The Electro-Magnetic Field Equation and the Electro-Magnetic Field Transformation in Rindler spacetime

Sangwha-Yi

Department of Math , Taejon University 300-716

ABSTRACT

In the general relativity theory, we find the electro-magnetic field transformation and the electro-magnetic field equation (Maxwell equation) in Rindler spacetime. We find the electro-magnetic wave equation and the electro-magnetic wave function in Rindler space-time. Specially, this article say the uniqueness of the accelerated frame because the accelerated frame can treat electro-magnetic field equation.

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e-mail address:sangwha1**@nate.com**

Tel:051-624-3953

1. Introduction

In the general relativity theory, our article's aim is that we find the electro-magnetic field equation in Rindler space-time.

The expansion of Rindler coordinate[9] is

$$ct = \gamma(\frac{c^2}{a_0} + \xi^1)\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\} - \gamma\frac{v_0 c}{a_0},$$

$$x = \gamma(\frac{c^2}{a_0} + \xi^1)\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - \gamma\frac{c^2}{a_0} \quad ,$$

$$y = \xi^2, z = \xi^3 \quad \gamma = \frac{1}{\sqrt{1 - \frac{v_0^{\ 2}}{c^2}}} \quad (1)$$

In this time, the tetrad $e^a{}_\mu$ is

$$d\tau^2 = dt^2 - \frac{1}{c^2}[dx^2 + dy^2 + dz^2]$$

$$= -\frac{1}{c^2}\eta_{ab}\frac{\partial x^a}{\partial\xi^\mu}\frac{\partial x^b}{\partial\xi^\upsilon}d\xi^\mu d\xi^\upsilon$$

$$= -\frac{1}{c^2}\eta_{ab}e^a{}_\mu e^b{}_\upsilon d\xi^\mu d\xi^\upsilon = -\frac{1}{c^2}g_{\mu\upsilon}d\xi^\mu d\xi^\upsilon \ , \ e^a{}_\mu = \frac{\partial x^a}{\partial\xi^\mu} \quad (2)$$

$$e^\alpha{}_0(\xi^0) = \frac{\partial x^\alpha}{c\partial\xi^0}$$

$$= ((1 + \frac{a_0}{c^2}\xi^1)(\gamma\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\gamma\sinh(\frac{a_0}{c}\xi^0)),$$

$$(1 + \frac{a_0}{c^2}\xi^1)(\gamma\sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\gamma\cosh(\frac{a_0}{c}\xi^0))0,0), \gamma = \frac{1}{\sqrt{1 - \frac{v_0^{\ 2}}{c^2}}} \quad (3)$$

About y -axis's and z -axis's orientation

$$e^\alpha{}_2(\xi^0) = \frac{\partial x^\alpha}{\partial\xi^2} = (0,0,1,0) \quad , \quad e^\alpha{}_3(\xi^0) = \frac{\partial x^\alpha}{\partial\xi^3} = (0,0,0,1) \quad (4)$$

The other unit vector $e^\alpha{}_1(\xi^0)$ is

$$e^{\alpha}{}_{1}(\xi^0) = \frac{\partial x^\alpha}{\partial \xi^1} = (\gamma \sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\gamma\cosh(\frac{a_0}{c}\xi^0),$$

$$\gamma\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\gamma\sinh(\frac{a_0}{c}\xi^0), 0, 0), \gamma = \frac{1}{\sqrt{1-\frac{v_0{}^2}{c^2}}} \qquad (5)$$

(5)

Therefore,

$$cdt = \gamma[(1+\frac{a_0}{c^2}\xi^1)\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}cd\xi^0$$

$$+\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}d\xi^1]$$

$$dx = \gamma[(1+\frac{a_0}{c^2}\xi^1)\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}cd\xi^0$$

$$+\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}d\xi^1], \gamma = \frac{1}{\sqrt{1-\frac{v_0{}^2}{c^2}}}$$

$$, dy = d\xi^2, \ dz = d\xi^3 \qquad (6)$$

The vector transformation is

$$V'^\mu = \frac{\partial x'^\mu}{\partial x^\alpha} V^\alpha, \qquad U'_\mu = \frac{\partial x^\alpha}{\partial x'^\mu} U_\alpha \qquad (7)$$

Therefore, the transformation of the electro-magnetic 4-vector potential $(\phi, \vec{A}) = A^\alpha$ is

$$A^\alpha = \frac{\partial x^\alpha}{\partial x'^\mu} A'^\mu = \frac{\partial x^\alpha}{\partial \xi^\mu} A_\xi{}^\mu = e^\alpha{}_\mu A_\xi{}^\mu \ , \ e^\alpha{}_\mu = \frac{\partial x^\alpha}{\partial \xi^\mu}$$

$$dx^\alpha = \frac{\partial x^\alpha}{\partial x'^\mu} dx'^\mu = \frac{\partial x^\alpha}{\partial \xi^\mu} d\xi^\mu = e^\alpha{}_\mu d\xi^\mu \ , e^\alpha{}_\mu = \frac{\partial x^\alpha}{\partial \xi^\mu} \qquad (8)$$

