SPIN CONNECTIONS FOR THE ELECTRIC AND MAGNETIC DIPOLE FIELDS

by

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ABSTRACT

The ECE2 spin connections are evaluated for the electric and magnetic dipole fields. It is shown that the theory conserves antisymmetry The vector antisymmetry equations are solved simultaneously for the three components of the vector spin connection from the vector potential of the electric dipole field. The time like part of the spin connection is identified as the rest frequency of the vacuum particle. The same overall procedure can be used to find the spin connections of the magnetic dipole field.

Keywords: ECE2 theory, solution for the static dipole field, conservation of antisymmetry.

UFT385

1. INTRODUCTION

In recent papers of this series {1 - 12}, self consistent solutions of the ECE2 field equations have been sought while conserving antisymmetry. In Section 2, solutions of this type are given for the static electric and static magnetic dipole fields. The four components of the spin connection four vector are found in each case. The time like components is identified as the rest frequency of the vacuum particle {1 -12} and the three spacelike components ae evaluated with conservation of antisymmetry. The methodology used is to start with an experimentally well observed electric field strength (**E**) or magnetic flux density **B**. The relevant vector potential is evaluated with the first antisymmetry law. For the static dipole field the vector antisymmetry laws are solved simultaneously using computer algebra to give the spacelike spin connection components. The methodology can be applied to any static **E**, and to any static **B** in regions where there is no current density.

This paper is a short synopsis of detailed calculations in the notes accompanying UFT385 on combined sites (www.aias.us and www.upitec.org). Note 385(1) is a preliminary calculation for the Coulombic E. Note 385(2) is a preliminary calculation for the electric dipole field, and gives the electric dipole field in spherical polar and Cartesian coordinates. Note 385(3) gives a preliminary complete solution for the electric dipole field and checks by computer algebra that it is irrotational. The timelike component of the spin connection is identified as the rest frequency of the vacuum particle, a new fundamental constant. Note 385(4) gives a preliminary calculation for the magnetic dipole field. Note 385(5) gives a complete solution in which the vector antisymmetry lawas are solved simultaneously with computer algebra. This procedure conserves antiymmetry and evaluates the spin connections from the vector potential components. In Note 385(6) the spin connections for the magnetic dipole potential are evaluated using the same method as Note 385(5). Finally in Note 385(7) new relations are introduced between **E** and **B** and the vector and scalar potentials.

2. COMPLETE SOLUTIONS AND CONSERVATION OF ANTISYMMETRY

Consider the experimentally well observed dipole electric field strength $\underline{E}$:

$$\underline{E}(\underline{r}) = \frac{3\underline{n}(\underline{p}\cdot\underline{n}) - \underline{p}}{4\pi\epsilon_0 |\underline{r} - \underline{r}_0|^3} \quad -(1)$$

where $\underline{p}$ is the electric dipole moment and where $\underline{n}$ is a unit vector from $\underline{r}$ to $\underline{r}_0$. Here ϵ_0 is the vacuum permittivity in S. I. Units. From |Eq. (1) it follows that $\underline{E}$ is irrotational:

$$\underline{\nabla} \times \underline{E} = \underline{0} \quad -(2)$$

and this property has been checked by computer algebra in this work. If the dipole moment is in the Z axis, then in spherical polar coordinates:

$$\underline{E} = \frac{p}{4\pi\epsilon_0 r^3}\left(2\cos\theta\, \underline{e}_r + \sin\theta\, \underline{e}_\theta\right). \quad -(3)$$

In Cartesian coordinates, evaluated by computer algebra:

$$\underline{E} = \frac{-p}{4\pi\epsilon_0 r^5}\left(3XZ\,\underline{i} + 3YZ\,\underline{j} + (2Z^2 - X^2 - Y^2)\,\underline{k}\right) \quad -(4)$$

where

$$r^5 = (X^2 + Y^2 + Z^2)^{5/2}. \quad -(5)$$

The first ECE2 antisymmetry law of preceding papers is:

$$\underline{E} = -\underline{\nabla}\phi + \underline{\omega}\phi = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(6)$$

where ϕ is the scalar potential, $\underline{A}$ is the vector potential, and:

$$\omega^{\mu} = \left(\frac{\omega_0}{c}, \underline{\omega} \right) \quad -(7)$$

is the spin connection four vector. For electrostatics it is assumed that:

$$\frac{\partial \underline{A}}{\partial t} = \underline{0} \quad -(8)$$

so

$$\underline{E} = -\omega_0 \underline{A} . \quad -(9)$$

This is a direct relation between the field $\underline{E}$ in a circuit and the potential $\underline{A}$, which can be considered to be the vacuum vector potential. Papers UFT311, UFT321, UFT363, UFT382 and UFT383 prove the existence of the spin connection and the field $\underline{E}$ induced in a circuit by the surrounding spacetime. In ECE and ECE2, the vector potential is:

$$\underline{A} = A^{(0)} \underline{q} \quad -(10)$$

where q is the Cartan tetrad vector. So $\underline{A}$ is the geometry of spacetime within a proportionaliy $A^{(0)}$. This is the well known ECE hypothesis. The word "vacuum" means geometry and is synonymous with the word "aether". The vacuum can be quantized with the de Broglie Einstein equations to give the rest frequency of the vacuum particle {1 - 12} in hertz (inverse seconds):

$$\omega_0 = \frac{mc^2}{2\pi\hbar} . \quad -(11)$$

The spin connection is also a property of the vacuum.

From Eqs. (9) and (11):

$$\underline{E} = -\frac{mc^2}{2\pi\hbar} \underline{A} \quad -(12)$$

so the vector potential of the electric dipole field is:

$$\underline{A} = -2\pi \frac{\hbar}{mc^2} \underline{E} \quad -(13)$$

where $\underline{E}$ is given by Eq. (4). The ECE2 vecctor antisymmetry law is:

$$\left(\frac{\partial}{\partial Y} - \omega_Y\right) A_Z = -\left(\frac{\partial}{\partial Z} - \omega_Z\right) A_Y \quad -(14)$$

$$\left(\frac{\partial}{\partial Z} - \omega_Z\right) A_X = -\left(\frac{\partial}{\partial X} - \omega_X\right) A_Z \quad -(15)$$

$$\left(\frac{\partial}{\partial X} - \omega_X\right) A_Y = -\left(\frac{\partial}{\partial Y} - \omega_Y\right) A_X . \quad -(16)$$

This set of equations has been solved by computer algebra to give the three components of the spin connection vector for the electric dipole field. They are graphed and analyzed in section 3. They can be thought of as representing the spacetime structure created by a dipole electric field. This concept does not exist in standard physics.

The well measured dipole magnetic flux density far from a current loop is

$$\underline{B} = \frac{\mu_0}{4\pi r^3} \left(I\pi a^2\right) \left(\cos\theta\, \underline{e}_r + \sin\theta\, \underline{e}_\theta\right) \quad -(17)$$

in spherical polar coordinates. Here μ_0 is the vacuum permeability, I the current in the loop and a its radius. The magnetic dipole moment of the loop is:

$$m = |\underline{m}| = \pi \underline{I} a^2 \quad -(18)$$

The flux density $\underline{B}$ from Eq. (17) has the same structure as the electric field strength from Eq. (3), both are dipole fields. It follows that the dipole magnetic field is irrotational:

$$\underline{\nabla} \times \underline{B} = \underline{0} . \quad -(19)$$

In general the equations of ECE2 magnetostatics are:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(20)$$

$$\underline{\nabla} \times \underline{B} = \mu_0 \underline{J} \quad -(21)$$

$$\frac{\partial \underline{B}}{\partial t} = \underline{0} \quad -(22)$$

so the dipole magnetic field far from a current loop is equivalent to :

$$\underline{J} = \underline{0} \quad -(23)$$

i.e. exists in regions where the electric current density is vanishingly small.

Therefore for the magnetic dipole field:

$$\underline{\nabla} \times \underline{B} = \underline{0} \quad -(24)$$

and it follows that $\underline{B}$ can be expressed in the standard model as:

$$c\underline{B} = -\underline{\nabla} \phi \quad -(25)$$

where ϕ is the {1 - 12} magnetic scalar potential. This is almost unknown compared with the electric scalar potential, but appears in a book such as that by Jackson {1 - 12}. On the level of the standard model (Maxwell Heaviside or MH theory) the field potential relations are the well known {1 - 12}:

$$\underline{E} = -\underline{\nabla} \phi - \partial \underline{A} / \partial t \quad -(26)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} . \quad -(27)$$

