Errata for: "Probing the Universe: A Geometrical View for Observers of Spacetime Physics"

Robin W. Tucker and Timothy J. Walton (Springer: 2026)

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A list of typographical errors and correction for the book will be kept here. Corrections are emphasised in **red** text.

Please email TWalton@lancashire.ac.uk if you find any typographical errors not already listed.

<u>page 177</u>: The line immediately below the first displayed equation should read:

"In the $\mathbf{g}_{\mathbb{R}^3}$-orthonormal cobasis for. . ."

<u>page 376</u>: The last displayed equation on this page should read:

$$\mathcal{G}_c = \mathcal{R} \star e_c - 2(i_a P_c) \star e^a + \mathbf{2}(i_c i_a i_b \mathfrak{D} T^b) \star e^a$$
$$= \mathcal{R} \star e_c - 2 \star P_c - 2i_a(i_c i_b \mathfrak{D} T^b) \star e^a$$

<u>page 380</u>: The line immediately below the first displayed equation should read:

". . .is a type-preserving *derivation* on the algebra of exterior forms on $\mathcal{M}$ **(see appendix ?? for further details)** that commutes with the exterior derivative. . ."

There is also a typographical error on this page. The eighth line below equation (20.8) should say:

". . .equality modulo d will below be **denoted** by. . ."

<u>page 382</u>: The line immediately below equation (20.13) should read:

". . .of the interior operator $i_c \equiv i_{\mathbf{X_c}}$,. . ."

<u>page 383</u>: The top displayed equation on this page should read:

$$\psi_2 = \dot{e}^{\mathbf{a}} \wedge e^b \wedge \star R_{ab}.$$

The displayed equation between (20.17) and (20.18) should read:

$$\mathfrak{D} \star e^{ab} = \frac{1}{2} \epsilon^{ab}{}_{cd} \mathfrak{D} e^{cd} = \frac{1}{2} \epsilon^{ab}{}_{cd} \left(T^c \wedge e^d - e^c \wedge T^d \right)$$
$$= \epsilon^{ab}{}_{cd} T^c \wedge e^d = T_c \wedge \star e^{abc}$$

<u>page 384</u>: The line of text above equation (20.22) should read:

"In this case the 3-forms $\{\mathcal{G}_c^{(\mathrm{EH})} \equiv -\frac{1}{2}\mathcal{G}_c\}$ define..."

<u>page 385</u>: Equation (20.24) should read:

$$
\begin{aligned}
\Lambda_{\mathrm{TOTAL}}(e,\omega,A,\phi,\overline{\phi}) \equiv{}& \frac{1}{2\kappa}\,R_{ab}(\omega)\wedge\star e^{ab} + \kappa_A dA\wedge\star dA \\
&+ \kappa_1 \mathrm{Re}\left(\overline{\mathfrak{D}_{\mathrm{U}(1)}\phi}\wedge\star\mathfrak{D}_{\mathrm{U}(1)}\phi\right) \\
&+ \kappa_2\,\phi\,\overline{\phi}\,\star 1 + \kappa_3\,R_{ab}(\omega)\wedge R^{ab}(\omega)
\end{aligned}
\tag{20.24}
$$

<u>page 386</u>: Equation (20.30) should read:

$$
\mathcal{I}_{\mathrm{EH}}[e,\omega] \equiv \frac{1}{2\kappa}\int_{\mathcal{M}} R_{ab}(\omega)\wedge\star(e^a\wedge e^b),
\tag{20.30}
$$

and the displayed equation below becomes:

$$
\mathcal{G}_c^{(\mathrm{EH})} \equiv -\frac{1}{2}\,R_{ab}\wedge i_c\star(e^a\wedge e^c) = 0, \quad a,b,c = 0,1,2,3, \ e^a(X_c) = \delta_c^a
$$

$$
T^c = 0.
$$

<u>page 388</u>: Equation (20.31) should read:

$$
\mathtt{Ein} \equiv (\star^{-1}\mathcal{G}_c^{(\mathrm{EH})})\otimes e^c = \kappa\,(\star^{-1}\tau_c^{(\mathrm{SOURCE})})\otimes e^c.
\tag{20.31}
$$

<u>page 392</u>: The first equation of section 20.4 should read:

$$
\mathcal{I}_{\mathrm{EH}}[e,\omega] \equiv \frac{1}{2\kappa}\int_{\mathcal{M}} R_{ab}(\omega)\wedge\star(e^a\wedge e^b),
\tag{20.30}
$$

and the second equation becomes:

$$
\begin{aligned}
\mathcal{I}_{\mathrm{SOURCE}}[e,A,\phi,\overline{\phi}] \equiv{}& \kappa_A\int_{\mathcal{M}}\Lambda_2(e,A) + \kappa_1\int_{\mathcal{M}}\Lambda_1(e,A,\phi,\overline{\phi}) \\
&+ \mu^2\int_{\mathcal{M}}\Lambda_3(e,\phi,\overline{\phi}) \qquad (\kappa_1,\mu\in\mathbb{R})
\end{aligned}
$$

: The displayed equation immediately above equation (20.37) should read:

$$\widehat{\overline{\delta}}\left(\, \mathcal{I}_{\text{EH}}[e,\omega] + \mathcal{I}_{\text{SOURCE}}[e,A,\phi,\overline{\phi}]\,\right) \simeq 0,$$

: Equation (20.39) should read:

$$\frac{\mathcal{G}_c^{(\text{EH})}}{\kappa} = \tau_c \tag{20.39}$$

and the text immediately after this displayed equation becomes:

"where $\mathcal{G}_c^{(\text{EH})} \equiv -\frac{1}{2}R_{ab} \wedge i_c \star e^{ab} \ldots$".

The text in the first paragraph immediately below the last displayed equation of this page should be:

"Note $[\tau_c] = {}_{\text{M}}[c_0^2]$. Since the $\dot{\omega}_{ab}$ partial variations in $\mathcal{I}_{\text{EH}}[e,\omega]$ *and* $\mathcal{I}_{\text{SOURCE}}[e,A,\phi,\overline{\phi}]$ yield a set of zero-torsion connection 1-forms (see section above), if these are assumed to be metric-compatible with respect to the metric tensor $\text{g} = \eta_{ab}\,e^a \otimes e^b$ then (20.37), (20.38), (20.20) constitute the necessary conditions for the functional $\mathcal{I}_{\text{EH}}[e,\omega] + \mathcal{I}_{\text{SOURCE}}[e,A,\phi,\overline{\phi}]$ to be extremal and (20.39) yields a *Levi-Civita Einstein tensor field equation with sources.* "

: The penultimate displayed equation on this page should read:

$$\text{T}^{(\text{MAX})}(X_0,X_0) = (\star\tau_c^{(\text{MAX})})(X_0)\,\boldsymbol{\delta_0^c} = i_0(\star\tau_0^{(\text{MAX})})$$

: Equation (22.8) should read:

$$\mathcal{G}_a^{(\text{EH})} = \kappa\,\tau_a^{(\text{SOURCE})}, \qquad a = 0,1,2,3. \tag{22.8}$$

The text immediately following this line should then read:

"Recall that it follows from $\left[\mathcal{G}_a^{(\text{EH})}\right]$ and $\ldots$".

Equation (22.9) should read:

$$\mathcal{G}_a^{(\text{EH})} = \kappa\sum_N \tau_a^N \equiv \kappa\,\tau_a^{(\text{SOURCE})}. \tag{22.9}$$