

Notes 61(1): Inverse Faraday Effect and RFR as Space-Time Resonance.

The approach taken is to consider the interaction Hamiltonian set up between the $\underline{B}^{(3)}$ spin field and a magnetic dipole moment \underline{m} :

$$H = - \underline{m} \cdot \underline{B}^{(3)} \quad - (1)$$

The $\underline{B}^{(3)}$ field is governed by eqns (53) to (57) of paper 60. Electrodynamics must be considered because $\underline{B}^{(3)}$ is not a static magnetic field. The $\underline{B}^{(3)}$ field is part of:

$$\underline{B}^a = \underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b \quad - (2)$$

It obeys the ECE equation:

$$\underline{\nabla} \cdot \underline{B}^a = \mu_0 \tilde{j}^{0a} \quad - (3)$$

Eq. (3) is however valid in free space, where there is no field matter interaction. Where there is field matter interaction, as in the inverse Faraday effect or RFR, the relevant ECE equation is the generally covariant Ampère Maxwell law:

$$\underline{\nabla} \times \underline{B}^a - \frac{1}{c} \frac{\partial \underline{E}^a}{\partial t} = \frac{\mu_0}{c} \tilde{j}^a \quad - (4)$$

2) where:

$$\underline{E}^a = -\frac{\partial A^a}{\partial t} - \underline{\nabla} \phi^a - c \omega^{ab} A^b + \omega^{ab} \phi^b \quad (5)$$

Therefore the IFC and RFR are described by resonance equation found from eqns. (1) to (5).

At resonance in RFR the electron spin is flipped over and absorption occurs. In the off-resonant condition the IFC effect occurs. The fundamental definition of $\underline{B}^{(3)}$ is:

$$\underline{B}^{(3)*} = -ig \underline{A}^{(1)} \times \underline{A}^{(2)} \quad (6)$$

and it must not be confused with a static magnetic field. The $\underline{B}^{(3)}$ spin field is generated by circularly polarized electromagnetic radiation, while a static magnetic field is usually thought of as generated by a magnet or similar device.

In general relativity and ECE theory, a magnetic field is always defined by eq. (2), which must be applied to the experiment in the correct way.

So this sets up the problem for paper 61