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THE VACUUM CURRENT IMPLIED BY CONSERVATION OF ANTISYMMETRY

by

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ABSTRACT

It is shown that conservation of antisymmetry in ECE2 physics, notably electrodynamics, leads to the inference of a spacetime, aether or vacuum current density. The spin connection is calculated for any material vector potential $\underline{A}$ by using the antisymmetry equations to give unique solutions of an exactly defined equation set. The vacuum current is defined by the Ampère and Gauss laws of ECE2 magnetostatics. Sample results are computed and graphed.

Keywords: ECE2 physics, electrodynamics, conservation of antisymmetry, vacuum current.

4FT 386

1. INTRODUCTION

In immediately preceding papers of this series {1 - 12} the ECE2 field equations have been solved with conservation of antisymmetry, a fundamental law of physics first inferred in UFT131. It was shown in UFT131 ff. that the standard model of electrodynamics (the Maxwell Heaviside (MH) theory) violates antisymmetry. The entire standard model of electrodynamics, the electroweak field, and of the Higgs boson for example is refuted by violation of antisymmetry. By now, the obsolescence of the standard model of physics is well known and accepted. On a philosophical plane, violation of antisymmetry is a disaster akin to violation of any other conservation law. On the ECE2 level, antisymmetry is conserved.

This paper is a brief synopsis of extensive calculations posted in the notes accompanying UFT386 on www.aias.us. Notes 381(1), 386(2), 386(4) and 386(5) are preliminary calculations, the final version of which is given in Note 386(9) and used in Section 2 of this paper. Note 386(3) provides an example of a magnetic material potential $\underline{A}$, which is translated in the note from spherical polar to Cartesian coordinates. Notes 386(6) and 386(7) give a convenient revision from UFT131 of the proof of violation of antisymmetry in the standard physics.

Section 2 is based on Note 386(9), and solves the antisymmetry equations of ECE2 electrodynamics for the three components of the spin connection. Therefore antisymmetry is conserved by this procedure for any material vector potential $\underline{A}$. The ECE2 Gauss and Ampère laws of magnetostatics are used to calculate a novel spacetime, vacuum or aether current density $\underline{J}$(vac). The spin connection is shown to be the intermediary between $\underline{A}$ and $\underline{J}$(vac). The latter provides energy from spacetime and does not exist in the MH theory.

Section 3 uses computer algebra to provide solutions which are graphed and discussed.

2. DERIVATION OF THE SPACETIME CURRENT

Consider the ECE2 antisymmetry equations {1 - 12}:

$$\frac{\partial A_Z}{\partial Y} + \frac{\partial A_Y}{\partial Z} = \omega_Y A_Z + \omega_Z A_Y \quad -(1)$$

$$\frac{\partial A_X}{\partial Z} + \frac{\partial A_Z}{\partial X} = \omega_Z A_X + \omega_X A_Z \quad -(2)$$

$$\frac{\partial A_Y}{\partial X} + \frac{\partial A_X}{\partial Y} = \omega_X A_Y + \omega_Y A_X \quad -(3)$$

where $\underline{A}$ is the usual material vector potential. Eqs. (1) to (3) are exactly determined and give unique solutions for the three Cartesian components of the spin connection vector:

$$\underline{\omega} = \omega_X \underline{i} + \omega_Y \underline{j} + \omega_Z \underline{k}. \quad -(4)$$

Using computer algebra, these solutions are:

$$\omega_X = -\frac{1}{2A_Y A_Z}\left[A_X\left(\frac{\partial A_Z}{\partial Y} + \frac{\partial A_Y}{\partial Z}\right) - A_Y\left(\frac{\partial A_Z}{\partial X} + \frac{\partial A_X}{\partial Z}\right) - A_Z\left(\frac{\partial A_Y}{\partial X} + \frac{\partial A_X}{\partial Y}\right)\right] \quad -(5)$$

$$\omega_Y = \frac{1}{2A_X A_Y}\left[A_X\left(\frac{\partial A_Z}{\partial Y} + \frac{\partial A_X}{\partial Z}\right) - A_Y\left(\frac{\partial A_Z}{\partial X} + \frac{\partial A_X}{\partial Z}\right) + A_Z\left(\frac{\partial A_Y}{\partial X} + \frac{\partial A_X}{\partial Y}\right)\right] \quad -(6)$$

$$\omega_Z = \frac{1}{2A_X A_Y}\left[A_X\left(\frac{\partial A_Z}{\partial Y} + \frac{\partial A_X}{\partial Z}\right) + A_Y\left(\frac{\partial A_Z}{\partial X} + \frac{\partial A_X}{\partial Z}\right) - A_Z\left(\frac{\partial A_Y}{\partial X} + \frac{\partial A_X}{\partial Y}\right)\right] \quad -(7)$$

Therefor the spin connection vector $\underline{\omega}$ can be calculated uniquely for any $\underline{A}$, Q. E. D.

