Излучение от равноускоренного источника

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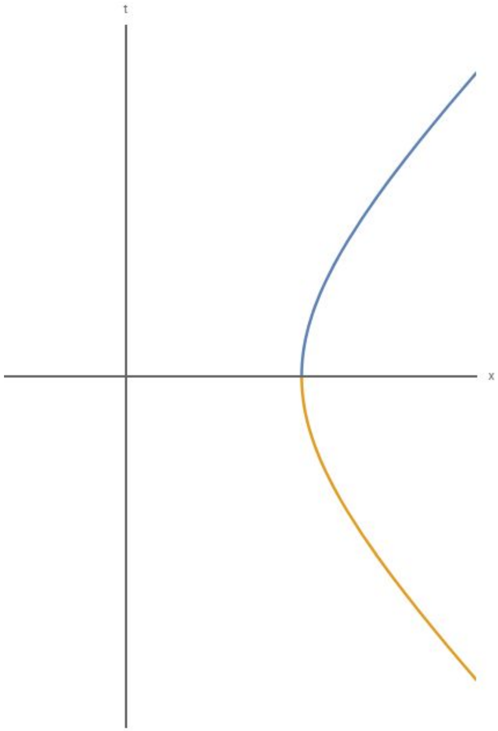
Системы отсчета



Лабораторная СО:

$$s^2 = dt^2 - dx^2 - dy^2 - dz^2$$

Сопутствующая СО:

$$s^2 = \rho^2 d\tau^2 - d\rho^2 - dy^2 - dz^2$$

Переход:

$$\begin{cases} t = \rho sh\tau \\ x = \rho ch\tau \end{cases} \qquad \begin{cases} \tau = arcth\frac{t}{x} \\ \rho^2 = x^2 - t^2 \end{cases}$$

$$|x| \geq |t|$$

Уравнения движения

$$S = \int \frac{1}{\sqrt{-g}} \left[-\frac{1}{16\pi} F^{\mu\nu} F_{\mu\nu} - A_\mu j^\mu \right] dx$$

$$\Downarrow$$

$$D_\mu F^{\mu\nu} = \frac{1}{\rho} \frac{\partial \rho F^{\mu\nu}}{\partial x^\mu} = 4\pi j^\nu$$

$$D^\mu A_\mu = \partial^\mu A_\mu - g^{\mu\nu} \Gamma^\eta_{\mu\nu} A_\eta = 0$$

$$\Updownarrow$$

$$\partial_\mu A^\mu = \frac{A_1}{\rho}$$

$$\begin{cases} \Box_R A_0 + 4\frac{\partial_1 A_0}{\rho} - 4\frac{A_0}{\rho^2} = 4\pi j_0 \\ \Box_R A_1 + \frac{A_1}{\rho^2} = 4\pi j_1 \\ \Box_R A_2 + \frac{A_2}{\rho^2} = 4\pi j_2 \\ \Box_R A_3 + \frac{A_3}{\rho^2} = 4\pi j_3 \end{cases}$$

где $\Box_R = \partial_\mu \partial^\mu - \frac{1}{\rho} \partial_1$

Уравнение движения

$$\begin{cases} z^0 = \frac{1}{a} sh(a\theta) \\ z^1 = \frac{1}{a} ch(a\theta) \\ z^2 = 0 \\ z^3 = 0 \end{cases}$$

$$\vartheta(\theta) = \frac{dz^i}{dz^0} = (th(a\theta), 0, 0)$$

$$\begin{cases} A_0(x^\mu) = \frac{1}{R-(\vec{R},\vec{\vartheta})} = \frac{ch(a\theta)}{\rho \ sh(\tau - a\theta)} \\ A_1(x^\mu) = -\frac{\vartheta^1}{R-(\vec{R},\vec{\vartheta})} = -\frac{sh(a\theta)}{\rho \ sh(\tau - a\theta)} \\ A_2(x^\mu) = A_3(x^\mu) = 0 \\ t = R + \frac{1}{sh(a\theta)} \end{cases}$$

$$R^i(\theta, x^\mu) = x^i - z^i = (x - ch(a\theta), y, z)$$

$$A^R_\mu = J^\nu_\mu A_\nu = \left(cth(\tau - a\theta), \frac{1}{\rho}, 0, 0\right) \quad \Rightarrow \quad A^R_\mu = J^\nu_\mu A_\nu = \left(cth(\tau - a\theta), 0, 0, 0\right)$$