Together with the Lorenz condition:

$$\underline{\nabla} \cdot \underline{A} + \frac{1}{c} \frac{\partial \phi}{\partial t} = 0 \quad -(28)$$

and the definitions:

$$A^\mu = \left(\frac{\phi}{c}, \underline{A}\right) \quad -(29)$$

$$J^\mu = \left(c\rho, \underline{J}\right) \quad -(30)$$

they produce the d'Alembert equation:

$$\Box A^\mu = \mu_0 J^\mu \quad -(31)$$

In Note 385(7), it is shown that:

$$\underline{E} = -c \underline{\nabla} \times \underline{A} \quad -(32)$$

$$c\underline{B} = -\underline{\nabla}\phi - \partial \underline{A} / \partial t \quad -(33)$$

produces the vacuum field equations and the vacuum d'Alembert equation:

$$\Box A^\mu = 0 \quad -(34)$$

of the MH theory. With the assumption (8), Eq. (33) becomes Eq. (25), which leads to an irrotational magnetic flux density. On the ECE2 level Eq. (33) becomes:

$$c\underline{B} = -\underline{\nabla}\phi - \underline{\omega}\phi = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(35)$$

Using Eq. (8), Eq. (35) simplifies to:

$$c\underline{B} = -\omega_0 \underline{A} \quad -(36)$$

so the vector potential of the magnetic dipole flux density is:

$$\underline{A} = -\frac{c}{\omega_0} \frac{\mu_0 I a^2}{4 r^3} \left(\cos\theta \, \underline{e}_r + \sin\theta \, \underline{e}_\theta \right) \quad -(37)$$

This has the same structure as the vector potential (13) of the electric dipole field strength.

The antisymmetry equations (14) to (16) can be solved in the same way as for the electric dipole field strength, giving the spin connections. The latter are graphed in Section 3.

More generally, the equations of magnetostatics on the ECE2 level are:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(38)$$

$$\underline{\nabla} \times \underline{B} = \mu_0 \underline{J} \quad -(39)$$

$$\partial \underline{B} / \partial t = \underline{0} \quad -(40)$$

where $\underline{J}$ is not zero in general. For non zero $\underline{J}$ the antisymmetry equations (14) to (16) conserve antisymmetry and must be solved and always used in addition to Eqs (38) and (40). The conservation of antisymmetry is a concept that does not exist in the standard model, but is a fundamental conservation law of physics, as fundamental as conservation of energy /momentum, charge/current density and the conservation laws of elementary particle theory. The method of solution that can be adopted for all static fields is as follows:

1) Consider an experimentally well observed field, i.e. start with experimental data.

2) Evaluate the vector potential with Eq. (9), using Eq. (11). For magnetic flux densities this works only in regions of vanishing $\underline{J}$.

3) Solve equations (14) to (16) simultaneously to give the spin connections.

4) More generally the problem can always be reduced to solving a number of simultaneous equations in the same number of unknowns, as in previous UFT papers.

3. NUMERICAL ANALYSIS AND GRAPHICS.

Spin connections for the electric and magnetic dipole fields

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3 Numerical analysis and graphics

3.1 Compatibility conditions

The electric field of a "real" dipole consisting of charges q_1 and q_2, placed at positions $\pm X_0$ on the X axis was already graphed in UFT 336 and UFT 346. Here we use the "mathematical" dipole field that follows from two infinitesimally displaced charges:

$$\mathbf{E} = \frac{3\mathbf{n}(\mathbf{p}\cdot\mathbf{n}) - \mathbf{p}}{4\pi\epsilon_0 r^3} \tag{41}$$

with $\mathbf{p}$ being the dipole moment and $\mathbf{n}$ the unit vector of the position vector $\mathbf{r}$ with modulus r. We assume that the dipole moment (with modulos p) is directed in the Z direction. Then the electric dipole field reads

$$\mathbf{E}_{\mathrm{cart}} = \frac{p}{4\pi\epsilon_0\, r^5}\begin{bmatrix} 3XZ \\ 3YZ \\ 2Z^2 - X^2 - Y^2 \end{bmatrix} \tag{42}$$

or

$$\mathbf{E}_{\mathrm{sph}} = \frac{p}{4\pi\epsilon_0\, r^3}\begin{bmatrix} 2\cos(\theta) \\ \sin(\theta) \\ 0 \end{bmatrix}, \tag{43}$$

for cartesian components or spherical coordinates (r, θ, ϕ), respectively.