Note carefully that if any more equations are added to Eqs. (1) to (3) the system becomes over determined and there is no solution. Eqs. (1) to (7) can be translated into any coordinate system using computer algebra.

Therefore in any problem of ECE2 electrodynamics, gravitation and fluid dynamics the spin connections are always defined by Eqs. (5) to (7). This procedure conserves antisymmetry, Q. E. D.. For example, the ECE2 field equations of magnetostatics are:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(8)$$

$$\underline{\nabla} \times \underline{B} = \mu_0 \underline{J} \quad -(9)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} - \underline{\omega} \times \underline{A}, \quad -(10)$$

where $\underline{B}$ is the magnetic flux density, μ_0 is the S. I. Vacuum permeability, and $\underline{J}$ is the material current density. Here, $\underline{A}$ is the material vector potential. From Eq. (9):

$$\underline{A} = \frac{\mu_0}{4\pi} \int \frac{\underline{J}(\underline{x}')}{|\underline{x} - \underline{x}'|} d^3x'. \quad -(11)$$

Therefore $\underline{A}$ can be calculated or computed from any current density $\underline{J}(\underline{x}')$ using Eq. (11). There are well known analytical solutions, for example a circular current loop and a magnetized sphere, but using a fast desktop, mainframe or supercomputer $\underline{A}$ can be computed for any current density $\underline{J}$.

Having found $\underline{A}$ from any $\underline{J}$, any spin connection vector $\underline{\omega}$ can be found from Eqs. (5) to (7).

For example, in a well defined approximation {1 -12}, a magnetic current loop gives a material vector potential component in spherical polar coordinates:

$$\underline{A} = \frac{\mu_0 I a^2}{4r^2} \sin\theta \, \underline{e}_\phi \quad -(12)$$

This is translated into Cartesian coordinates in Note 386(3)

$$\underline{A} = \frac{\mu_0 I a^2}{4}\left(\frac{-Y\underline{i}}{(x^2+y^2+Z^2)^{3/2}} + \frac{X\underline{j}}{(x^2+y^2+Z^2)^{3/2}}\right). \quad -(13)$$

Here I is the current in a loop of radius a. Computer algebra can be used to compute the spin connection from Eqs. (5), (6), (7) and (13). This procedure rigorously conserves antisymmetry. Similarly $\underline{\omega}$ can be computed from any $\underline{A}$ and examples are given in Section 3. In general the solutions for $\underline{A}$ of a circular current loop are given in Note 386(5).

From the Gauss law (8), it follows that:

$$\underline{\nabla}\cdot\left(\underline{\omega}\times\underline{A}\right) = 0 \quad -(14)$$

because:

$$\underline{\nabla}\cdot\underline{\nabla}\times\underline{A} = 0. \quad -(15)$$

It follows from Eq. (14) that a spacetime, vacuum or aether vector potential $\underline{\alpha}$ can always be defined:

$$\underline{\nabla}\times\underline{\alpha} := \underline{\omega}\times\underline{A} \quad -(16)$$

It follows that:

$$\underline{\nabla}\cdot\underline{B} = \underline{\nabla}\cdot\left(\underline{\nabla}\times\underline{A} - \underline{\nabla}\times\underline{\alpha}\right) = 0. \quad -(17)$$

So the ECE2 Gauss law (8) is obeyed Q. E. D.

The concept of $\underline{\alpha}$ does not exist in MH theory.

The spacetime, vacuum or aether current density $\underline{J}$(vac) is defined by

$$\underline{\alpha} = \frac{\mu_0}{4\pi} \int \frac{\underline{J}(\text{vac})(\underline{x}')}{|\underline{x} - \underline{x}'|} d^3x \quad -(18)$$

and by the vacuum Ampère law of ECE2 electrodynamics:

$$\underline{\nabla} \times \underline{B}(\text{vac}) = \mu_0 \underline{J}(\text{vac}) \quad -(19)$$

where $\underline{B}$(vac) is the vacuum, aether or spacetime magnetic flux density. Again this concept does not exist in MH theory. It follows that:

$$\underline{J}(\text{vac}) = \frac{1}{\mu_0} \underline{\nabla} \times (\underline{\nabla} \times \underline{\alpha}) = \frac{1}{\mu_0} \underline{\nabla} \times (\underline{\omega} \times \underline{A}) \quad -(20)$$

Q. E. D. So $\underline{J}$(vac) can be computed from any material $\underline{A}$. Clearly, the spin connection vector $\underline{\omega}$ is the intermediary between the material $\underline{A}$ and the vacuum current $\underline{J}$(vac).