$A^R_\mu \to A^R_\mu - \partial_\mu \alpha$, где $\partial_\mu \partial^\mu \alpha = \frac{\partial_1 \alpha}{\rho}$

$$\alpha = ln \ \rho$$

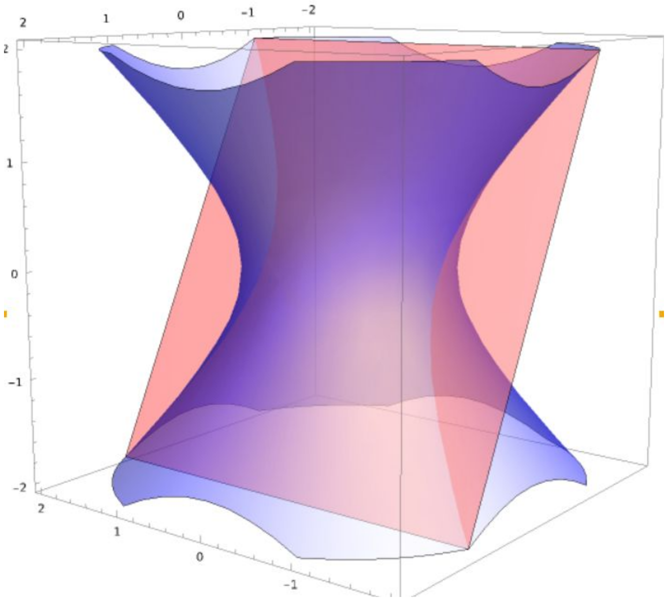
Излучение

$$A_0^R = \frac{a^2(\rho^2 + y^2 + z^2) + 1}{\sqrt{\left(a^2(\rho^2 + y^2 + z^2) + 1 \right)^2 - 4a^2\rho^2}}$$

$$S_R^i = T^{0i} = -\partial^0 A^\rho F^i{}_\rho = 0$$

$$S^i = \frac{1}{4\pi}[\vec{E},\vec{H}]^i = \begin{cases} \frac{16a^8R^4 sin^2\theta cos\theta}{\pi(1+4a^2R^2sin^2\theta)^3} \\ \frac{8a^6(2a^2R^2sin^2\theta+1)sin\theta cos\phi}{\pi(1+4a^2R^2sin^2\theta)^3} \\ \frac{8a^6(2a^2R^2sin^2\theta+1)sin\theta sin\phi}{\pi(1+4a^2R^2sin^2\theta)^3} \end{cases}$$

Новая мировая линия



$$
\begin{cases}
z^0 = \frac{\gamma}{a} sh(a\theta) \\
z^1 = \frac{1}{a} ch(a\theta) \\
z^2 = \frac{\gamma V}{a} sh(a\theta) \\
z^3 = 0
\end{cases}
$$

$$\vartheta^i = (\frac{1}{\gamma} th(a\theta), V, 0)$$

Излучение для новой мировой линии

$$\begin{cases} A_0 = \dfrac{\gamma ch(a\theta)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \\ A_1 = -\dfrac{sh(a\theta)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \\ A_2 = -\dfrac{\gamma V ch(a\theta)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \end{cases}$$

$$\begin{cases} A_0^R = \dfrac{\rho(\gamma ch(a\theta) ch\tau - sh(a\theta) sh\tau)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \\ A_1^R = \dfrac{1}{\rho} \dfrac{y\gamma V ch(a\theta)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \\ A_2^R = -\dfrac{\gamma V ch(a\theta)}{\rho(\gamma ch(a\theta) sh\tau - sh(a\theta) ch\tau) - y\gamma V ch(a\theta)} \end{cases}$$

$$ch\tau ch(a\theta) - \gamma sh\tau sh(a\theta) + \frac{y\gamma V}{\rho} sh(a\theta) = \frac{a^2(\rho^2 + y^2 + z^2) + 1}{2a\rho}$$

СПАСИБО ЗА ВНИМАНИЕ