   2       2       2                      2               2              2  ~
 xpr  + ypr  + zpr ) (z + zpr) + √(x  - 2 xpr x + y  - 2 ypr y + z  +~
─────────────────────────────────────────────────────────────────────────~
              2                  2       2       2      2               2  ~
- 2 ypr y + z  + 2 zpr z + xpr  + ypr  + zpr ) √(x  - 2 xpr x + y  - ~

              2       2       2
 2 zpr z + xpr  + ypr  + zpr ) (z - zpr))
─────────────────────────────────────────, 0 ]
          2                 2       2       2
2 ypr y + z  - 2 zpr z + xpr  + ypr  + zpr )  ]
```

#7: lim
z→+∞

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 ⎡                           2                2               2               ~
 ⎢      dmm μ0 (y - ypr) (√(x  - 2 xpr x + y  - 2 ypr y + z  - 2 zpr z ~
 ⎢───────────────────────────────────────────────────────────────────────~
 ⎢        2              2                  2       2     2             2~
 ⎣ 4 π (x  - 2 xpr x + y  - 2 ypr y + xpr  + ypr ) √(x  - 2 xpr x + y ~

     2       2       2                 2               2              2  ~
+ xpr  + ypr  + zpr ) (z + zpr) + √(x  - 2 xpr x + y  - 2 ypr y + z  ~
─────────────────────────────────────────────────────────────────────────~
               2                 2       2       2      2              2  ~
 - 2 ypr y + z  + 2 zpr z + xpr  + ypr  + zpr ) √(x  - 2 xpr x + y  -~

                2       2       2
+ 2 zpr z + xpr  + ypr  + zpr ) (z - zpr))
──────────────────────────────────────────,
           2                 2       2       2
 2 ypr y + z  - 2 zpr z + xpr  + ypr  + zpr )

                               2               2               2             ~
      dmm μ0 (xpr - x) (√(x  - 2 xpr x + y  - 2 ypr y + z  - 2 zpr z +~
─────────────────────────────────────────────────────────────────────────~
       2              2                  2       2     2               2  ~
 4 π (x  - 2 xpr x + y  - 2 ypr y + xpr  + ypr ) √(x  - 2 xpr x + y  ~

   2       2       2                      2               2              2  ~
 xpr  + ypr  + zpr ) (z + zpr) + √(x  - 2 xpr x + y  - 2 ypr y + z  +~
─────────────────────────────────────────────────────────────────────────~
              2                  2       2       2      2               2  ~
- 2 ypr y + z  + 2 zpr z + xpr  + ypr  + zpr ) √(x  - 2 xpr x + y  - ~

              2       2       2
 2 zpr z + xpr  + ypr  + zpr ) (z - zpr))
─────────────────────────────────────────, 0 ]
          2                 2       2       2
2 ypr y + z  - 2 zpr z + xpr  + ypr  + zpr )  ]
```

Simplifying:

$$\#8: \left[\frac{dmm\cdot\mu0\cdot(y - ypr)}{2\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + xpr^2 + ypr^2)}, \frac{dmm\cdot\mu0\cdot(xpr - x)}{2\cdot\pi\cdot(x^2 - 2\cdot xpr\cdot x + y^2 - 2\cdot ypr\cdot y + xpr^2 + ypr^2)}, 0\right]$$

This is the A field at [xpr, ypr, 0] due to the dipole gas at [x, y, z] assuming a doubly infinite cylinderal magnet. And we may estimate at finite cylinder of length Lt using it if we ignore edge and end effects ... which we do. And since the magnet is assumed above to be doubly infinite to simplify the integrals, this is also the A field at [xpr, ypr, zpr].