Conservation of ECE2 antisymmetry implies the existence of a vacuum current $\underline{J}$(vac).

3. COMPUTATION AND GRAPHICS

(Section by Dr. Horst Eckardt).

The vacuum current implied by conservation of antisymmetry

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3 Computation and graphics

We investigate three examples of magnetostatics and analyse the spacetime properties resulting from the antisymmetry laws.

3.1 Dipole field (far field of magnetic current loop)

In classical electrodynamics, the magnetic dipole field is based on a vector potential havin only a ϕ component in spherical coordinates, see Eq. (12). For practical reasons we transform all fields to cartesian coordinates so that the antisymmetry equations (1-3) can be applied directly. Then the vector potential of a magnetic dipole takes the form

$$\mathbf{A} = \frac{I\, a^2\, \mu_0}{4(X^2+Y^2+Z^2)^{\frac{3}{2}}} \begin{bmatrix} -Y \\ X \\ 0 \end{bmatrix} \tag{21}$$

as given by Eq. (13). The spin connection should be computable from Eqs. (5-7), however the problem arises that one component of $\mathbf{A}$, appearing in the denominator, is zero. Therefore one has to solve Eqs. (1-3) directly for this special case. As a result, the equation system has one dependent equation so that it is not uniquely solveable any more. Such cases can appear for simple application cases where some components of the vector potential vanish (see also next paragraph). Therefore we make a special choice of $\boldsymbol{\omega}$, requiring

$$\boldsymbol{\nabla} \times \mathbf{A} = -\boldsymbol{\omega} \times \mathbf{A}. \tag{22}$$

When taking two independent equations of (1-3) and one equation of (22), the equation set is of rank 3. We obtain:

$$\boldsymbol{\omega} = \begin{bmatrix} -\frac{Z^2-2Y^2+X^2}{X\,(X^2+Y^2+Z^2)} \\ -\frac{Z^2+Y^2-2X^2}{Y\,(X^2+Y^2+Z^2)} \\ \frac{3Z}{X^2+Y^2+Z^2} \end{bmatrix}. \tag{23}$$

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This is the spin connection of the magnetic dipole. By inserting (23) and (21) into (22), we have verified that (22) is valid. It should be noticed that the component equations of (22) are not of rank 3 in general. Therefore using (22) alone as a general approximation without antisymmetry constraints does not lead to a unique solution for $\boldsymbol{\omega}$.

The magnetic dipole potential then is

$$\begin{aligned}\mathbf{B} &= \boldsymbol{\nabla}\times\mathbf{A} - \boldsymbol{\omega}\times\mathbf{A} = 2\,\boldsymbol{\nabla}\times\mathbf{A} \\ &= \frac{I\,a^2\,\mu_0}{4(X^2+Y^2+Z^2)^{\frac{5}{2}}}\begin{bmatrix} 3XZ \\ 3YZ \\ 2Z^2-X^2-Y^2\end{bmatrix}.\end{aligned} \tag{24}$$

It follows that

$$\boldsymbol{\nabla}\times\mathbf{B} = \mathbf{0} \tag{25}$$

i.e. there is no current connected with $\mathbf{B}$, neither a material current (based on $\boldsymbol{\nabla}\times\mathbf{A}$ nor a vacuum current (based on $\boldsymbol{\omega}\times\mathbf{A}$).

The fields are graphed in Figs. 1-3. In Fig. 1 the vector potential in the XY plane is shown which is a pure rotational field. Some selected field lines are drawn as red lines. The spin connection is graphed in Fig. 2, by a cut through the XZ plane. It can be seen from the field lines that spacetime is bent around the dipole centre. The three-dimensional structure is plotted in Fig. 3. From the base plane ($Z = 0$) it can be seen that there is a fourfold symmetry, coming from the single factors X and Y appearing in Eq. (23). The vectors are bent to the Z direction when moving from the plane $Z = 0$. The spin connection is not divergence-free, but $\boldsymbol{\omega}\times\mathbf{A}$ is.

The resulting magnetic field (24), graphed in Fig. 4, is the well known dipole field which is rotationally symmetric around Z. Because of Eq. (25), there is no material and vacuum current density. It cannot be excluded that this is a consequence of the special choice (22).

3.2 Field of a magnetic current loop

A single current loop is another standard example and has the vector potential ϕ component

$$A_\phi = \frac{I\,a^2\,\mu_0}{4(r^2+a^2)^{\frac{3}{2}}}\left(\frac{15a^2\,r^2\sin(\theta)^2}{8(r^2+a^2)^2}+1\right). \tag{26}$$

Here a is the radius of the loop. Transforming this vector potential into cartesian form gives highly complicated expressions, therefore we only present the graphical results.