The first step in solving the antisymmetry problem is finding out, which scalar spin connection ω_0 fulfills the condition

$$\boldsymbol{\nabla} \times \mathbf{E} = \mathbf{0} \tag{44}$$

which by the electric antisymmetry condition can be written:

$$\boldsymbol{\nabla} \times (\omega_0 \mathbf{A}) = \mathbf{0} \tag{45}$$

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or

$$\omega_0 \boldsymbol{\nabla} \times \mathbf{A} + \mathbf{A} \times \boldsymbol{\nabla} \omega_0 = \mathbf{0}. \tag{46}$$

In case of the constant vacuum spin connection (11),

$$\omega_0 = \frac{mc^2}{2\pi\hbar}, \tag{47}$$

this condition is fulfilled for the dipole field because of

$$\boldsymbol{\nabla} \times \mathbf{A} = -\frac{1}{\omega_0} \boldsymbol{\nabla} \times \mathbf{E} = \mathbf{0}. \tag{48}$$

If ω_0 is assumed to have the form as for a point charge,

$$\omega_0 = -\frac{c}{r}, \tag{49}$$

then Eq. (46) leads to the compatibility equation (in spherical coordinates):

$$\frac{p \sin(\theta)}{4\pi c\, \epsilon_0 r^3} = 0, \tag{50}$$

which cannot be fulfilled for any dipole moment $p \neq 0$. However using

$$\omega_0 = -\frac{c}{r} \cos(\theta) \tag{51}$$

fulfills condition (46). Therefore this is a valid scalar spin connection. The expression is similar to the scalar dipole potential

$$\phi = \frac{p \cos(\theta)}{4\pi\epsilon_0 r^2}, \tag{52}$$

giving evidence that a factor of $\cos(\theta)$ delivers the right symmetry of ω_0. In cartesian coordinates, this spin connection is

$$\omega_0 = -\frac{c\, Z}{r^2}, \tag{53}$$

i.e. it is an antisymmetric function in Z direction.

Having found two valid scalar spin connections, we compute the vector spin connection by solving Eqs. (14-16) simultaneously by computer algebra. We use cartesian coordinates. The results are presented in Table 1. Both spin connections give formally similar vector potentials, however with different symmetry in Z direction. The second vector potential is not irrotational but this is not required since condition (46) is fulfilled. Both spin connections produce a secondary magnetic field which is divergence-free as required. The last line of the table presents a kind of current density according to

$$\boldsymbol{\nabla} \times \mathbf{B} = \mu_0 \mathbf{J}. \tag{54}$$

All fields have been graphed in Figs. 1-10 as denoted in Table 1. The dipole field is strongest near to the origin, as can be seen from Fig. 1. The vectors have been rescaled to unit vectors in Fig. 2, giving a better impression on the field directions. The equipotential lines of the scalar potential are added as guideline for the eyes. The same was done for nearly all aller graphs.

The **A** fields (Figs. 3-4) are of different in angular characteristics for both scalar spin connections. The same holds for the vector spin connections $\boldsymbol{\omega}$ (Figs. 5-6). Both have a significant divergence on the X axis, which represents the XY plane since nearly all diagrams are cuts through the XZ plane. The secondary **B** fields are different in direction and radial extension. This can only be seen in the unscaled plot, therefore this representation was chosen for Figs. 7 and 8. The secondary current density is highly concentrated to the dipole region due to its rapid decrease as $1/r^7$ and $1/r^5$. To see the directional characteristics, we have chosen the unit vector representation again. Parity of **J** in Z direction is different for both scalar spin connections, as is the direction in the (weak) outer range.