We next need to calculate the total A field at [xpr, ypr, 0] that is also the A field at [xpr, ypr, zpr] by our estimation, and so we introduce cylindrical coordinates:

$$\#9: x = \rho\cdot COS(\theta)$$

$$\#10: y = \rho\cdot SIN(\theta)$$

Substituting into #8:

$$\#11: \left[\frac{dmm\cdot\mu0\cdot(\rho\cdot SIN(\theta) - ypr)}{2\cdot\pi\cdot((\rho\cdot COS(\theta))^2 - 2\cdot xpr\cdot(\rho\cdot COS(\theta)) + (\rho\cdot SIN(\theta))^2 - 2\cdot ypr\cdot(\rho\cdot SIN(\theta)) + xpr^2 + ypr^2)}, \frac{dmm\cdot\mu0\cdot(xpr - \rho\cdot COS(\theta))}{2\cdot\pi\cdot((\rho\cdot COS(\theta))^2 - 2\cdot xpr\cdot(\rho\cdot COS(\theta)) + (\rho\cdot SIN(\theta))^2 - 2\cdot ypr\cdot(\rho\cdot SIN(\theta)) + xpr^2 + ypr^2)}, 0\right]$$

Simplifying:

$$\#12: \left[\frac{dmm\cdot\mu0\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)},\right.$$

$$\frac{dmm\cdot\mu0\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, 0\Bigg]$$

Multiplying by ρ, the Jacobian:

#13: $$\left[\frac{dmm\cdot\mu0\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, \frac{dmm\cdot\mu0\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, 0\right]\cdot\rho$$

#14: $$\left(\left[\frac{dmm\cdot\mu0\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, \frac{dmm\cdot\mu0\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, 0\right]\cdot\rho\right)_1$$

Simplifying:

#15: $$\frac{dmm\cdot\mu0\cdot\rho\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}$$

#16: $$\int_0^{Rt}\int_0^{2\cdot\pi}\frac{dmm\cdot\mu0\cdot\rho\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}\,d\theta\,d\rho$$

Simplifying:

#17: $$\frac{dmm\cdot\mu0\cdot ypr\cdot\left|Rt^2 - xpr^2 - ypr^2\right|}{4\cdot(xpr^2 + ypr^2)} - \frac{dmm\cdot\mu0\cdot ypr\cdot(Rt^2 + xpr^2 + ypr^2)}{4\cdot(xpr^2 + ypr^2)}$$

This just above is the total A1 field at [xpr, ypr, 0].

#18: $$\left(\left[\frac{dmm\cdot\mu0\cdot(ypr - \rho\cdot SIN(\theta))}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, \frac{dmm\cdot\mu0\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}, 0\right]\cdot\rho\right)_2$$

Simplifying:

#19: $$\frac{dmm\cdot\mu0\cdot\rho\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}$$

This just above is A2, the second coordinate of A.

#20: $$\int_0^{Rt}\int_0^{2\cdot\pi}\frac{dmm\cdot\mu0\cdot\rho\cdot(\rho\cdot COS(\theta) - xpr)}{2\cdot\pi\cdot(2\cdot\rho\cdot xpr\cdot COS(\theta) + 2\cdot\rho\cdot ypr\cdot SIN(\theta) - \rho^2 - xpr^2 - ypr^2)}\, d\theta\, d\rho$$

#21: $$\frac{dmm\cdot\mu0\cdot xpr\cdot(Rt^2 + xpr^2 + ypr^2)}{4\cdot(xpr^2 + ypr^2)} - \frac{dmm\cdot\mu0\cdot xpr\cdot\left|Rt^2 - xpr^2 - ypr^2\right|}{4\cdot(xpr^2 + ypr^2)}$$

This just above is the total A2 field at [xpr, ypr, 0] and hence as [xpr, ypr, zpr].

We next calculate the B = curl(A) field, where by symmetry only the third coordinate does not vanish:

$$\#22: \frac{d}{d\ xpr} \left(\frac{dmm \cdot \mu 0 \cdot xpr \cdot (Rt^2 + xpr^2 + ypr^2)}{4 \cdot (xpr^2 + ypr^2)} - \frac{dmm \cdot \mu 0 \cdot xpr \cdot \left| Rt^2 - xpr^2 - ypr^2 \right|}{4 \cdot (xpr^2 + ypr^2)} \right)$$

Simplifying:

$$\#23: \frac{dmm \cdot \mu 0 \cdot (Rt^2 \cdot (xpr^2 - ypr^2) + xpr^4 + 2 \cdot xpr^2 \cdot ypr^2 + ypr^4) \cdot SIGN(Rt^2 - xpr}{4 \cdot (xpr^2 + ypr^2)^2}$$

$$\frac{- ypr^2)}{} - \frac{dmm \cdot \mu 0 \cdot (Rt^2 \cdot (xpr^2 - ypr^2) - xpr^4 - ypr^2 \cdot (2 \cdot xpr^2 + ypr^2))}{4 \cdot (xpr^2 + ypr^2)^2}$$

