Einstein – Cartan – Evans in Detail

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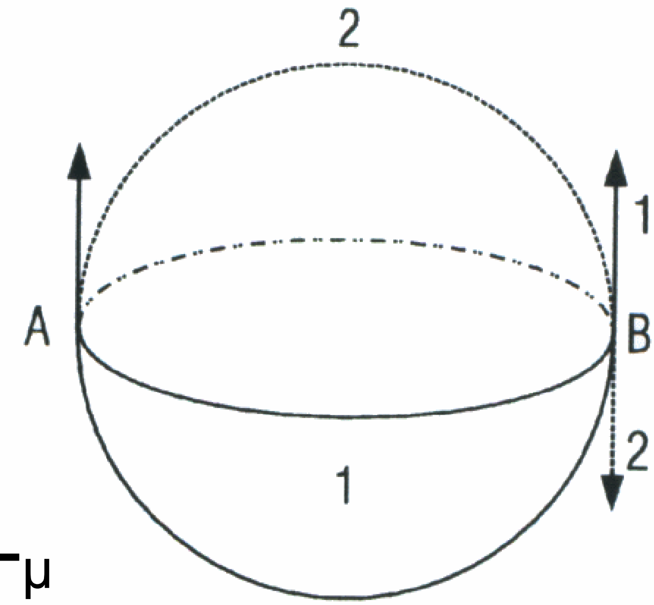
Contents

- Cartan geometry
- ECE field equations
- Resonant Coulomb law
- Experimental proofs of ECE theory

Riemann Geometry in General Relativity



- Covariant derivative

$$D_\mu V^\nu = \frac{\partial V^\nu}{\partial x^\mu} + \Gamma^\nu{}_{\rho\mu} V^\rho$$

- Christoffel symbol: $\Gamma^\mu{}_{\nu\rho} = \Gamma^\mu{}_{\rho\nu}$
- Line element: $ds^2 = g_{\mu\nu} dx^\mu dx^\nu$
- Metric tensor: $g_{\mu\nu}$
  - Flat space:

$$g_{\mu\nu} \to \eta_{\mu\nu} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

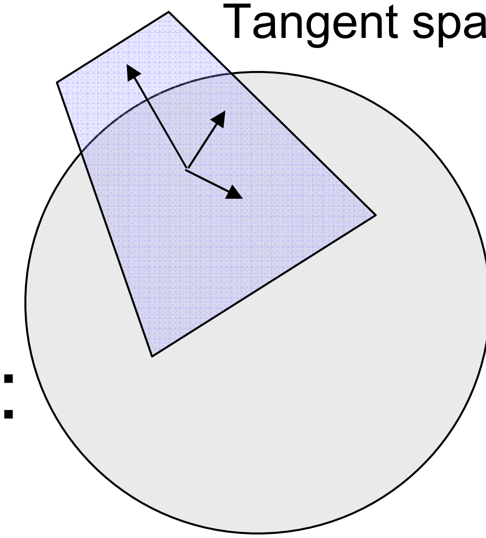
Cartan Geometry

- Coordinate transformation between base manifold (basis x^μ) and tangent space (basis x^a)

$$V^a = q^a{}_\nu V^\nu$$

- $q^a{}_\nu$ is 4x4 matrix
- Connection to Einstein theory:

$$g_{\mu\nu} = q^a{}_\mu q^b{}_\nu \eta_{ab}$$



Covariant Derivative

- Covariant derivative in tangent space

$$D_\mu V^a = \frac{\partial V^a}{\partial x^\mu} + \omega_\mu{}^a{}_b V^b$$

- $\omega_\mu{}^a{}_b$ is „spin connection“
- definition of 1- and 2-forms, exterior product

$$\left(DV^a\right)_\mu = D_\mu V^a$$

$$\left(d \wedge X\right)_{\mu\nu} = \partial_\mu X_\nu{}^a - \partial_\nu X_\mu{}^a$$

$$\left(X^a \wedge Y^b\right)_{\mu\nu} = X_\mu{}^a Y_\nu{}^b - X_\nu{}^a Y_\mu{}^b$$

Cartan Structure Equations

- First and second Maurer-Cartan structure equations (2-forms)

$$T^a = d \wedge q^a + \omega^a{}_b \wedge q^b$$

$$R^a{}_b = d \wedge \omega^a{}_b + \omega^a{}_c \wedge \omega^c{}_b$$

- First and second Bianchi identity (2-forms)

$$d \wedge T^a + \omega^a{}_b \wedge T^b = R^a{}_b \wedge q^b$$

$$d \wedge R^a{}_b + \omega^a{}_c \wedge R^c{}_b - R^a{}_c \wedge \omega^c{}_b = 0$$

$$D \wedge T^a = R^a{}_b \wedge q^b$$

$$D \wedge R^a{}_b = 0$$

ECE Wave Equation

- Tetrad postulate
  - Ensures independence of physical quantities from coordinate system (metric compatibility)

$$Dq^a = 0$$

- Taking additional derivative yields
  - (13 proofs by Evans!)