Hence, the transformation of the electro-magnetic 4-vector potential $(\phi, \vec{A})$ in inertial frame and the eletro-magnetic 4-vector potential $(\phi_\xi, \vec{A}_\xi)$ in uniformly accelerated frame is

$$(\frac{1}{c^2}\frac{\partial^2}{\partial t^2}-\nabla^2)\phi = 4\pi\rho$$

$$(\frac{1}{c^2}\frac{\partial^2}{\partial t^2}-\nabla^2)\vec{A} = \frac{4\pi}{c}\vec{j}$$

4-vector $(c\rho, \vec{j}) = \rho_0 \frac{dx^\alpha}{d\tau}$

$$\phi = \gamma[(1+\frac{a_0}{c^2}\xi^1)\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\phi_\xi + \{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$A_x = \gamma[(1+\frac{a_0}{c^2}\xi^1)\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\phi_{\xi^1} + \{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}A_{\xi^1}], \gamma = \frac{1}{\sqrt{1-\frac{{v_0}^2}{c^2}}}$$

$$A_y = A_{\xi^2}, A_z = A_{\xi^3} \tag{9}$$

$$g = \begin{pmatrix} -(1+\frac{a_0\xi^1}{c^2})^2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}, \eta = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$e^a{}_\mu e_b{}^\mu = \delta^a{}_b \ , \ e^a{}_\mu e_a{}^\upsilon = \delta_\mu{}^\upsilon$$

$$e^a{}_\mu e^b{}_\upsilon \eta_{ab} = g_{\mu\upsilon} \ \rightarrow \ A^T\eta A = g$$

$$e_a{}^\mu e_b{}^\upsilon g_{\mu\upsilon} = \eta_{ab} \rightarrow \ (A^T)^{-1}gA^{-1} = (A^T)^{-1}A^T\eta AA^{-1} = \eta$$

$$e^a{}_\mu = \eta^{ab}g_{\mu\upsilon}e_b{}^\upsilon \rightarrow \eta^{-1}(A^T)^{-1}A^T\eta A = A = \eta^{-1}(A^T)^{-1}g \tag{10}$$

$$\begin{pmatrix} cdt \\ dx \\ dy \\ dz \end{pmatrix}$$

$$=\begin{pmatrix} \gamma(1+\frac{a_0\xi^1}{c^2})\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} & \gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\} & 0 & 0 \\ \gamma(1+\frac{a_0\xi^1}{c^2})\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\} & \gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} cd\xi^0 \\ d\xi^1 \\ d\xi^2 \\ dz^3 \end{pmatrix}$$

$$= A\begin{pmatrix} cd\xi^0 \\ d\xi^1 \\ d\xi^2 \\ dz^3 \end{pmatrix} \qquad (11)$$

$$e_\mu{}^\alpha = \frac{\partial\xi^\alpha}{\partial x^\mu} = A^{-1} = \begin{pmatrix} \frac{c\partial\xi^0}{c\partial t} & \frac{c\partial\xi^0}{\partial x} & \frac{c\partial\xi^0}{\partial y} & \frac{c\partial\xi^0}{\partial z} \\ \frac{\partial\xi^1}{c\partial t} & \frac{\partial\xi^1}{\partial x} & \frac{\partial\xi^1}{\partial y} & \frac{\partial\xi^1}{\partial z} \\ \frac{\partial\xi^2}{c\partial t} & \frac{\partial\xi^2}{\partial x} & \frac{\partial\xi^2}{\partial y} & \frac{\partial\xi^2}{\partial z} \\ \frac{\partial\xi^3}{c\partial t} & \frac{\partial\xi^3}{\partial x} & \frac{\partial\xi^3}{\partial y} & \frac{\partial\xi^3}{\partial z} \end{pmatrix}$$

$$=\begin{pmatrix} \frac{\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c}\}}{(1+\frac{a_0\xi^1}{c^2})} & -\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})}{(1+\frac{a_0\xi^1}{c^2})} & 0 & 0 \\ -\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\} & \gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