This just above is d(A2)/d(xpr).

$$\#24: \frac{d}{d\ ypr} \left(\frac{dmm \cdot \mu 0 \cdot ypr \cdot \left| Rt^2 - xpr^2 - ypr^2 \right|}{4 \cdot (xpr^2 + ypr^2)} - \frac{dmm \cdot \mu 0 \cdot ypr \cdot (Rt^2 + xpr^2 + ypr^2)}{4 \cdot (xpr^2 + ypr^2)} \right)$$

Simplifying:

$$\#25: \frac{dmm \cdot \mu 0 \cdot (Rt^2 \cdot (xpr^2 - ypr^2) - xpr^4 - ypr^2 \cdot (2 \cdot xpr^2 + ypr^2)) \cdot SIGN(Rt^2 - x}{4 \cdot (xpr^2 + ypr^2)^2}$$

$$\frac{r^2 - ypr^2)}{} - \frac{dmm \cdot \mu 0 \cdot (Rt^2 \cdot (xpr^2 - ypr^2) + xpr^4 + 2 \cdot xpr^2 \cdot ypr^2 + ypr^4}{4 \cdot (xpr^2 + ypr^2)^2}$$

This just above is d(A1)/d(ypr).

Thus B3, the third coordinate of B, is d(A2)/d(xpr) - d(A1)/d (ypr):

$$\#26:\quad \frac{dmm\cdot\mu0\cdot(Rt^2\cdot(xpr^2 - ypr^2) + xpr^4 + 2\cdot xpr^2\cdot ypr^2 + ypr^4)\cdot SIGN(Rt^2 - xpr^2 - ypr^2)}{4\cdot(xpr^2 + ypr^2)^2} -$$

$$\frac{dmm\cdot\mu0\cdot(Rt^2\cdot(xpr^2 - ypr^2) - xpr^4 - ypr^2\cdot(2\cdot xpr^2 + ypr^2))}{4\cdot(xpr^2 + ypr^2)^2} -$$

$$\left(\frac{dmm\cdot\mu0\cdot(Rt^2\cdot(xpr^2 - ypr^2) - xpr^4 - ypr^2\cdot(2\cdot xpr^2 + ypr^2))\cdot SIGN(Rt^2 - xpr^2 - ypr^2)}{4\cdot(xpr^2 + ypr^2)^2} -\right.$$

$$\left.\frac{dmm\cdot\mu0\cdot(Rt^2\cdot(xpr^2 - ypr^2) + xpr^4 + 2\cdot xpr^2\cdot ypr^2 + ypr^4)}{4\cdot(xpr^2 + ypr^2)^2}\right)$$

Simplifying:

$$\#27:\quad \frac{dmm\cdot\mu0\cdot SIGN(Rt^2 - xpr^2 - ypr^2)}{2} + \frac{dmm\cdot\mu0}{2}$$

This just above is B3, where B1 = B2 = 0. But (Rt^2 - xpr^2 - ypr^2) is non-negative, so we have:

$$\#28:\quad \frac{dmm\cdot\mu0}{2} + \frac{dmm\cdot\mu0}{2}$$

Simplifying:

$$\#29:\quad dmm\cdot\mu0$$

This just above is B3.

But dmm = lim((λ dV)/dV) as dV -->0 from above, so

#30: $\mu 0\cdot\lambda$

is the B field in the magnet, and so [CHANGING NOTATION (see just below)]:

#31: $$\frac{(2\cdot\pi)\cdot Lt\cdot\int_0^{Rt}\frac{\lambda}{\mu 0}\cdot\rho\, d\rho}{(\pi\cdot Rt^2)\cdot Lt}$$

is the (Tesla) pole strength of the cylindrical magnet, first approximated by being assumed doubly infinite in the z integration above at #5 - #7 to avoid edge and end effects, where we have CHANGED NOTATION (from #30) to λ being the B field density of the dipole [so that the M field is then (λ / mu0)] to agree with Christian's and Hans' useage.