$\omega_0 = \frac{mc^2}{2\pi\hbar}$	$\omega_0 = -\frac{c}{r}\cos(\theta)$
$\mathbf{E} = \frac{p}{4\pi\epsilon_0\, r^5} \begin{bmatrix} 3XZ \\ 3YZ \\ 2Z^2 - X^2 - Y^2 \end{bmatrix}$ (Fig. 1/2)	$\mathbf{E} = \frac{p}{4\pi\epsilon_0\, r^5} \begin{bmatrix} 3XZ \\ 3YZ \\ 2Z^2 - X^2 - Y^2 \end{bmatrix}$ (Fig. 1/2)
$\mathbf{A} = -\frac{p\hbar}{2mc^2\epsilon_0 r^5} \begin{bmatrix} 3XZ \\ 3YZ \\ 2Z^2 - X^2 - Y^2 \end{bmatrix}$ (Fig. 3)	$\mathbf{A} = -\frac{p}{4\pi c\epsilon_0\, r^3} \begin{bmatrix} 3X \\ -3Y \\ 2Z^2 - X^2 - Y^2 \end{bmatrix}$ (Fig. 4)
$\boldsymbol{\omega} = -\frac{1}{r^2} \begin{bmatrix} 5X \\ 5Y \\ \frac{14Z^2 - X^2 - Y^2}{3Z} \end{bmatrix}$ (Fig. 5)	$\boldsymbol{\omega} = -\frac{1}{r^2} \begin{bmatrix} 3X \\ 3Y \\ \frac{11Z^2 + 2X^2 + 2Y^2}{3Z} \end{bmatrix}$ (Fig. 6)
$\boldsymbol{\nabla} \times \mathbf{A} = \mathbf{0}$	$\boldsymbol{\nabla} \times \mathbf{A} = \frac{p}{4\pi c\epsilon_0\, Z\, r^3} \begin{bmatrix} Y \\ -X \\ 0 \end{bmatrix}$
$\boldsymbol{\nabla} \times \boldsymbol{\omega} = \mathbf{0}$	$\boldsymbol{\nabla} \times \boldsymbol{\omega} = \mathbf{0}$
$\mathbf{B} = -\boldsymbol{\omega} \times \mathbf{A} = \frac{2p\hbar}{mc^2\epsilon_0\, r^5} \begin{bmatrix} Y \\ -X \\ 0 \end{bmatrix}$ (Fig. 7)	$\mathbf{B} = \boldsymbol{\nabla} \times \mathbf{A} - \boldsymbol{\omega} \times \mathbf{A} = \frac{p}{2\pi c\epsilon_0\, Z\, r^3} \begin{bmatrix} -Y \\ X \\ 0 \end{bmatrix}$ (Fig. 8)
$\boldsymbol{\nabla} \cdot \mathbf{B} = 0$	$\boldsymbol{\nabla} \cdot \mathbf{B} = 0$
$\boldsymbol{\nabla} \times \mathbf{B} = -\frac{2p\hbar}{mc^2\epsilon_0\, r^7} \begin{bmatrix} 5XZ \\ 5YZ \\ 2Z^2 - 3X^2 - 3Y^2 \end{bmatrix}$ (Fig. 9)	$\boldsymbol{\nabla} \times \mathbf{B} = \frac{p}{\pi c\epsilon_0\, Z^2\, r^5} \begin{bmatrix} X(4Z^2 + X^2 + Y^2) \\ Y(4Z^2 + X^2 + Y^2 \\ Z(2Z^2 - X^2 - Y^2) \end{bmatrix}$ (Fig. 10)

Table 1: Field strength, vector potential and spin connections for a dipole field, computed for both scalar spin connections.

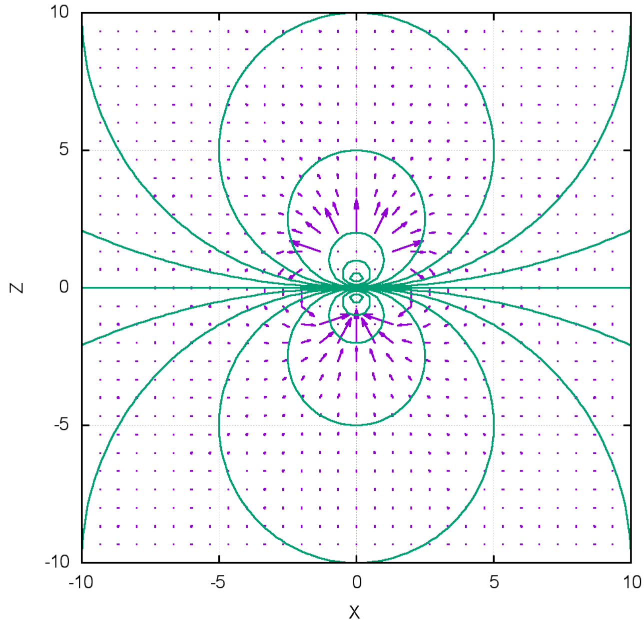

Figure 1: **E** dipole field, vectors not rescaled, and scalar potential.