Similar as for the dipole field, the vector potential in cartesian coordinates has no Z component. Therefore we proceed as described in the preceding section, using the auxiliary condition $\boldsymbol{\nabla}\times\mathbf{A} = -\boldsymbol{\omega}\times\mathbf{A}$. The vector potential is graphed in Fig. 5 and looks quite similar to that of the dipole field (Fig. 1). The same holds for the spin connection (Fig. 6). The magnetic field (Fig. 7), however, shows the field lines of the current loop which is in the XY plane, i.e. perpendicular to the plotted XZ plane. This is the result known from standard electrodynamics.

In contrast to the simple dipole, the magnetic field of the current loop produces a current density

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J}. \tag{27}$$

As can be seen from Fig. 8, it is circular in the XY plane, however it changes direction at the radius where the physical loop is placed. There is an inner and an outer vortex, both with contrary directions. The physical loop separates both vortices. Because of the choice (22), $\mathbf{J}$ corresponds to a material as well as a spacetime or aether of vacuum current density.

3.3 Constant magnetic field from non-constant potential

In a third example we show that a constant magnetic field can be produced from a non-trivial vector potential. Consider the potential

$$\mathbf{A} = \frac{B_0}{4} \begin{bmatrix} -Y \\ X \\ \frac{Z^3}{XY} \end{bmatrix} \tag{28}$$

which now has three components different from zero. Therefore Eqs. (1-3) are unique and the general solutions (4-6) can be used, without requiring additional assumptions. The simple spin connection

$$\boldsymbol{\omega} = \begin{bmatrix} -\frac{1}{X} \\ -\frac{1}{Y} \\ 0 \end{bmatrix} \tag{29}$$

is obtained, leading to

$$\boldsymbol{\omega} \times \mathbf{A} = \frac{B_0}{2} \begin{bmatrix} -\frac{Z^3}{2XY^2} \\ \frac{Z^3}{2X^2Y} \\ -1 \end{bmatrix}. \tag{30}$$

From Eq. (28) follows

$$\nabla \times \mathbf{A} = \frac{B_0}{2} \begin{bmatrix} -\frac{Z^3}{2XY^2} \\ \frac{Z^3}{2X^2Y} \\ 1 \end{bmatrix} \tag{31}$$

so both terms $\nabla \times \mathbf{A}$ and $\boldsymbol{\omega} \times \mathbf{A}$ are not identical due to different signs in the components. It follows

$$\mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ B_0 \end{bmatrix}, \tag{32}$$

i.e. the magnetic field is constant despite of a non-constant and even non-linear vector potential and spin connection. It is trivially valid

$$\nabla \cdot \mathbf{B} = 0 \tag{33}$$

and

$$\boldsymbol{\nabla} \times \mathbf{B} = \mathbf{0} \tag{34}$$

so that the conditions of magnetostatics (8, 9) are fulfilled. Although the total current density disappears, its constituents, the material and spacetime current density, do not disappear:

$$\boldsymbol{\nabla} \times (\boldsymbol{\nabla} \times \mathbf{A}) = \boldsymbol{\nabla} \times (\boldsymbol{\omega} \times \mathbf{A}) = -\frac{B_0}{2} \begin{bmatrix} \frac{3Z^2}{2X^2Y} \\ \frac{3Z^2}{2XY^2} \\ \frac{Z^3(X^2+Y^2)}{X^3Y^3} \end{bmatrix}. \tag{35}$$

The potential (28) is graphed in Fig. 9 for a plane $Z = 1$. In contrast to the cases considered before, the potential grows with increasing radius. In Z direction there is a directional change at $Z = 0$ (Fig. 10), and similar in the X and Y direction (the latter not shown). The directional growth is restricted to the Z direction. The spin connection shows hyperbolic field lines (Fig. 11). A similar picture results for the magnetic field component $\boldsymbol{\omega} \times \mathbf{A}$, presented in Fig. 12. The hyperbolic field lines are rotated by 45 degrees, compared to Fig. 11, and there are no divergences. The total $\mathbf{B}$ field is constant.

Finally the spacetime part of the current density is graphed. In the XY plane (Fig. 13) it looks similar to the spin connection, but without divergences on the coordinate lines. In the XZ plane the current density is vertical, similar to the A field in this plane (cf. Fig. 10) but with no divergence plane at $Z = 0$. This is because in general the relation

$$\boldsymbol{\nabla} \cdot (\boldsymbol{\omega} \times \mathbf{A}) = 0 \tag{36}$$

is valid.