We note that the late J.P. Wesley, in his "Scientific Physics" makes the point that the A field is actually basic to electromagnetic theory, NOT the B field; and we also note that we tried for considerable time to work primarily with the dipole B field formula ... thereby avoiding the diplole A field formula above, but we did NOT succeed in this. And the dipole gas idea used here was given to us by Dr. Thomas E. Phipps's idea of a "clock gas" in his critical analysis of Einstein's SRT that may be found on page 278 of his monumental "Old Physics for New", second edition (2012). Further, we note that Dr. Phipps has also recently published a paper in the (now) AIP journal, "Physics Essays", in which he reports that he built and tested a version of the Marinov motor (in his home work shop) and that the Lorentz law of force was found to FAIL in explaining this device of Marinov; and so he concludes that the A field is basic to EM theory, NOT the B field ... just as Dr. Wesley maintained.

We now realize that P.W. Bridgman was correct in his important book, "The Logic of Modern Physics" that to understand just what an experiment says, we must consider just what it measures and just how it measures it. Christian's and Hans' magnetic data is in Tesla's, it must then follow that they are not actually measuring pole strength as magnetization times pole area, but rather the B field just off a pole since that is what a flux meter that gives its results in milli-Teslas must measure. Thus, to obtain the (magnetization) pole strength, one must convert the meter reading in milli-Teslas to the M field by dividing by 1000 to obtain the B field in Teslas, and then convert to M by dividing by mu0 ... as just off the pole, M = 0, but then the B field then yields the M field in this way as H = 0 everywhere inside this cylindrical (permanent) magnet. [This matter caused us to waste WEEKS of time trying to get our numbers to be correct.]

Simplifying:

#32: $\frac{\lambda}{\mu 0}$

This just above is the (Tesla) pole strength of the magnet.

Christian's and Hans' data give this pole strength to be 0.5 Tesla, so:

#33: $\frac{\lambda}{\mu 0} = 0.5$

#34: $\text{SOLVE}\left(\frac{\lambda}{\mu 0} = 0.5,\ \lambda\right)$

#35: $\lambda = \frac{\mu 0}{2}$

This just above is λ, and it is equal to:

#36: $\frac{e \cdot v}{2 \cdot \pi \cdot R} \cdot (\pi \cdot R^2) \cdot NUM$

where NUM is the number of dipoles in the (assumed) cubic lattice (having sides of length "Le") that we use to approximate the actual uniformly magnetized material, not as a dipole gas [see Reitz and Milford's (1960) classical treatment of magnetic material and magnetization in their "Foundations of Electromagnetic Theory" (pages 182-5)]. And "v" is the charge velocity of the rings at the lattice points ... that is "c" in the ground state electron ring model. But simplifying:

#37: $\frac{NUM \cdot R \cdot e \cdot v}{2}$

Since we assume a cubic lattice having sides "Le", we have approxmately:

#38: $NUM = Le^{-3}$

Substituting:

#39: $$\frac{e\cdot v}{2\cdot\pi\cdot R}\cdot(\pi\cdot R^2)\cdot Le^{-3}$$

#40: $$SOLVE\left(\frac{e\cdot v}{2\cdot\pi\cdot R}\cdot(\pi\cdot R^2)\cdot Le^{-3} = \frac{\mu0}{2},\ Le\right)$$

Simplifying:

#41: $$Le = \frac{R^{1/3}\cdot e^{1/3}\cdot\left(-\frac{v^{1/3}}{2} - \frac{\sqrt{3}\cdot\hat{\imath}\cdot v^{1/3}}{2}\right)}{\mu0^{1/3}} \lor Le = \frac{R^{1/3}\cdot e^{1/3}\cdot\left(-\frac{v^{1/3}}{2} + \frac{\sqrt{3}\cdot\hat{\imath}\cdot v^{1/3}}{2}\right)}{\mu0^{1/3}} \lor Le = \frac{R^{1/3}\cdot e^{1/3}\cdot v^{1/3}}{\mu0^{1/3}}$$

Taking the real root:

#42: $$Le = \frac{R^{1/3}\cdot e^{1/3}\cdot v^{1/3}}{\mu0^{1/3}}$$

This just above is ”Le”.