(12)

$$\begin{pmatrix} \frac{1}{c}\frac{\partial}{\partial t} \\ \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \\ \frac{\partial}{\partial z} \end{pmatrix} = (A^{-1})^T \begin{pmatrix} \frac{1}{c}\frac{\partial}{\partial \xi^0} \\ \frac{\partial}{\partial \xi^1} \\ \frac{\partial}{\partial \xi^2} \\ \frac{\partial}{\partial \xi^3} \end{pmatrix} = (A^T)^{-1} \begin{pmatrix} \frac{1}{c}\frac{\partial}{\partial \xi^0} \\ \frac{\partial}{\partial \xi^1} \\ \frac{\partial}{\partial \xi^2} \\ \frac{\partial}{\partial \xi^3} \end{pmatrix}$$

$$= \begin{pmatrix} \dfrac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})} & -\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\} & 0 & 0 \\ -\dfrac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})]}{(1+\frac{a_0\xi^1}{c^2})} & \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} \frac{1}{c}\frac{\partial}{\partial \xi^0} \\ \frac{\partial}{\partial \xi^1} \\ \frac{\partial}{\partial \xi^2} \\ \frac{\partial}{\partial \xi^3} \end{pmatrix} \qquad (13)$$

$$\frac{1}{c}\frac{\partial}{\partial t} = \frac{c\partial\xi^0}{c\partial t}\frac{1}{c}\frac{\partial}{\partial \xi^0} + \frac{\partial \xi^1}{c\partial t}\frac{\partial}{\partial \xi^1}$$

$$= \frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c}\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}$$

$$\frac{\partial}{\partial x} = \frac{c\partial\xi^0}{\partial x}\frac{1}{c}\frac{\partial}{\partial \xi^0} + \frac{\partial \xi^1}{\partial x}\frac{\partial}{\partial \xi^1}$$

$$= -\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}$$

$$\frac{\partial}{\partial y} = \frac{\partial}{\partial\xi^2}, \frac{\partial}{\partial z} = \frac{\partial}{\partial\xi^3}$$

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \nabla^2 = \frac{1}{c^2(1+\frac{a_0}{c^2}\xi^1)^2}(\frac{\partial}{\partial\xi^0})^2 - \nabla_\xi{}^2$$

$$\vec{\nabla} = (\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}), \quad \vec{\nabla}_\xi = (\frac{\partial}{\partial\xi^1}, \frac{\partial}{\partial\xi^2}, \frac{\partial}{\partial\xi^3}) \tag{14}$$

2. Electro-magnetic Field in the Rindler space-time

The electro-magnetic field $(\vec{E},\vec{B})$ is in the inertial frame,

$$\vec{E} = -\vec{\nabla}\phi - \frac{\partial\vec{A}}{c\partial t}, \vec{B} = \vec{\nabla}\times\vec{A} \tag{15}$$

$$E_x = -\frac{\partial\phi}{\partial x} - \frac{\partial A_x}{c\partial t}$$

$$= -[-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]\cdot$$

$$\cdot[\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0\xi^1}{c^2})\phi_\xi + \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$-[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]\cdot$$

$$\cdot[\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0\xi^1}{c^2})\phi_\xi + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$= -\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{\partial\xi^1}[(1+\frac{a_0}{c^2}\xi^1)^2\phi_\xi] - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^1}}{c\partial\xi^0} \tag{16}$$

$$E_y = -\frac{\partial\phi}{\partial y} - \frac{\partial A_y}{c\partial t}$$

$$= -\frac{\partial}{\partial \xi^2}[\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0}{c^2}\xi^1)\phi_\xi + \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$-[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]A_{\xi^2}$$

$$= -(1+\frac{a_0\xi^1}{c^2})\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial \phi_\xi}{\partial \xi^2}$$

$$-\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial A_{\xi^2}}{c\partial \xi^0}$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\cosh(\frac{a_0}{c}\xi^0)\}[\frac{\partial A_{\xi^2}}{\partial \xi^1} - \frac{\partial A_{\xi^1}}{\partial \xi^2}]$$

$$= \gamma\{\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial \xi^2}[\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2] - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^2}}{c\partial \xi^0}]$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial A_{\xi^2}}{\partial \xi^1} - \frac{\partial A_{\xi^1}}{\partial \xi^2}]$$

(17)

$$E_z = -\frac{\partial \phi}{\partial z} - \frac{\partial A_z}{c\partial t}$$

$$= -\frac{\partial}{\partial \xi^3}[\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0}{c^2}\xi^1)\phi_\xi + \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$-[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]A_{\xi^3}$$

$$= -(1+\frac{a_0\xi^1}{c^2})\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial \phi_\xi}{\partial \xi^3}$$

$$-\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial A_{\xi^3}}{c\partial\xi^0}$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0)+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial A_{\xi^3}}{\partial\xi^1}-\frac{\partial A_{\xi^1}}{\partial\xi^3}]$$

$$=\gamma\{\cosh(\frac{a_0}{c}\xi^0)+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^3}[\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2]-\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^3}}{c\partial\xi^0}]$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0)+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial A_{\xi^3}}{\partial\xi^1}-\frac{\partial A_{\xi^1}}{\partial\xi^3}]$$