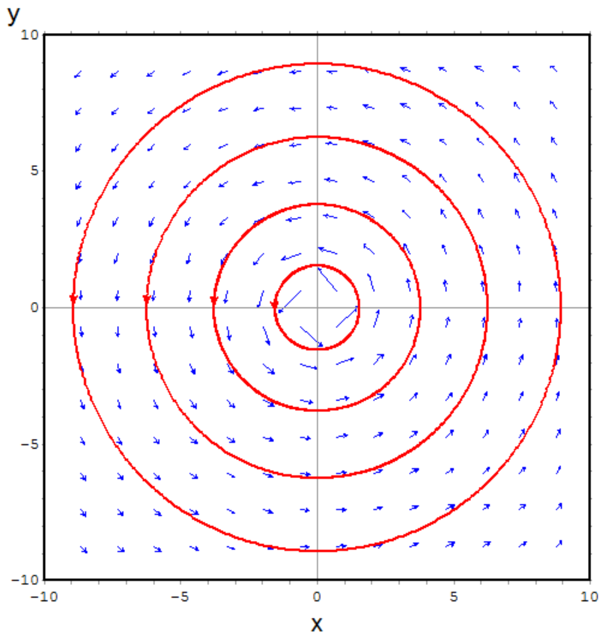

Figure 1: **A** field of far field dipole, XY plane.

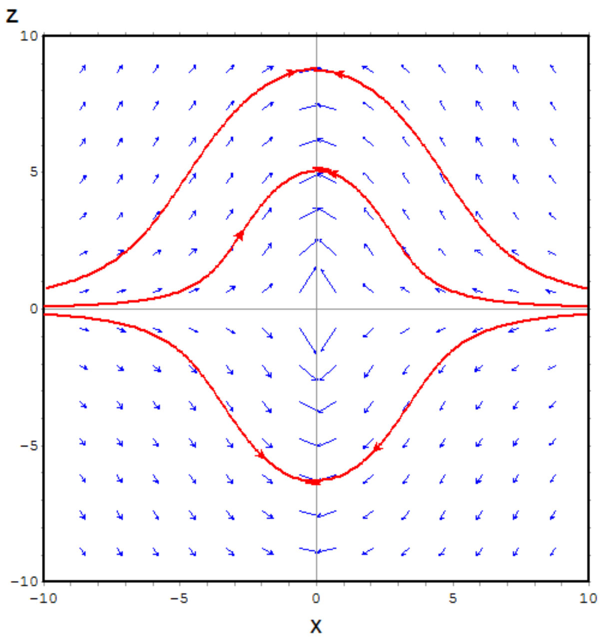

Figure 2: $\boldsymbol{\omega}$ field of far field dipole, XZ plane.

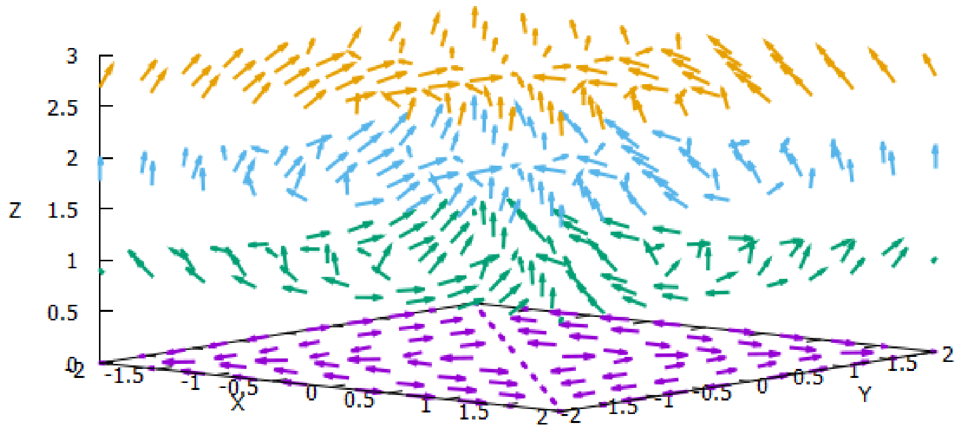

Figure 3: 3D plot (direction vectors) for $\boldsymbol{\omega}$ of far field dipole.

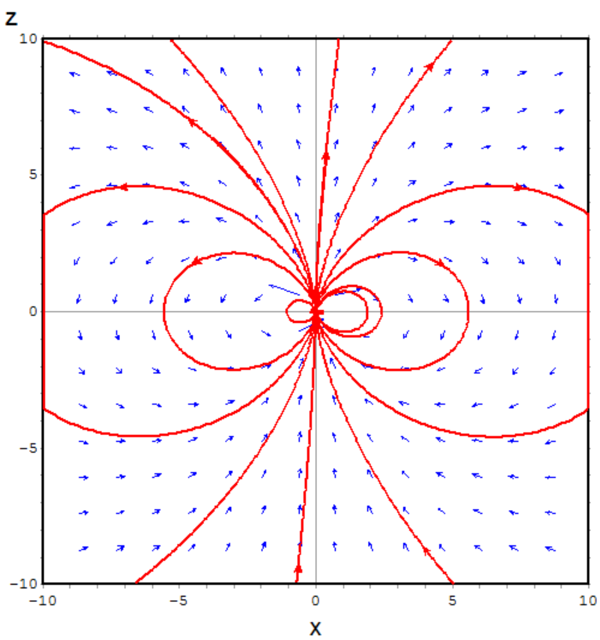

Figure 4: $\mathbf{B}$ field of far field dipole, XZ plane.