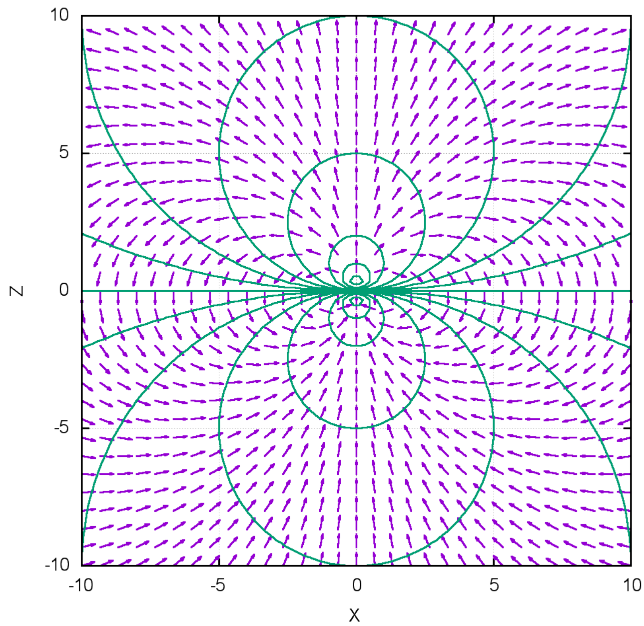

Figure 2: **E** dipole field, unit vectors, and scalar potential.

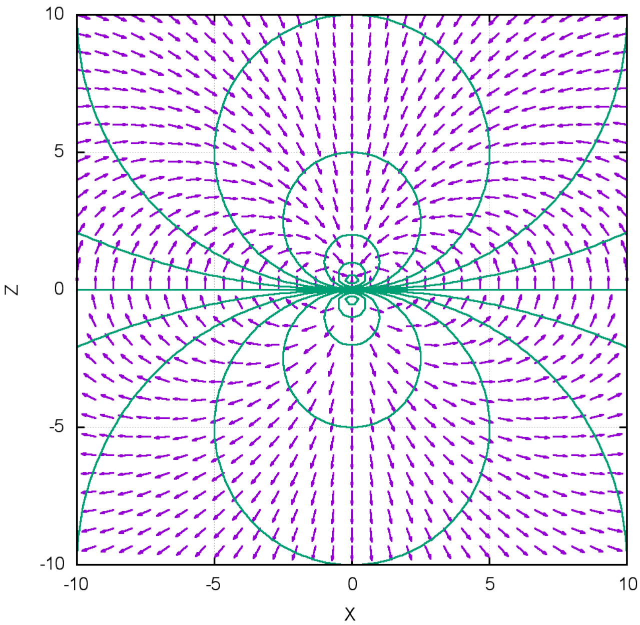

Figure 3: **A** field, unit vectors, first ω_0.

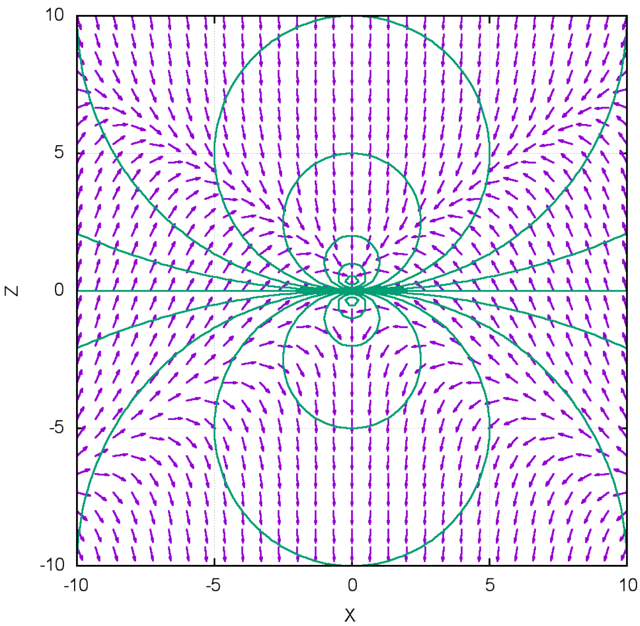

Figure 4: **A** field, unit vectors, second ω_0.