(18)

$$B_x=\frac{\partial A_z}{\partial y}-\frac{\partial A_y}{\partial z}=\frac{\partial A_{\xi^3}}{\partial\xi^2}-\frac{\partial A_{\xi^2}}{\partial\xi^3} \quad (19)$$

$$B_y=\frac{\partial A_x}{\partial z}-\frac{\partial A_z}{\partial x}=\frac{\partial A_x}{\partial\xi^3}-\frac{\partial A_{\xi^3}}{\partial x}$$

$$=-\frac{\partial}{\partial\xi^3}[\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0}{c^2}\xi^1)\phi_\xi+\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$-[-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0}+\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]A_{\xi^3}$$

$$=\gamma\{\cosh(\frac{a_0}{c}\xi^0)+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[\frac{\partial A_{\xi^1}}{\partial\xi^3}-\frac{\partial A_{\xi^3}}{\partial\xi^1}]$$

$$-\gamma\{\sinh(\frac{a_0}{c}\xi^0)+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^3}[\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2]-\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^3}}{c\partial\xi^0}]$$

(20)

$$B_z = \frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = \frac{\partial A_{\xi^2}}{\partial x} - \frac{\partial A_x}{\partial \xi^2}$$

$$= [-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]A_{\xi^3}$$

$$-\frac{\partial}{\partial\xi^2}[\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}(1+\frac{a_0}{c^2}\xi^1)\phi_\xi + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}A_{\xi^1}]$$

$$= \gamma\{\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[\frac{\partial A_{\xi^2}}{\partial\xi^1} - \frac{\partial A_{\xi^1}}{\partial\xi^2}]$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^2}[\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2] - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^2}}{c\partial\xi^0}]$$

(21)

Hence, we can define the electro-magnetic field $(\vec{E}_\xi, \vec{B}_\xi)$ in Rindler spacetime.

$$\vec{E}_\xi = -\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\vec{\nabla}_\xi\{\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2\} - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial\vec{A}_\xi}{c\partial\xi^0}$$

$$\vec{B}_\xi = \vec{\nabla}_\xi \times \vec{A}_\xi$$

In this time, $\vec{\nabla}_\xi = (\frac{\partial}{\partial\xi^1}, \frac{\partial}{\partial\xi^2}, \frac{\partial}{\partial\xi^3}), \vec{A}_\xi = (A_{\xi^1}, A_{\xi^2}, A_{\xi^3})$ (22)

We obtain the transformation of the electro-magnetic field.

$$E_x = -\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{\partial\xi^1}\{\phi_\xi(1+\frac{a_0\xi^1}{c^2})^2\} - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial A_{\xi^1}}{c\partial\xi^0} = E_{\xi^1} ,$$

$$E_y = E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},$$

$$E_z = E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_x = B_{\xi^1},$$

$$B_y = B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_z = B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

(23)

Hence,

$$E_x = E_{\xi^1}, B_x = B_{\xi^1},$$

$$\begin{pmatrix} E_y \\ B_y \\ E_z \\ B_z \end{pmatrix} = H \begin{pmatrix} E_{\xi^2} \\ B_{\xi^2} \\ E_{\xi^3} \\ B_{\xi^3} \end{pmatrix}$$

$$H = \begin{pmatrix} \alpha & 0 & 0 & \beta \\ 0 & \alpha & -\beta & 0 \\ 0 & -\beta & \alpha & 0 \\ \beta & 0 & 0 & \alpha \end{pmatrix}$$

$$\alpha = \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}, \beta = \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

(24)

The inverse-transformation of the electro-magnetic field is

$$E_{\xi^1} = E_x, B_{\xi^1} = B_x$$

$$\begin{pmatrix} E_{\xi^2} \\ B_{\xi^2} \\ E_{\xi^3} \\ B_{\xi^3} \end{pmatrix} = H^{-1} \begin{pmatrix} E_y \\ B_y \\ E_z \\ B_z \end{pmatrix}$$

$$H^{-1}=\begin{pmatrix}\alpha & 0 & 0 & -\beta\\ 0 & \alpha & \beta & 0\\ 0 & \beta & \alpha & 0\\ -\beta & 0 & 0 & \alpha\end{pmatrix}$$

$$\alpha=\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\},\ \beta=\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

(25)

$$E_{\xi^1}=E_x,B_{\xi^1}=B_x$$

$$E_{\xi^2}=E_y\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}-B_z\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},$$

$$B_{\xi^2}=B_y\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+E_z\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$E_{\xi^3}=E_z\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+B_y\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_{\xi^3}=B_z\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})-E_y\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