$$\Box q^a = R q^a$$

$$\Box = \frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \nabla^2$$

  - or with Einstein relation R=-kT

$$\left(\Box + kT\right) q^a = 0$$

Hodge Dual

- Hodge dual of a tensor in 4 dimemsions:

$$\tilde{X}_{\mu\nu} = \frac{1}{2}|g|^{1/2}\varepsilon^{\rho\sigma}{}_{\mu\nu}X_{\rho\sigma}$$

  - ε is Levi-Civita-Symbol
  - |g| cancels out in most cases
- Example: electromagnetic field tensor

$$F^{\mu\nu} = \begin{pmatrix} 0 & -E^1 & -E^2 & -E^3 \\ E^1 & 0 & -cB^3 & cB^2 \\ E^2 & cB^3 & 0 & -cB^1 \\ E^3 & -cB^2 & cB^1 & 0 \end{pmatrix} \qquad \tilde{F}^{\mu\nu} = \begin{pmatrix} 0 & -cB^1 & -cB^2 & -cB^3 \\ cB^1 & 0 & -E^3 & E^2 \\ cB^2 & E^3 & 0 & -E^1 \\ cB^3 & -E^2 & E^1 & 0 \end{pmatrix}$$

ECE Postulates

- Electromagnetic potential is proportional to tetrad
- Electromagnetic field is proportional to torsion

$$A^a = A^{(0)} q^a$$

$$F^a = A^{(0)} T^a$$

- $\rightarrow$ All physics is geometry
- $\rightarrow$ Potential is a genuine physical quantity

ECE Field Equations

- Indexless form notation (condensed form)

$$D \wedge F = R \wedge A$$

$$D \wedge R = 0$$

Bianchi identities

$$F = D \wedge A$$

$$R = D \wedge \omega$$

Structure equations

$$\left(\Box + kT\right)A = 0$$

Wave equation

Introduction of Current Terms

- From definitions follows

$$d \wedge F = A^{(0)}\left(R \wedge q - \omega \wedge T\right) =: \mu_0 j$$

$$d \wedge \tilde{F} = A^{(0)}\left(\tilde{R} \wedge q - \omega \wedge \tilde{T}\right) =: \mu_0 J$$

- → Maxwell-like field equations (3-forms)

$$\left(d \wedge F^a\right)_{\mu\nu\rho} = \left(\mu_0 j^a\right)_{\mu\nu\rho}$$

$$\left(d \wedge \tilde{F}^a\right)_{\mu\nu\rho} = \left(\mu_0 J^a\right)_{\mu\nu\rho}$$

Tensor and Vector Notation of ECE Field Equations

- Tensor notation

$$\partial_\mu F^a{}_{\nu\rho} + \partial_\rho F^a{}_{\mu\nu} + \partial_\nu F^a{}_{\rho\mu} = \mu_0 \left(j^a{}_{\mu\nu\rho} + j^a{}_{\rho\mu\nu} + j^a{}_{\nu\rho\mu} \right)$$

$$\partial_\mu \tilde{F}^a{}_{\nu\rho} + \partial_\rho \tilde{F}^a{}_{\mu\nu} + \partial_\nu \tilde{F}^a{}_{\rho\mu} = \mu_0 \left(J^a{}_{\mu\nu\rho} + J^a{}_{\rho\mu\nu} + J^a{}_{\nu\rho\mu} \right)$$

- Vector notation

$$\nabla \cdot \mathbf{B}^a = \mu_0 j^{0a} \qquad \nabla \cdot \mathbf{E}^a = \mu_0 J^{0a}$$

$$\nabla \times \mathbf{E}^a + \frac{\partial \mathbf{B}^a}{\partial t} = \mu_0 \mathbf{j}^a \qquad \nabla \times \mathbf{B}^a - \frac{1}{c^2} \frac{\partial \mathbf{E}^a}{\partial t} = \mu_0 \mathbf{J}^a$$