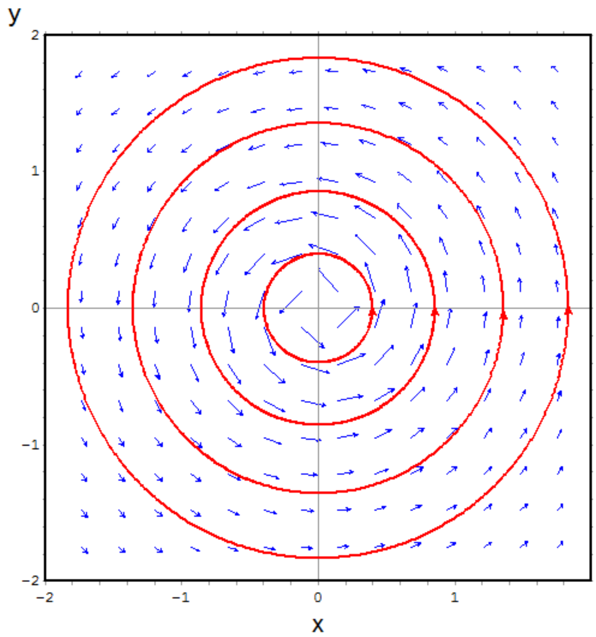

Figure 5: **A** field of magnetic current loop, XY plane.

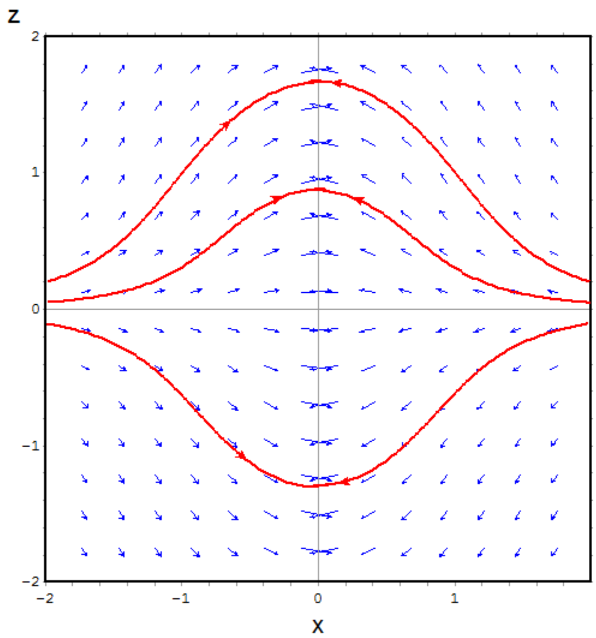

Figure 6: $\boldsymbol{\omega}$ field of magnetic current loop, XZ plane.

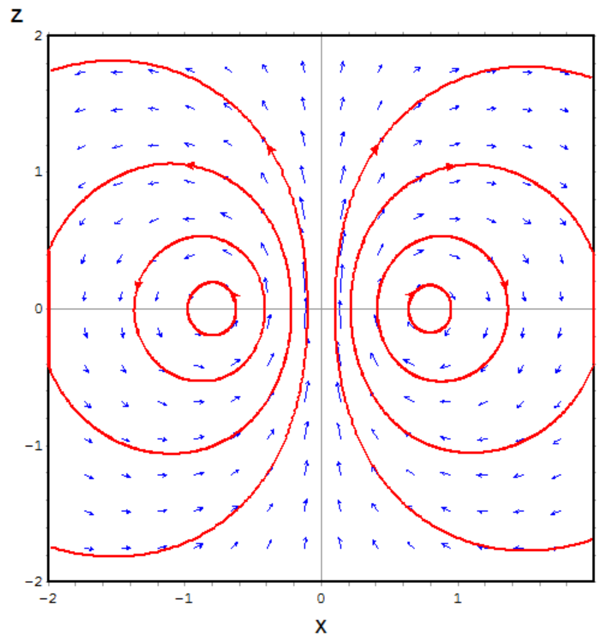

Figure 7: **B** field of magnetic current loop, XZ plane.