Christian’s data and our ring model give Rt = 0.025 meter, Lt = 0.077 meter, v = c, R = 3.87056242 10^-13, e = 1.602176487 10^-19 [absolute value], and 6000 rpm gives about a 9.8% effect.

#43: $$(3.87056242\cdot 10^{-13})^{1/3}\cdot(1.602176487\cdot 10^{-19})^{1/3}\cdot(4\cdot\pi\cdot 10^{-7})^{-1/3}\cdot 299792458^{1/3}$$

Simplifying:

#44: $$2.454888413\cdot 10^{-6}$$

This just above is ”Le”, the lattice spacing of the lined up electrons in the assumed cubic lattice to get a Tesla pole strength of 0.5 Tesla assuming v = c for these ring electrons. Note that Le >> R = 3.87056242 10^-13, the ring electron large radius ... as it certainly must here ... because each cubic cell of side Δx must contain just one (lined up) dipole electron, and this electron and the enclosing cell must both have the same point as centers ... as well.

We have that the magnetic moment of the ring is (I Area) which equals:

$$\#45:\ \frac{e\cdot c}{2\cdot\pi\cdot R}\cdot(\pi\cdot R^{2})$$

Simplifying:

$$\#46:\ \frac{R\cdot c\cdot e}{2}$$

Thus I = (e c / (2 π R)), where e < 0 so I is negative as well.

Thus, by the right hand rule, if we consider a square in the x-y plane with (equal) sides Δx and Δy, then if there is current I flowing in the square, it is flowing clockwise viewed from the positive z-axis as that is in the negative direction. And then the M vector of this current is pointing in the direction of the negative z-axis. And (with the "v" below NOT the same as v = c of the electron ring above):

$$\#47:\ I = \frac{e\cdot v}{4\cdot\Delta x}$$

We set the ring's magnetic moment equal to the square's magnetic moment (so they look the same from a distance), where we picture the ring center at the square center as well, and also the ring's circle of symmetry in the x-y plane. Thus, if we consider the square of side Δx and the ring centered at the square center, they both look the same magnetically from a distance as they should.

$$\#48:\ \frac{e\cdot v}{4\cdot\Delta x}\cdot\Delta x^{2} = \frac{c\cdot e}{2\cdot\pi\cdot R}\cdot(\pi\cdot R^{2})$$

$$\#49:\ \text{SOLVE}\left(\frac{e\cdot v}{4\cdot\Delta x}\cdot\Delta x^{2} = \frac{c\cdot e}{2\cdot\pi\cdot R}\cdot(\pi\cdot R^{2}),\ v\right)$$

Simplifing:

$$\#50:\quad v = \frac{2 \cdot R \cdot c}{\Delta x} \lor e = 0$$

Selecting the first solution as e < 0:

$$\#51:\quad \frac{2 \cdot R \cdot c}{\Delta x}$$

This just above is v, the speed of the charge in the square of side Δx to make the magnetic moments of the square and of the ring equal as vectors and the square's and the ring's centers being at the same point.

If we set Δx = Le, we have:

$$\#52:\quad \frac{2 \cdot R \cdot c}{Le}$$

Substituting:

$$\#53:\quad \frac{2 \cdot (3.87056242 \cdot 10^{-13}) \cdot 299792458}{2.454797759 \cdot 10^{-6}}$$

Simplifying:

#54: 94.53857593

This just above is "v", the speed of current flow (clockwise) around the square of side Δx.

Now, suppose that the square has center on the x positive axis at distance ρ from the coordinate system origin and that the sides Δy (equalling Δx) are perpendicular to the x-axis while the sides Δx are parallel to this x-axis. Then, if the x-y plane is rotating at a constant angular velocity ω > 0 about the origin (i.e. counterclockwise viewed from the positive z-axis), we see that approximately we have that the velocity of charge around the square of side Δx is still v for the Δx sides, but the near Δy side (where Δy = Δx) has new (clockwise) speed (v + (ρ - Δx / 2) ω) while the far Δy side has new speed (-v + (ρ + Δx / 2)ω) so that the speed sum is (where we add since we are going around):

$$\#55:\quad \left(v + \left(\rho - \frac{\Delta x}{2}\right) \cdot \omega\right) + \left(-v + \left(\rho + \frac{\Delta x}{2}\right) \cdot \omega\right)$$

Simplifying:

#56: $2\cdot\omega\cdot\rho$

Note that this is a function of ω and ρ.