(26)

3. Electro-magnetic Field Equation(Maxwell Equation) in the Rindler space-time

Maxwell equation is

$$\vec{\nabla}\cdot\vec{E}=4\pi\rho \tag{27-i}$$

$$\vec{\nabla}\times\vec{B}=\frac{\partial\vec{E}}{c\partial t}+\frac{4\pi}{c}\vec{j} \tag{27-ii}$$

$$\vec{\nabla}\cdot\vec{B}=0 \tag{27-iii}$$

$$\vec{\nabla}\times\vec{E}=-\frac{\partial\vec{B}}{c\partial t} \tag{27-iv}$$

1. $\vec{\nabla}\cdot\vec{E}=4\pi\rho$

$E_x=E_{\xi^1}$,

$$E_y=E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})+B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},$$

$$E_z = E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$4\pi\rho = \frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z}$$

$$= [-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]E_{\xi^1}$$

$$+\frac{\partial}{\partial\xi^2}[E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$+\frac{\partial}{\partial\xi^3}[E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})]$$

$$= \gamma\{\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}(\vec{\nabla}_\xi \cdot \vec{E}_\xi)$$

$$+\gamma\{\sinh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial B_{\xi^3}}{\partial\xi^2} - \frac{\partial B_{\xi^2}}{\partial\xi^3} - \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial E_{\xi^1}}{c\partial\xi^0}] \quad (28)$$

2. $\vec{\nabla}\times\vec{B} = \frac{\partial\vec{E}}{c\partial t} + \frac{4\pi}{c}\vec{j}$

$$B_x = B_{\xi^1}$$

$$B_y = B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_z = B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

X-component) $\frac{\partial B_z}{\partial y} - \frac{\partial B_y}{\partial z}$

$$= \frac{\partial}{\partial\xi^2}[B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c}) + E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$-\frac{\partial}{\partial\xi^3}[B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$= \gamma\{\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[\frac{\partial B_{\xi^3}}{\partial \xi^2} - \frac{\partial B_{\xi^2}}{\partial \xi^3}]$$

$$+ \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial E_{\xi^2}}{\partial \xi^2} + \frac{\partial E_{\xi^3}}{\partial \xi^3}]$$

$$= \frac{\partial E_x}{c\partial t} + \frac{4\pi}{c} j_x$$

$$= [\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1 + \frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]E_{\xi^1} + \frac{4\pi}{c} j_x$$

Hence,

$$\frac{4\pi}{c} j_x$$

$$= \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}(\vec{\nabla}_\xi \cdot \vec{E}_\xi)$$

$$+ \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[\frac{\partial B_{\xi^3}}{\partial \xi^2} - \frac{\partial B_{\xi^2}}{\partial \xi^3} - \frac{1}{(1 + \frac{a_0\xi^1}{c^2})}\frac{\partial E_{\xi^1}}{c\partial \xi^0}] \quad (29)$$

Y-component) $\frac{\partial B_x}{\partial z} - \frac{\partial B_z}{\partial x}$

$$= \frac{\partial B_{\xi^1}}{\partial \xi^3}$$

$$- [-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1 + \frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]$$

$$\cdot [B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$= \frac{\partial E_y}{c\partial t} + \frac{4\pi}{c} j_y$$

$$= [\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot[E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$+\frac{4\pi}{c}j_y$$

$$\frac{4\pi}{c}j_y = \frac{\partial B_{\xi^1}}{\partial\xi^3} - \frac{\partial B_{\xi^3}}{\partial\xi^1} - \frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{a_0}{c^2}B_{\xi^3} - \frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial E_{\xi^2}}{c\partial\xi^0}$$

$$= \frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^3}\{B_{\xi^1}(1+\frac{a_0}{c^2}\xi^1)\} - \frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^1}\{B_{\xi^3}(1+\frac{a_0\xi^1}{c^2})\} - \frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial E_{\xi^2}}{c\partial\xi^0}$$

(30)

Z-component) $\frac{\partial B_y}{\partial x} - \frac{\partial B_x}{\partial y}$

$$= [-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot[B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$-\frac{\partial B_{\xi^1}}{\partial\xi^2}$$

$$= \frac{\partial E_z}{c\partial t} + \frac{4\pi}{c}j_z$$

$$= [\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot[E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$+\frac{4\pi}{c}j_z$$

$$\frac{4\pi}{c}j_z=\frac{\partial B_{\xi^2}}{\partial\xi^1}-\frac{\partial B_{\xi^1}}{\partial\xi^2}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{a_0}{c^2}B_{\xi^2}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial E_{\xi^3}}{c\partial\xi^0}$$

$$=\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^1}\{B_{\xi^2}(1+\frac{a_0}{c^2}\xi^1)\}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^2}\{B_{\xi^1}(1+\frac{a_0\xi^1}{c^2})\}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial E_{\xi^3}}{c\partial\xi^0}$$