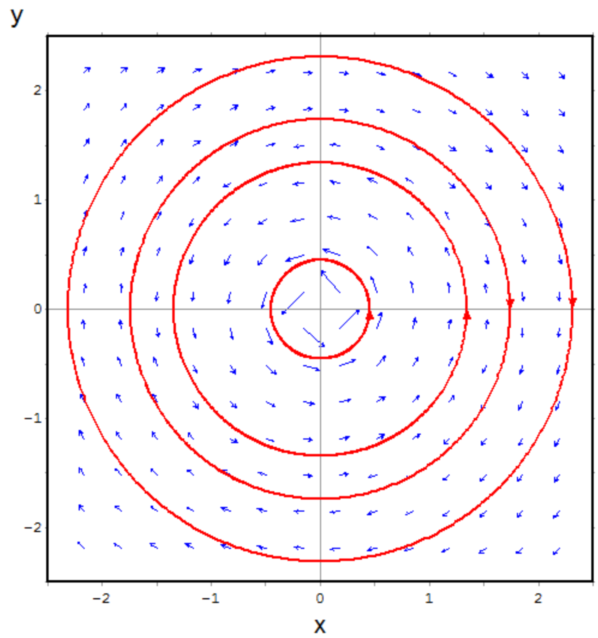

Figure 8: Current density **J** of magnetic current loop, material and spacetime, XY plane (notice alternating directions).

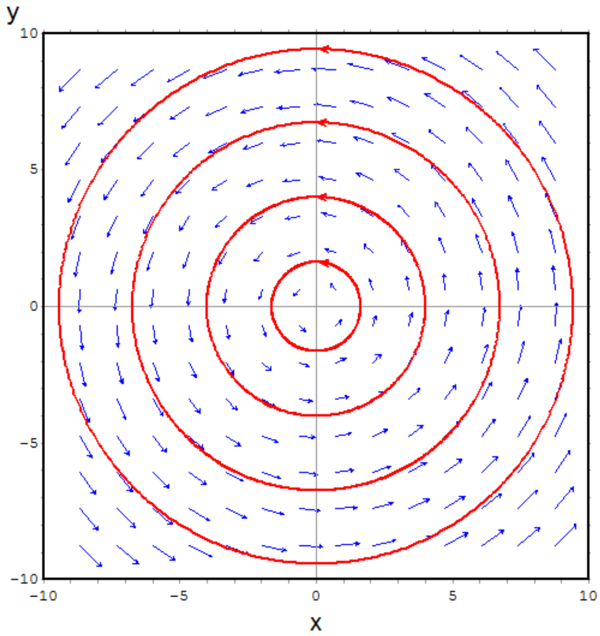

Figure 9: **A** field of special example, XY plane with $Z = 1$.

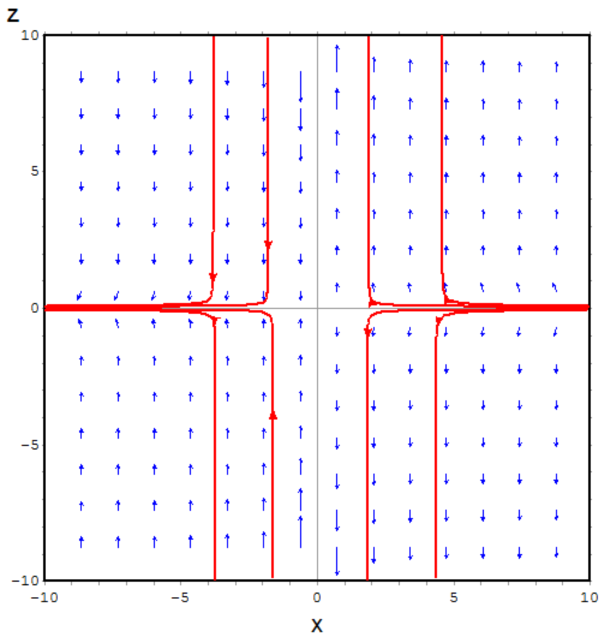

Figure 10: **A** field of special example, XZ plane with $Y = 0.1$.

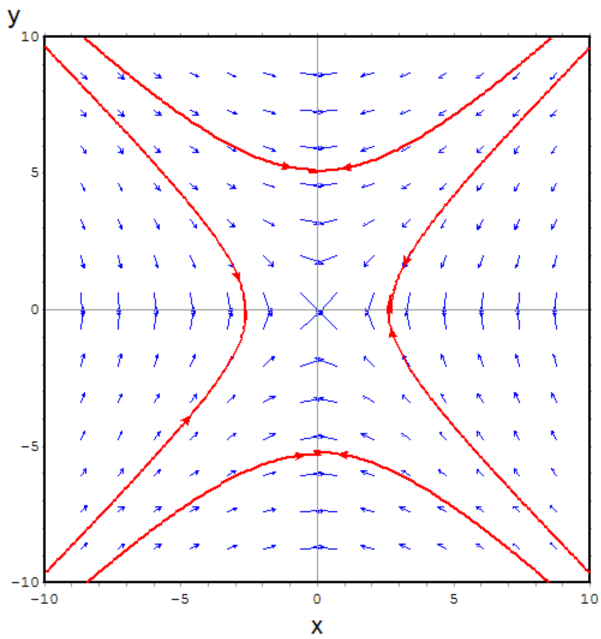

Figure 11: $\boldsymbol{\omega}$ field of special example, XY plane.