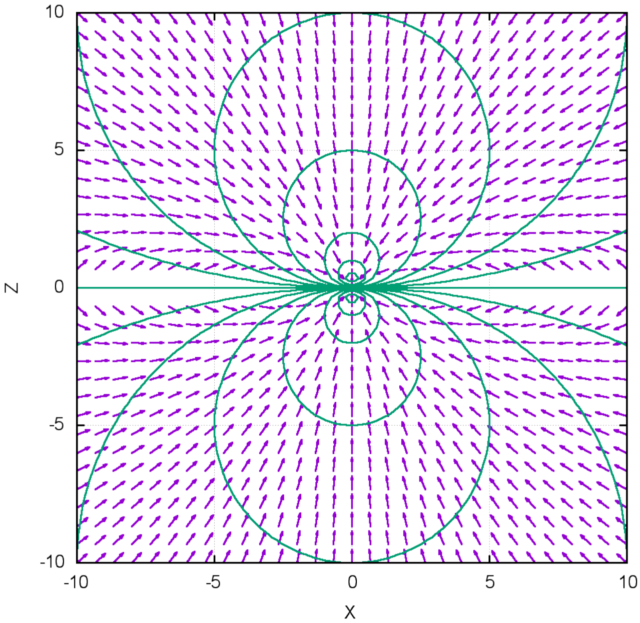

Figure 5: $\boldsymbol{\omega}$ field, unit vectors, first ω_0.

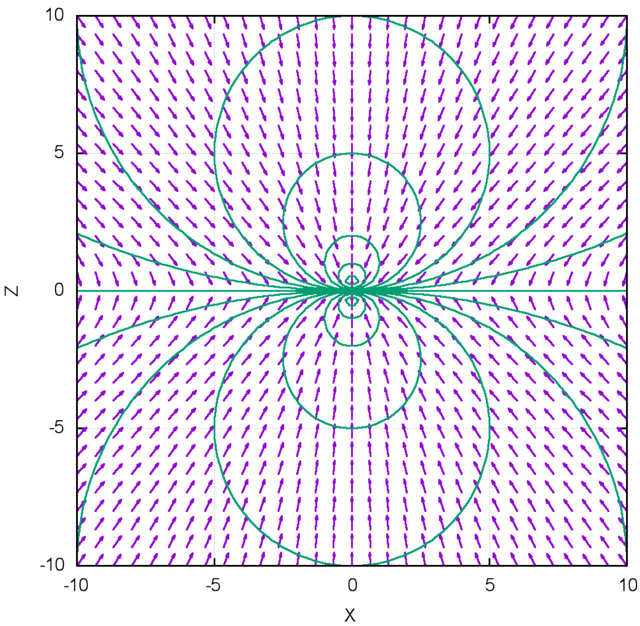

Figure 6: $\boldsymbol{\omega}$ field, unit vectors, second ω_0.

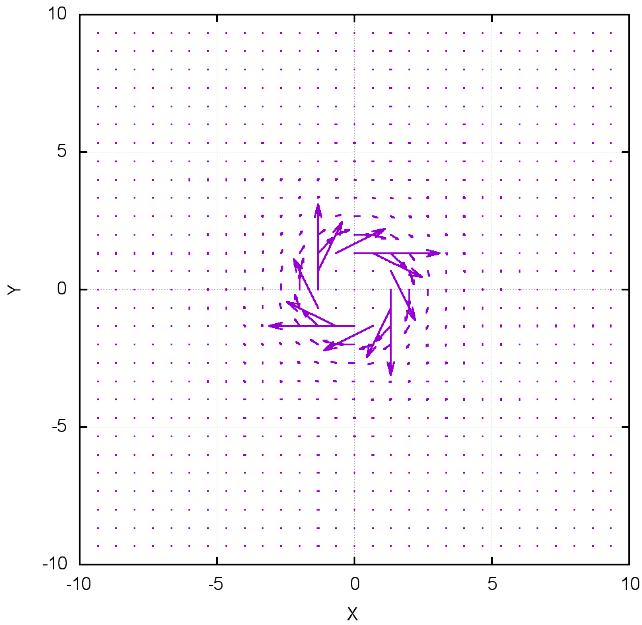

Figure 7: Secondary **B** field, vectors not rescaled, first ω_0.