(31)

3. $\vec{\nabla}\cdot\vec{B}=0$

$$\vec{\nabla}\cdot\vec{B}=\frac{\partial B_x}{\partial x}+\frac{\partial B_y}{\partial y}+\frac{\partial B_z}{\partial z}$$

$$=[-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0}+\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]B_{\xi^1}$$

$$+\frac{\partial}{\partial\xi^2}[B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}-E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$+\frac{\partial}{\partial\xi^3}[B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$=\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}(\vec{\nabla}_\xi\cdot\vec{B}_\xi)$$

$$+\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[-(-\frac{\partial E_{\xi^2}}{\partial\xi^3}+\frac{\partial E_{\xi^3}}{\partial\xi^2})-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial B_{\xi^1}}{c\partial\xi^0}]=0$$

(32)

4. $\vec{\nabla}\times\vec{E}=-\frac{\partial\vec{B}}{c\partial t}$

$E_x=E_{\xi^1}$,

$$E_y=E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},$$

$$E_z=E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}-B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

X-component) $\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z}$

$$= -\frac{\partial}{\partial \xi^2}[E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$-\frac{\partial}{\partial \xi^3}[E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$= \gamma\{\cosh(\frac{a_0}{c}\xi^0) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[\frac{\partial E_{\xi^3}}{\partial \xi^2} - \frac{\partial E_{\xi^2}}{\partial \xi^3}]$$

$$-\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}[\frac{\partial B_{\xi^2}}{\partial \xi^2} + \frac{\partial B_{\xi^3}}{\partial \xi^3}]$$

$$= -\frac{\partial B_x}{c\partial t}$$

$$= -[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} - \gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]B_{\xi^1}$$

Hence,

$$-\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}(\vec{\nabla}_\xi \cdot \vec{B}_\xi)$$
$$+\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}[(\frac{\partial E_{\xi^3}}{\partial \xi^2} - \frac{\partial E_{\xi^2}}{\partial \xi^3}) + \frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial B_{\xi^1}}{c\partial \xi^0}] = 0 \quad (33)$$

Y-component) $\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x}$

$$= \frac{\partial E_{\xi^1}}{\partial \xi^3}$$

$$-[-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial \xi^0} + \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial \xi^1}]$$

$$\cdot[E_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}-B_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$=-\frac{\partial B_y}{c\partial t}$$

$$=-[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0}-\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot[B_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}-E_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})]$$

$$\frac{\partial E_{\xi^1}}{\partial\xi^3}-\frac{\partial E_{\xi^3}}{\partial\xi^1}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{a_0}{c^2}E_{\xi^3}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial B_{\xi^2}}{c\partial\xi^0}$$

$$=\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^3}\{E_{\xi^1}(1+\frac{a_0}{c^2}\xi^1)\}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial\xi^1}\{E_{\xi^3}(1+\frac{a_0\xi^1}{c^2})\}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial B_{\xi^2}}{c\partial\xi^0}$$

$$=0 \qquad (34)$$

Z-component) $\frac{\partial E_y}{\partial x}-\frac{\partial E_x}{\partial y}$

$$=[-\frac{\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0}+\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot[E_{\xi^2}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+B_{\xi^3}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$-\frac{\partial E_{\xi^1}}{\partial\xi^2}$$

$$=-\frac{\partial B_z}{c\partial t}$$

$$=-[\frac{\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial}{c\partial\xi^0}-\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}\frac{\partial}{\partial\xi^1}]$$

$$\cdot [B_{\xi^3}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}+E_{\xi^2}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}]$$

$$\frac{\partial E_{\xi^2}}{\partial \xi^1}-\frac{\partial E_{\xi^1}}{\partial \xi^2}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{a_0}{c^2}E_{\xi^2}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial B_{\xi^3}}{c\partial \xi^0}$$

$$=\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial \xi^1}\{E_{\xi^2}(1+\frac{a_0}{c^2}\xi^1)\}-\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial}{\partial \xi^2}\{E_{\xi^1}(1+\frac{a_0\xi^1}{c^2})\}+\frac{1}{(1+\frac{a_0}{c^2}\xi^1)}\frac{\partial B_{\xi^3}}{c\partial \xi^0}$$

$$=0 \tag{35}$$

Therefore, we obtain the electro-magnetic field equation by Eq (28)-Eq(35) in Rindler spacetime .