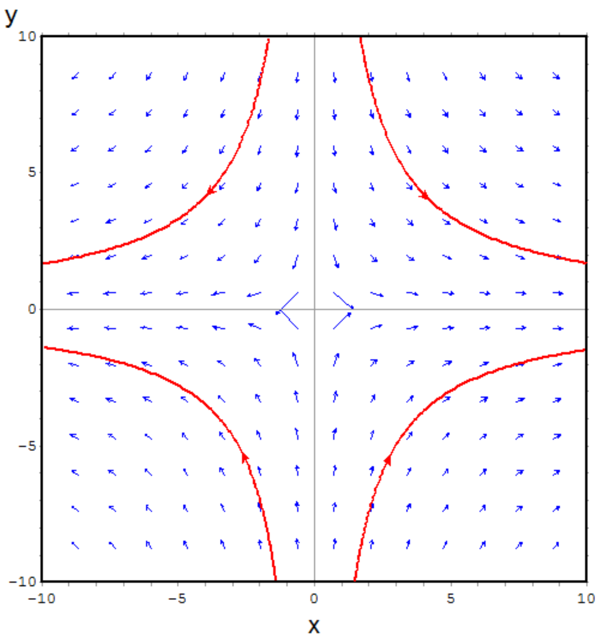

Figure 12: Magnetic field component $\boldsymbol{\omega} \times \mathbf{A}$, special example, XY plane with $Z = -1$.

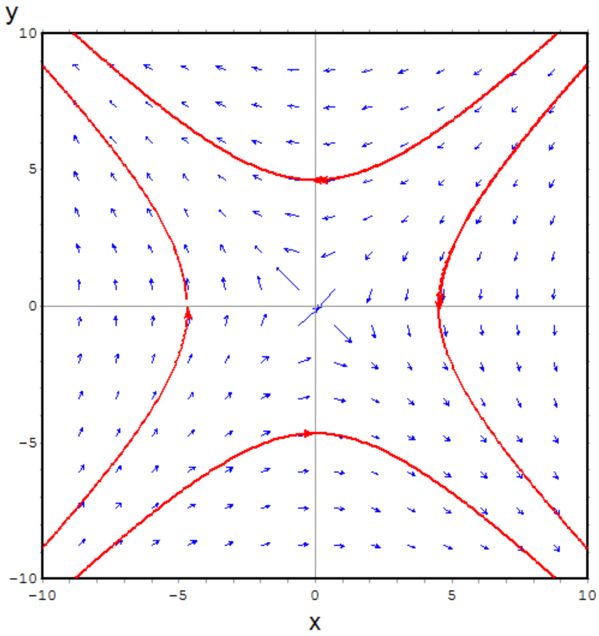

Figure 13: Current component $\mathbf{J}_{vac}$, special example, XY plane with $Z = 0.1$.

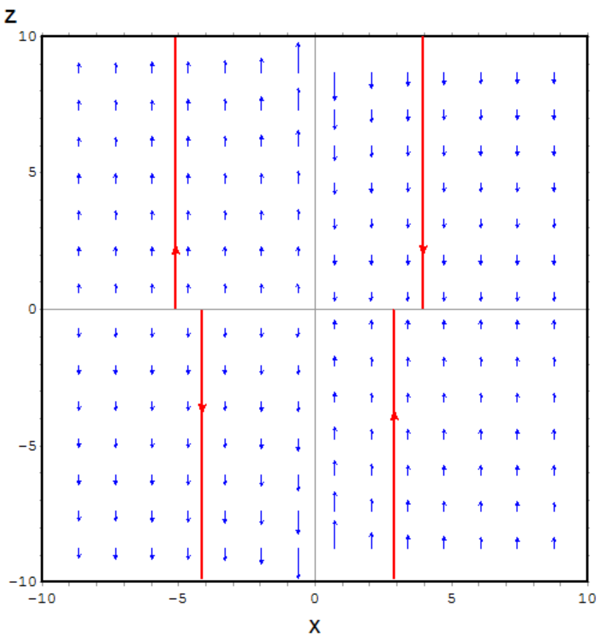

Figure 14: Current component $\mathbf{J}_{vac}$, special example, XZ plane with $Y = 0.1$.

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