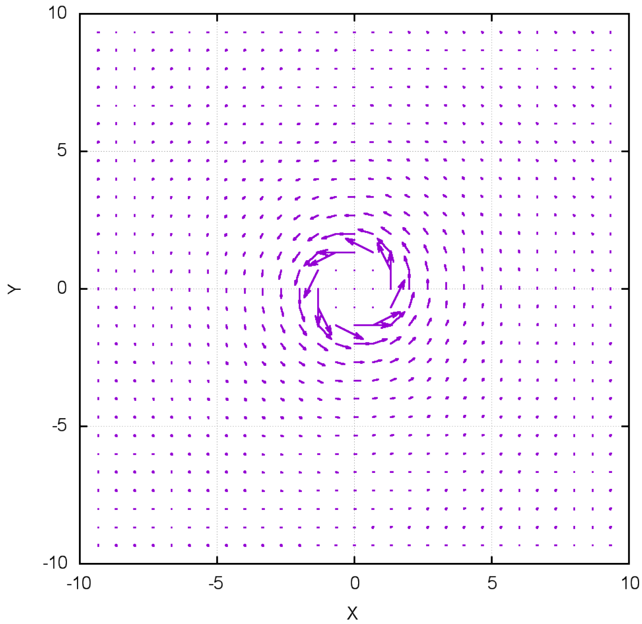

Figure 8: Secondary **B** field, vectors not rescaled, second ω_0.

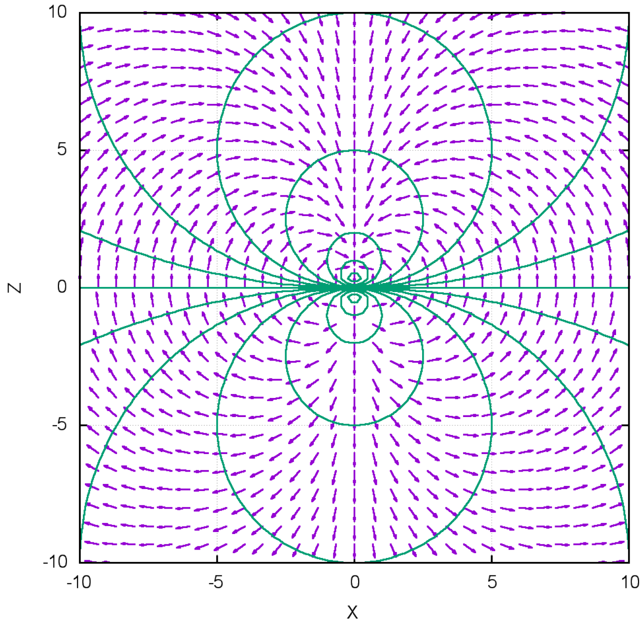

Figure 9: Secondary current density, unit vectors, first ω_0.

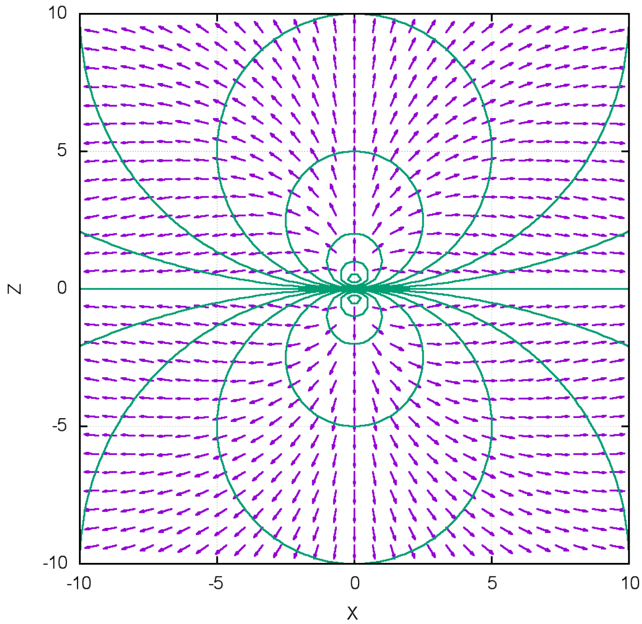

Figure 10: Secondary current density, unit vectors, second ω_0.

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