Field Equations for the Potential

- Field equations in indexless notation

$$d \wedge F = \mu_0 j$$

$$d \wedge \tilde{F} = \mu_0 J$$

- From structure equation F=D^A follows

$$d \wedge F = d \wedge \left(d \wedge A + \omega \wedge A\right) = \mu_0 j$$

$$d \wedge \tilde{F} = d \wedge \left(d \wedge \tilde{A} + \omega \wedge \tilde{A}\right) = \mu_0 J$$

Field-Potential Relations

- Rewriting in vector form:

$$\mathbf{E}^a = -\frac{\partial \mathbf{A}^a}{\partial t} - c\nabla A^{0a} - c\omega^{0a}{}_b \mathbf{A}^b + c\boldsymbol{\omega}^a{}_b A^{0b}$$

$$\mathbf{B}^a = \nabla \times \mathbf{A}^a - \boldsymbol{\omega}^a{}_b \times \mathbf{A}^b$$

- Maxwell-Heaviside fields augmented by spin connection terms
- Effect of spacetime torsion, general covariance
- Spin connection is source of various new effects

Electromagnetic Potential

electric potential

$$A_\mu{}^a = \begin{pmatrix} A_0{}^0 & A_0{}^1 & A_0{}^2 & A_0{}^3 \\ A_1{}^0 & A_1{}^1 & A_1{}^2 & A_1{}^3 \\ A_2{}^0 & A_2{}^1 & A_2{}^2 & A_2{}^3 \\ A_3{}^0 & A_3{}^1 & A_3{}^2 & A_3{}^3 \end{pmatrix}$$

3 polarization vectors
of magnetic vector potential

Resonance Equations

- Rewrite field equation containing the Coulomb law

$$d \wedge \left(d \wedge \tilde{A} + \omega \wedge \tilde{A} \right) = \mu_0 J$$

to form

$$\phi'' + \alpha \phi' + {\omega_0}^2 \phi = \mu_0 J^0$$

- Equation of forced oscillation
  - for oscillatory J
  - linear in Φ
  - coefficients may depend on space/time coordinates

Generally Covariant Coulomb Law

- Coulomb law (simplified ECE ansatz),

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon^0}, \qquad \mathbf{E} = -(\nabla + \boldsymbol{\omega})\Phi$$

- gives generalized Poisson equation:

$$\nabla^2 \phi + \boldsymbol{\omega} \cdot \nabla \Phi + (\nabla \cdot \boldsymbol{\omega})\Phi = -\frac{\rho}{\varepsilon^0}$$

