3. $\vec{E} = -\nabla\phi - \frac{\partial}{\partial t}\vec{A}$

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

$\nabla\cdot\vec{B} = \nabla\cdot(\nabla\times\vec{A}) = 0$ 矢量的旋度无源

$\nabla\times\vec{E} = \nabla\times(-\nabla\phi) - \nabla\times\frac{\partial\vec{A}}{\partial t}$

$= -\nabla\times\frac{\partial\vec{A}}{\partial t} = -\frac{\partial}{\partial t}(\nabla\times\vec{A}) = -\frac{\partial\vec{B}}{\partial t}$

即上述两均满足 Maxwell 方程组

4. 速率方程组，稳态时 $\frac{dN_0}{dt} = -RN_0 + \frac{N_1}{t_{10}} = 0 \Rightarrow N_1 = t_{10}RN_0$

$\frac{dN_1}{dt} = \frac{N_2}{\tau} - \frac{N_1}{t_{10}} = 0 \Rightarrow N_2 = \frac{\tau}{t_{10}}N_1$

$\frac{dN_2}{dt} = \frac{N_3}{t_{32}} - \frac{N_2}{\tau} = 0$

$\frac{dN_3}{dt} = RN_0 - \frac{N_3}{t_{32}} = 0$

则 $N_0 = \frac{1}{\tau R}N_2$ $\quad N_1 = \frac{t_{10}}{\tau}N_2$

$N_0 + N_1 + N_2 = N \Rightarrow \frac{1}{\tau R}N_2 + \frac{t_{10}}{\tau}N_2 + N_2 = N$

$$N_2 = \frac{1}{\frac{1}{\tau R} + \frac{t_{10}}{\tau} + 1}N = \frac{R}{(\frac{t_{10}}{\tau}+1)R + \frac{1}{\tau}}N$$

$N_1 = \frac{t_{10}}{\tau}N_2$

$$N_2 - N_1 = \frac{(1-\frac{t_{10}}{\tau})R}{(\frac{t_{10}}{\tau}+1)R + \frac{1}{\tau}}N$$