$$\vec{\nabla}_\xi\cdot\vec{E}_\xi=4\pi\rho_\xi(1+\frac{a_0\xi^1}{c^2}) \tag{36-i}$$

$$\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\vec{\nabla}_\xi\times\{\vec{B}_\xi(1+\frac{a_0\xi^1}{c^2})\}=\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial\vec{E}_\xi}{c\partial\xi^0}+\frac{4\pi}{c}\vec{j}_\xi \tag{36-ii}$$

$$\vec{\nabla}_\xi\cdot\vec{B}_\xi=0 \tag{36-iii}$$

$$\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\vec{\nabla}_\xi\times\{\vec{E}_\xi(1+\frac{a_0\xi^1}{c^2})\}=-\frac{1}{(1+\frac{a_0\xi^1}{c^2})}\frac{\partial\vec{B}_\xi}{c\partial\xi^0} \tag{36-iv}$$

$$\vec{E}_\xi=(E_{\xi^1},E_{\xi^2},E_{\xi^3}),\vec{B}_\xi=(B_{\xi^1},B_{\xi^2},B_{\xi^3}),\vec{\nabla}_\xi=(\frac{\partial}{\partial\xi^1},\frac{\partial}{\partial\xi^2},\frac{\partial}{\partial\xi^3})$$

Hence, the transformation of 4-vector $(c\rho,\vec{j})=\rho_0\frac{dx^\alpha}{d\tau}$ is

$$\rho=\rho_\xi(1+\frac{a_0\xi^1}{c^2})\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$+\frac{j_{\xi^1}}{c}\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$j_x=j_{\xi^1}\gamma\{\cosh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$+c\rho_\xi(1+\frac{a_0}{c^2}\xi^1)\gamma\{\sinh(\frac{a_0\xi^0}{c})+\frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},\quad j_y=j_{\xi^2},j_z=j_{\xi^3}$$

In this time, 4-vector $(c\rho_{\xi}, \vec{j}_{\xi}) = \rho_0 \dfrac{d\xi^{\alpha}}{d\tau}$ (37)

4. Electro-magnetic wave equation in Rindler space-time

The electro-magnetic wave function is

$$E_{\xi^1} = E_x = E_{x0} \sin\Phi,$$

$$B_{\xi^1} = B_x = B_{x0} \sin\Phi$$

$$E_{\xi^2} = E_y \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - B_z\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\},$$

$$= E_{y0}\sin\Phi\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$- B_{z0}\sin\Phi\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_{\xi^2} = B_y \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + E_z\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$= B_{y0}\sin\Phi\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$+ E_{z0}\sin\Phi\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$E_{\xi^3} = E_z \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} + B_y\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$= E_{z0}\sin\Phi\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$+ B_{y0}\sin\Phi\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$B_{\xi^3} = B_z \gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\} - E_y\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

$$= B_{z0}\sin\Phi\gamma\{\cosh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\sinh(\frac{a_0\xi^0}{c})\}$$

$$- E_{y0}\sin\Phi\gamma\{\sinh(\frac{a_0\xi^0}{c}) + \frac{v_0}{c}\cosh(\frac{a_0\xi^0}{c})\}$$

In this time, $\Phi = \omega(t - l\dfrac{x}{c} - m\dfrac{y}{c} - n\dfrac{z}{c}),\ l^2 + m^2 + n^2 = 1$ (38)

The electro-magnetic wave equation is in vacuum

$$\vec{\nabla}_\xi \times (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi \times \{\vec{E}_\xi(1+\frac{a_0}{c^2}\xi^1)\}$$

$$= \vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{\nabla}_\xi \times \{\vec{E}_\xi(1+\frac{a_0}{c^2}\xi^1)\} + (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi \times \vec{\nabla}_\xi \times \{\vec{E}_\xi(1+\frac{a_0}{c^2}\xi^1)\}$$

$$= \vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{E}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{\nabla}_\xi \times \vec{E}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi \times \vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{E}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)^2\vec{\nabla}_\xi \times \vec{\nabla}_\xi \times \vec{E}_\xi$$

$$= \vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\times\vec{E}_\xi + (1+\frac{a_0}{c^2}\xi^1)^2\vec{\nabla}_\xi \times \vec{\nabla}_\xi \times \vec{E}_\xi$$

$$= [\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\cdot\vec{E}_\xi]\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1) - [\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\cdot\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)]\vec{E}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)^2[\vec{\nabla}_\xi(\vec{\nabla}_\xi\cdot\vec{E}_\xi) - \nabla_\xi{}^2\vec{E}_\xi]$$

$$= -\frac{1}{c}\frac{\partial}{\partial\xi^0}[\vec{\nabla}_\xi \times \{\vec{B}_\xi(1+\frac{a_0\xi^1}{c^2})\}] = -\frac{1}{c^2}(\frac{\partial}{\partial\xi^0})^2\vec{E}_\xi\,,$$