- $\rightarrow$ resonance equation for Φ

Resonant Coulomb Potential

- Use spherical polar coordinates, only r-dependence

$$E_r = -\left(\frac{\partial}{\partial r}\Phi + \omega_r \Phi\right)$$

- Comparison with off-resonance case gives

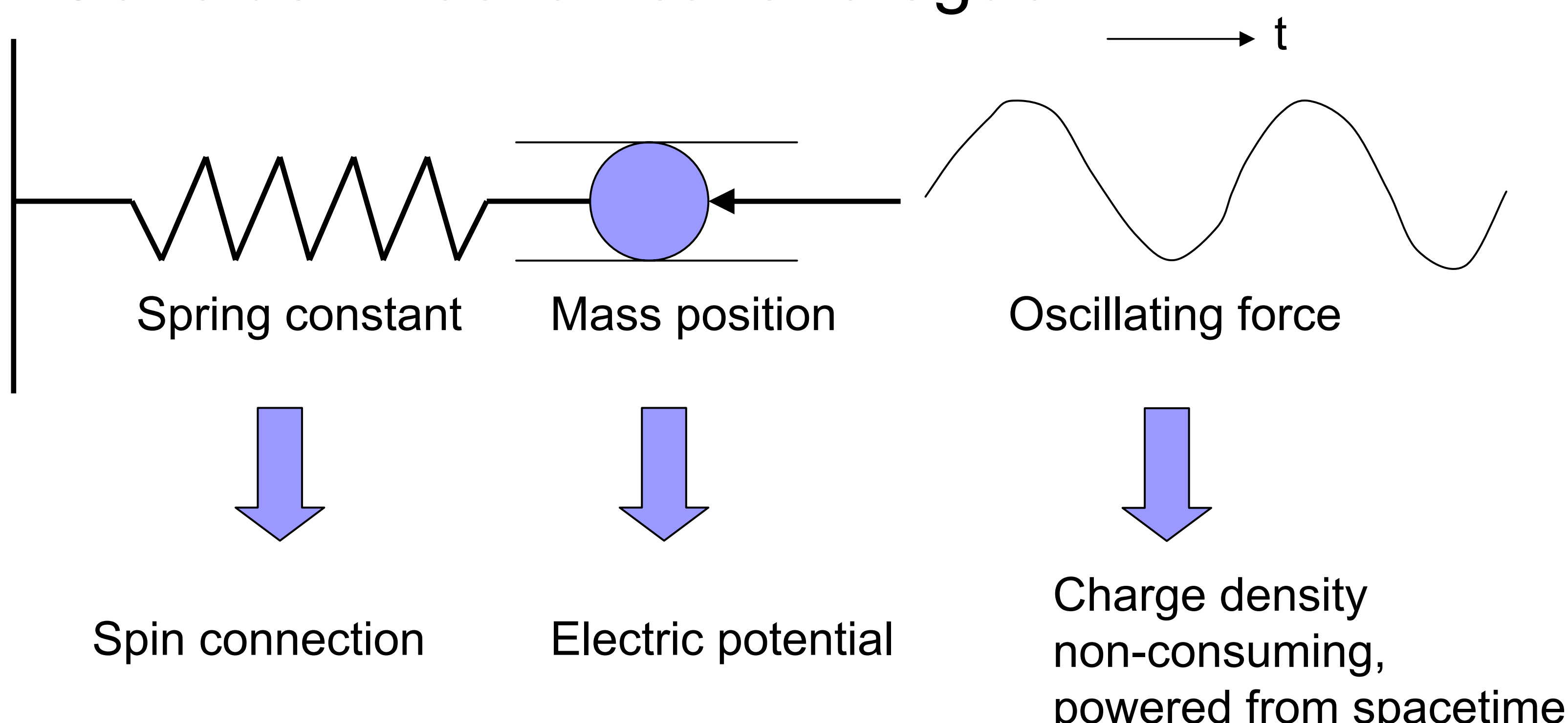
$$\omega_r = \pm \frac{1}{r}$$

- generalized Poisson equation:

$$\frac{d^2}{dr^2}\Phi + \frac{1}{r}\frac{d}{dr}\Phi - \frac{1}{r^2}\Phi = -\frac{\rho}{\varepsilon^0}$$

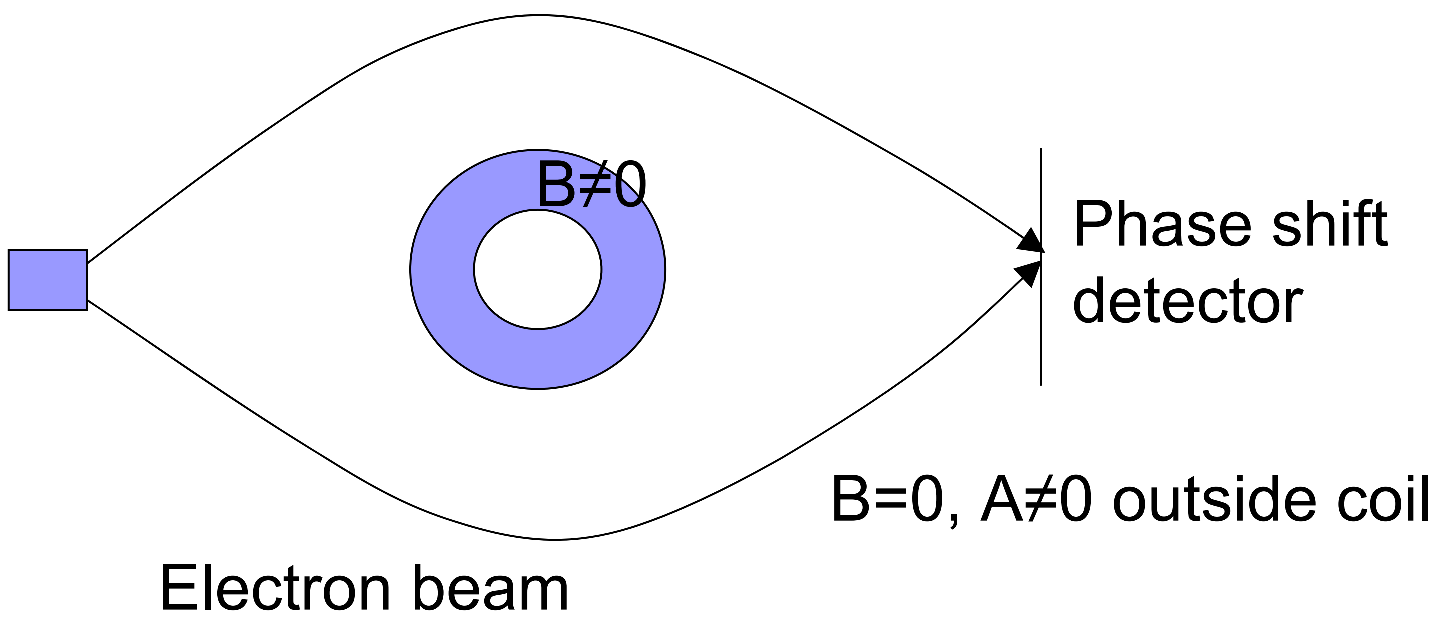
Interpretation of Resonance

- Where does the energy come from?
  - Consider mechanical analogue:



Aharonov-Bohm Effect

- Role of vector potential A
  - In Maxwell-Heaviside theory: not relevant (re-gaugable)
  - Re-gauging: $\mathbf{A} \rightarrow \mathbf{A} + \nabla \varphi$



Explanation of Aharonov-Bohm Effect

- Experimental phase shift ~ magnetic flux:

$$\delta \sim \Phi = \int_S B = \int_S d \wedge A = \int_S \nabla \times A$$

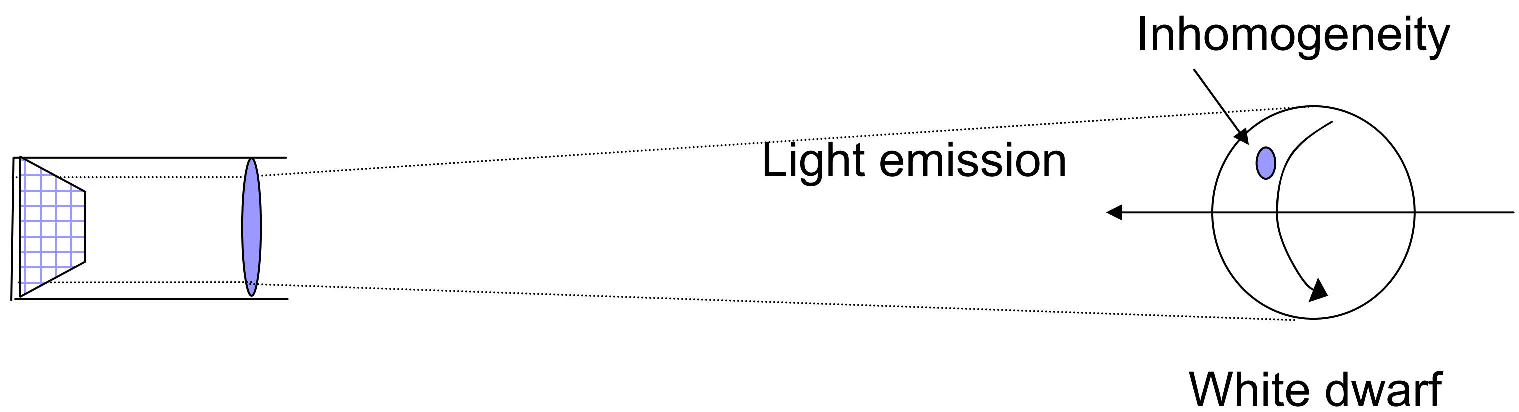
(outer region, must be 0)

- Explanation by ECE theory:

$$\delta \sim \int_S d \wedge A + \int_S \omega \wedge A = 0 + \int_S \omega \wedge A \neq 0$$

  - Effect of spin connection ω
  - Φ≠0 where classically d^A=0
  - Result of spinning spacetime

Polarization of Light by a Cosmological Gravitational Field



- Circular polarization is shifted to elliptical
  - Influence of gravitation on electromagnetic radiation
  - Not explainable by Maxwell-Heaviside theory or Einstein general relativity
  - Only explainable by ECE theory

ESA Experiment (2006)

- ESA's European Space and Technology Research Centre (ESTEC)
- Experimental Detection of the Gravitomagnetic London Moment
  - The paper predicts the presence of a large gravitomagnetic field within a rotating superconductor, and describes the experimental detection of this phenomenon as an extra-gravitational acceleration on the superconductor of the order of 100µg.
  - Results „are 30 orders of magnitude higher than what general relativity predicts classically“.
  - Similar finding as for Podkletnov-Experiment (in 90‘s, not well reproducible)

Steorn Magnetic Motor (2006)

- In 2003 Steorn (Irish company) undertook a project to develop more efficient micro generators. Early into this project the company developed certain generator configurations that appeared to be over 100% efficient. Further investigation and development has led to the company’s current technology, a technology that produces free energy. The technology is patent pending.
- Based on „non-conservative B field“
  - resonance effect or
  - clever extraction of field energy