A First Course in General Relativity

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Errata

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This document contains corrections to known errors in the first printing (2009) of the second edition of *A First Course in General Relativity*. The book was reprinted with these corrections in 2011.

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Chapter 1, page 2: the third displayed equation should read

$$\boldsymbol{a}' = \mathrm{d}\boldsymbol{v}'/\mathrm{d}\,t = \mathrm{d}(\boldsymbol{v} - \boldsymbol{V})/\mathrm{d}\,t = \mathbf{d}\boldsymbol{v}/\mathrm{d}\,t = \boldsymbol{a}.$$

Chapter 3, page 59. Equation 3.6b should read

$$\left.\begin{array}{l}\tilde{s}(\vec{A}) = \tilde{p}(\vec{A}) + \tilde{q}(\vec{A}),\\ \tilde{r}(\vec{A}) = \alpha\tilde{p}(\vec{A}).\end{array}\right\}$$

Chapter 3, page 62. The first and second sentences of the subsection "Gradient of a function is a one-form" should read

> Consider a scalar field $\phi(\vec{x})$ defined at every event $\vec{x}$. The world line of some particle (or person) encounters a value of ϕ at each event on it (see Fig. 3.2), and this value changes from event to event.

Chapter 3, page 70. Equation 3.45 should read

$$\vec{\mathrm{d}}\phi \to \left(-\frac{\partial\phi}{\partial t}, \frac{\partial\phi}{\partial x}, \dots\right).$$

Chapter 4, page 92. The first three lines should read (changed at the very end)

> In the frame $\bar{\mathcal{O}}$ we again have that the number density is $n/\sqrt{}(1-v^2)$, but now the energy of each particle is $m/\sqrt{}(1-v^2)$, since it is moving. Therefore the energy density is $mn/(1-v^2)$:

Chapter 4, page 103. Equation 4.52 should read

$$(\rho + p)U^i{}_{,\beta}U^\beta + p_{,\beta}\eta^{i\beta} = 0.$$

Chapter 6, page 151. Equation 6.30 should read

$$V^\alpha{}_{;\beta} = V^\alpha{}_{,\beta} \quad \text{at}\,\mathcal{P}\,\text{in this frame.}$$

Chapter 6, page 151. Equation 6.31 should read

$$\blacklozenge \qquad g_{\alpha\beta;\gamma} = 0 \quad \text{in any basis.}$$

Chapter 6, page 164. Equation 6.91 should read

$$\blacklozenge \quad R_{\alpha\beta} := R^\mu{}_{\alpha\mu\beta} = R_{\beta\alpha}. \qquad (1)$$

Chapter 6, page 167. Exercise 11(b) should read

(b) By relabeling indices, work this into the form

$$(\Gamma^{\alpha}{}_{\mu\beta,\nu} - \Gamma^{\alpha}{}_{\mu\nu,\beta} + \Gamma^{\alpha}{}_{\sigma\nu}\Gamma^{\sigma}{}_{\mu\beta} - \Gamma^{\alpha}{}_{\sigma\beta}\Gamma^{\sigma}{}_{\mu\nu})\, V^{\mu} = 0.$$

Chapter 7, page 173. The first paragraph should read (changed in final sentence only)

> By 'freely falling' we mean particles unaffected by other forces, such as electric fields, etc. All other known forces in physics are distinguished from gravity by the fact that there *are* particles unaffected by them. So the Weak Equivalence Principle (Postulate IV) is a very strong statement, capable of experimental test. And it has been tested, and continues to be tested, to high accuracy. Experiments typically compare the rate of fall of objects that are composed of different materials; current experimental limits bound the fractional differences in acceleration to a few parts in 10^{13} (Will 2006). The WEP is therefore one of the most precisely tested law in all of physics. There are even proposals to test it up to the level of parts in 10^{18} using satellite-borne experiments.

Chapter 9, page 242. Equations 9.144 and 9.145 should read

$$\mathrm{d}P/\mathrm{d}t = -2.4 \times 10^{-12},$$
$$= -7.2 \times 10^{-5}\,\mathrm{s\,yr}^{-1}.$$

Chapter 9, page 249. Exercise 13 should read

13 One kind of background Lorentz transformation is a simple 45° rotation of the x and y axes in the $x - y$ plane. Show that under such a rotation from (x, y) to (x', y'), we have $h^{\mathrm{TT}}_{x'y'} = -h^{\mathrm{TT}}_{xx}, h^{\mathrm{TT}}_{x'x'} = h^{\mathrm{TT}}_{xy}$. This is consistent with Fig. 9.1.

Chapter 9 page 254. Exercise 39(a) should read

(a) Use Newtonian gravity to calculate the equation of the orbits of both masses about their center of mass. Express the orbital period P, minimum separation l_0, and eccentricity e as functions of E and L.

Chapter 12, page 372. Exercise 20(c) should read

(c) Compute the second derivative of the right-hand-side of Eq. 12.54 with respect to R and show that, at the static solution, it is positive. This means that the 'potential' is a maximum and *Einstein's static solution is unstable.*