This means that the new total average speed "vpr"(clockwise) around is:

#57: $$\frac{4\cdot v + 2\cdot\omega\cdot\rho}{4}$$

Simplifying:

#58: $$\frac{\omega\cdot\rho}{2} + v$$

This just above is "vpr", the average (clockwise) speed of charge around the square of side Δx under rotation ω.

But then the new current is "Ipr":

#59: $$\frac{e\cdot vpr}{4\cdot\Delta x}$$

Substituting:

#60: $$\frac{e\cdot\left(\frac{\omega\cdot\rho}{2} + v\right)}{4\cdot\Delta x}$$

Simplifying:

#61: $$\frac{e\cdot(\omega\cdot\rho + 2\cdot v)}{8\cdot\Delta x}$$

This just above is "Ipr", the new current (taking into account rotation) about the square at radius ρ having side Δx = Le.

Thus the new magnetic moment is then:

#62: $$\frac{e\cdot(\omega\cdot\rho + 2\cdot v)}{8\cdot\Delta x}\cdot\Delta x^2$$

Simplifying:

#63: $$\frac{e\cdot\Delta x\cdot(\omega\cdot\rho + 2\cdot v)}{8}$$

Substituting (with Δx = Le):

$$\#64: \frac{(-1.602176\cdot 10^{-19})\cdot(2.454797759\cdot 10^{-6})\cdot(\omega\cdot\rho + 2\cdot 94.53857593)}{8}$$

Simplifying:

$$\#65: -4.916272567\cdot 10^{-26}\cdot\omega\cdot\rho - 9.295548148\cdot 10^{-24}$$

This just above is the square's magnetic moment under rotation.

Note that have the NUMERICALLY correct magnetic moment if $\omega = 0$.

At #86 below we find (by definition of the magnetization) that we must divide this just above magnetic moment by Δx^3 to obtain "Mpr", the (rotational) magnetization of the cubic cell of side Δx and at perpendicular distance ρ from the axis of the cylindrical magnet which has at the ring center as its center. Here we abuse notation slightly by using "Mpr" for the magnetization of the square at radius ρ instead of the weighed average magnetization as below.

$$\#66: \frac{-4.916272567\cdot 10^{-26}\cdot\omega\cdot\rho - 9.295548148\cdot 10^{-24}}{\Delta x^3}$$

Simplifying after setting Δx = Le:

$$\#67: \frac{-4.916272567\cdot 10^{-26}\cdot\omega\cdot\rho - 9.295548148\cdot 10^{-24}}{(2.454888413\cdot 10^{-6})^3}$$

Simplifying:

$$\#68: -3.323079142\cdot 10^{-9}\cdot\omega\cdot\rho - 6.283183396\cdot 10^{-7}$$

The value of ω according to Christian's and Hans's data is 6000 rpm equalling in radians per second:

$$\#69: \frac{6000}{60}\cdot(2\cdot\pi)$$

Simplifying:

$$\#70: 200\cdot\pi$$

Substituting into #71:

$$\#71: - 3.323079142 \cdot 10^{-9} \cdot (200 \cdot \pi) \cdot \rho - 6.283183396 \cdot 10^{-7}$$

Simplifying:

$$\#72: - 2.087952203 \cdot 10^{-6} \cdot \rho - 6.283183396 \cdot 10^{-7}$$

This just above is the (rotational) magnetization of the square at cylindrical radius, and is a function of ρ.