In this time, $\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1) = (\frac{a_0}{c^2},0,0)$ (39)

Hence,

$$\vec{\nabla}_\xi \times (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi \times \{\vec{E}_\xi(1+\frac{a_0}{c^2}\xi^1)\} + \frac{1}{c^2}(\frac{\partial}{\partial\xi^0})^2\vec{E}_\xi$$

$$= [\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\cdot\vec{E}_\xi]\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1) - [\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)\cdot\vec{\nabla}_\xi(1+\frac{a_0}{c^2}\xi^1)]\vec{E}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)^2[\vec{\nabla}_\xi(\vec{\nabla}_\xi\cdot\vec{E}_\xi) - \nabla_\xi{}^2\vec{E}_\xi] + \frac{1}{c^2}(\frac{\partial}{\partial\xi^0})^2\vec{E}_\xi$$

$$= \frac{a_0{}^2}{c^4}(E_{\xi^1},0,0) - \frac{a_0{}^2}{c^4}(E_{\xi^1},E_{\xi^2},E_{\xi^3}) + (1+\frac{a_0}{c^2}\xi^1)^2[\frac{1}{c^2}\frac{1}{(1+\frac{a_0}{c^2}\xi^1)^2}(\frac{\partial}{\partial\xi^0})^2 - \nabla_\xi{}^2]\vec{E}_\xi$$

$$= \frac{a_0{}^2}{c^4}(0,-E_{\xi^2},-E_{\xi^3}) + (1+\frac{a_0}{c^2}\xi^1)^2[\frac{1}{c^2}\frac{1}{(1+\frac{a_0}{c^2}\xi^1)^2}(\frac{\partial}{\partial\xi^0})^2 - \nabla_\xi{}^2]\vec{E}_\xi$$

$$= \vec{0} \tag{40}$$

Hence, the magnetic wave equation is in vacuum

$$\vec{\nabla}_\xi \times (1+\frac{a_0}{c^2}\xi^1)\vec{\nabla}_\xi \times \{\vec{B}_\xi (1+\frac{a_0}{c^2}\xi^1)\} + \frac{1}{c^2}(\frac{\partial}{\partial \xi^0})^2 \vec{B}_\xi$$

$$= [\vec{\nabla}_\xi (1+\frac{a_0}{c^2}\xi^1)\cdot \vec{B}_\xi]\vec{\nabla}_\xi (1+\frac{a_0}{c^2}\xi^1) - [\vec{\nabla}_\xi (1+\frac{a_0}{c^2}\xi^1)\cdot \vec{\nabla}_\xi (1+\frac{a_0}{c^2}\xi^1)]\vec{B}_\xi$$

$$+ (1+\frac{a_0}{c^2}\xi^1)^2 [\vec{\nabla}_\xi (\vec{\nabla}_\xi \cdot \vec{B}_\xi) - \nabla_\xi{}^2 \vec{B}_\xi] + \frac{1}{c^2}(\frac{\partial}{\partial \xi^0})^2 \vec{B}_\xi$$

$$= \frac{a_0{}^2}{c^4}(0, -B_{\xi^2}, -B_{\xi^3}) + (1+\frac{a_0}{c^2}\xi^1)^2 [\frac{1}{c^2}\frac{1}{(1+\frac{a_0}{c^2}\xi^1)^2}(\frac{\partial}{\partial \xi^0})^2 - \nabla_\xi{}^2]\vec{B}_\xi$$

$$= \vec{0} \tag{41}$$

The electromagnetic wave function, Eq(39) satisfy the electromagnetic wave equation,Eq(40),Eq(41)

5. Conclusion

We find the electro-magnetic field transformation and the electro-magnetic equation in uniformly accelerated frame.

Generally, the coordinate transformation of accelerated frame is

(I) $ct = (\frac{c^2}{a_0} + \xi^1)\sinh(\frac{a_0 \xi^0}{c})$

$$x = (\frac{c^2}{a_0} + \xi^1)\cosh(\frac{a_0 \xi^0}{c}) - \frac{c^2}{a_0} \quad , y = \xi^2, z = \xi^3 \tag{42}$$

(II) $ct = \frac{c^2}{a_0}\exp(\frac{a_0}{c^2}\xi^1)\sinh(\frac{a_0 \xi^0}{c})$

$$x = \frac{c^2}{a_0}\exp(\frac{a_0}{c^2}\xi^1)\cosh(\frac{a_0 \xi^0}{c}) - \frac{c^2}{a_0}, y = \xi^2, z = \xi^3 \tag{43}$$

Hence, this article say the accelerated frame is Rindler coordinate (I) that can treat electro-magnetic field equation.

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