We want to integrate from ρ = 0 to ρ = Rt (taking into account area), so we multiply by the Jacobian ρ:

$$\#73: (- 2.087952203 \cdot 10^{-6} \cdot \rho - 6.283183396 \cdot 10^{-7}) \cdot \rho$$

Integrating:

$$\#74: \int_0^{Rt} (- 2.087952203 \cdot 10^{-6} \cdot \rho - 6.283183396 \cdot 10^{-7}) \cdot \rho \, d\rho$$

We cannot integrate with respect to θ from 0 to (2 π) in Derive as the integrand is not a function of θ, so we multiply by (2 π) instead:

$$\#75: (2 \cdot \pi) \cdot \int_0^{Rt} (- 2.087952203 \cdot 10^{-6} \cdot \rho - 6.283183396 \cdot 10^{-7}) \cdot \rho \, d\rho$$

Simplifying

$$\#76: - 4.372996863 \cdot 10^{-6} \cdot Rt^3 - 1.973920278 \cdot 10^{-6} \cdot Rt^2$$

We divide by the pole face area to obtain our weighed average (taking into account cylinder surface area):

$$\#77: \frac{- 4.372996863 \cdot 10^{-6} \cdot Rt^3 - 1.973920278 \cdot 10^{-6} \cdot Rt^2}{\pi \cdot Rt^2}$$

Simplifying:

$$\#78: - 1.391968133 \cdot 10^{-6} \cdot Rt - 6.283183388 \cdot 10^{-7}$$

Substituting for Rt = 0.025:

#79: $- 1.391968133\cdot10^{-6}\cdot0.025 - 6.283183388\cdot10^{-7}$

Simplifying:

#80: $- 6.631175421\cdot10^{-7}$

This just above is "Mpr", the weighed average of the (rotational) magnetization of a square of side Δx = Le taking into account area.

We now pause to consider the relation between the (rotational) magnetization "Mpr" of an weighed average of a square and its current "Ipr" and also its magnetic moment (Ipr Δx^2).

#81: $Mpr\cdot\Delta x^3 = Ipr\cdot\Delta x^2$

The right side of the just above is the square magnetic moment, and so this magnetic moment must be divided by Δx^3 to obtain the averaged (rotational) magnetization of the square of side Δx.

#82: $SOLVE(Mpr\cdot\Delta x^3 = Ipr\cdot\Delta x^2, Mpr)$

#83: $Mpr = \frac{Ipr}{\Delta x} \lor \Delta x = 0$

Taking the first root since Δx > 0:

#84: $\frac{Ipr}{\Delta x}$

This just above is "Mpr".

The percent change in magnitization then is:

#85: $\frac{100\cdot(Mpr - M)}{M}$

Sunstituting using M from #78 (since the second term is just the non-rotational magnetization) with ω = 0 and Mpr from #80:

#86: $\frac{100\cdot(- 6.631175421\cdot10^{-7} - - 6.283183388\cdot10^{-7})}{- 6.283183388\cdot10^{-7}}$

Simplifying:

#87: 5.538466912

This just above (being about 5.5%) is the weighed average of the percent change in magnetization of the cylindrical magnet of Christian's and Hans', where we weigh by area. Their measured value is given as 9.8% $\pm$ 4.5%, and since 9.8 - 4.5 = 5.3, our theoretically (just above) calculated percent number is within this range. We believe that the larger 9.8% figure is (probably) due to the fact that while the non-rotating magnet is (assumed) uniformly magnetized, the rotating magnet NO longer is ... because the dipole moment change (due to rotation) becomes larger [or smaller in the case of rotation in the other direction ... as then $\omega < 0$] as ρ (the distance from the magnet axis of symmetry) increases. Thus, the flux meter probe used would tend to measure the edge value as the magnet radius is just 2.5 centimeters, that is, only about one inch.

The interested reader is referred to the (free) e-book, "Central Oscillator and Space-Quanta-Medium" by O. Crane, J-M.Lehner, and C. Monstein on Hans Lehner's web site (where Hans is the late J-C. Lehner's son) and the magnet used was a sophisticated NdFeB-Magnet. (See page 230 for an exact write-up of this experiment treated here theoretically.) The central theoretical notion introduced in this book is "Magnetic Space Quanta Flux", but we do NOT use this notion here ... nor do we see why it is necessary one. Quantum theory must, in our view, be replaced by a semi-classical electron (and proton) theory where a neutron is simply a ring electron and a ring proton in a certain close proximiity with each other (with the possible addition of a neutrino having no charge and very, very little mass ... that need not concern us as far as basic atomic theory and chemistry are concerned).