Erratum for Chapter 2, Ch02BridgeSRtoGR170511v1.pdf:

The following error correction is for those who use the *Safari* browser. This browser fails to show Figure 9 in Chapter 2, which is reproduced below.

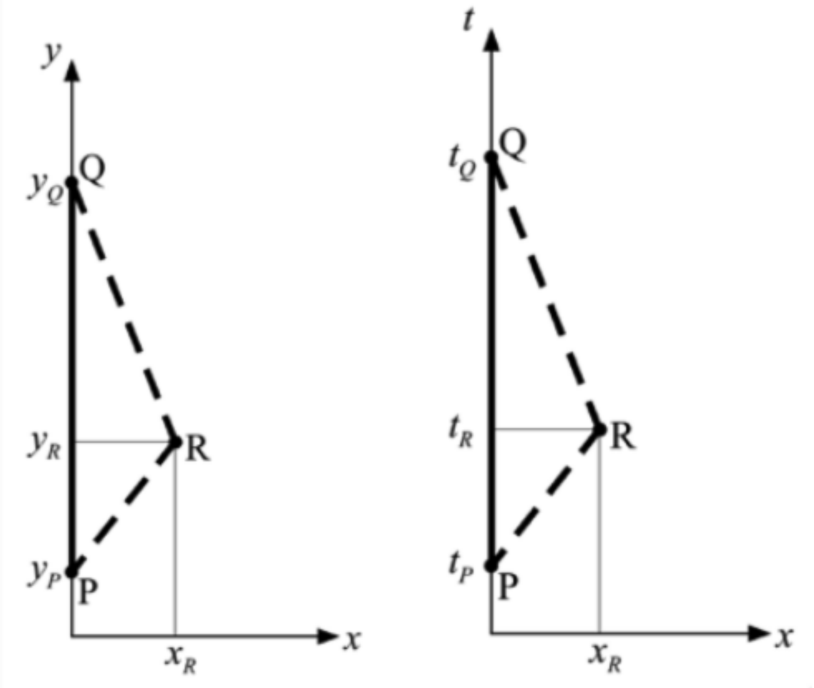

FIGURE 9 Left panel: Euclidean plane showing straight line PQ and broken line PRQ. Right panel: Spacetime diagram showing straight worldline PQ and broken worldline PRQ.

This is the only error that the Safari browser makes for the entire book.

The Firefox browser correctly shows Figure 9 in Chapter 2 and all of every other chapter.

We ask users of other browsers to let us know if they make errors of reproduction of the second edition of Exploring Black Holes.

Errata for Exploring Black Holes, 2nd edition:

CHAPTER	WHERE	CHANGE FROM	CHANGE TO
Ch07InsideTheBlackHole200331v1.pdf	p. 7-38, equation (83)	τ_{Aail}	τ_{hail}
Ch07InsideTheBlackHole200331v1.pdf	p. 7-39, Line 956	equation (33) of Chapter 6	equation (34) of Chapter 6
Ch11OrbitsOfLight200331v1.pdf	p. 11-6, Figure 2	first as a set	first as a set
Ch11OrbitsOfLight200331v1.pdf	p. 11-9, Line 225	Recall equation (21)	Recall equation (19)
Ch11OrbitsOfLight200331v1.pdf	p. 11-13, left margin	Definitions: Turning point Outer turning point Inner turning point Circular orbit poin	Definitions: Turning point Outer turning point Inner turning point Circular orbit point
Ch11OrbitsOfLight200331v1.pdf	p. 11-15, equation (35)	$0 \leq \Psi \leq \pi$	$0 \leq \Psi < \pi/3$
Ch11OrbitsOfLight200331v1.pdf	p. 11-15, Line 347	*principle value*	*principal value*
Ch11OrbitsOfLight200331v1.pdf	p. 11-18, equation (38)	$\int_{r=\infty}^{r_{\mathrm{tp}}} \frac{b}{r^2} F^{-1}(b,r)\, dr + \int_{r_{\mathrm{tp}}}^{r_{\mathrm{obs}}} \frac{b}{r^2} F^{-1}(b,r)\, dr$	$\int_{r=\infty}^{r_{\mathrm{tp}}} \frac{b}{r^2} F^{-1}(b,r)\, dr - \int_{r_{\mathrm{tp}}}^{r_{\mathrm{obs}}} \frac{b}{r^2} F^{-1}(b,r)\, dr$
Ch11OrbitsOfLight200331v1.pdf	p. 11-19, Line 443	So equations (38) and (39)	So equations (37) and (38)
Ch12DivingPanoramas190403v1.pdf	p. 12-3, Line 73	see the to see	see
Ch12DivingPanoramas190403v1.pdf	p. 12-7, Figure 3		<The Figure should be rotated clockwise by 90 degrees.>

Ch12DivingPanoramas190403v1.pdf	p. 12-8, Line 154	Figure 3 above an	Figure 3 above and
Ch12DivingPanoramas190403v1.pdf	p. 12-12, Sample Problems 1, part C	SOLUTION: Begin with Figure 10	SOLUTION: Begin with Figure 8
Ch12DivingPanoramas190403v1.pdf	p. 12-12, Sample Problems 1, part C	These intersections correspond to $\theta_{\text{rain}} \approx \pm 110°$. These angles are greater than $\pm 90°$, so the rain observer looks somewhat benind her	These intersections correspond to $\theta_{\text{rain}} \approx \pm 35°$. These angles are smaller than $\pm 90°$, so the rain observer looks in front of her
Ch12DivingPanoramas190403v1.pdf	p. 12-14, Line 344	becomes $360° - \cos\theta$	becomes $\cos(360° - \theta)$
Ch12DivingPanoramas190403v1.pdf	p. 12-14, Line 345-346	aberration equation (54) in exercise 18 of Chapter 1	aberration equation (56) in exercise 22 of Chapter 1
Ch12DivingPanoramas190403v1.pdf	p. 12-23, Line 575	Exercise 18	Exercise 22
Ch13GravitationalMirages160510v1.pdf	p. 13-8, Line 187	equation (40) of Section 11.6	equation (38) of Section 11.7
Ch13GravitationalMirages160510v1.pdf	p. 13-8, Line 191	equation (40) of Section 11.6	equation (38) of Section 11.7
Ch13GravitationalMirages160510v1.pdf	p. 13-8, Line 198	equation (27) in Section 11.4 to convert	equation (29) in Section 11.5 to convert
Ch13GravitationalMirages160510v1.pdf	p. 13-9, Line 206	$b_{\text{critical}} = 3(3)^{1/2}$	$b_{\text{critical}}/M = 3(3)^{1/2}$
Ch13GravitationalMirages160510v1.pdf	p. 13-10, Box 1, left column	From (11) plus equation (27) in Section 11.4	From (11) plus equation (29) in Section 11.5
Ch14ExpandUniverse170331v1.pdf	p. 14-0, Line 5	Roberson-Walker	Robertson-Walker

Ch14ExpandUniverse170331v1.pdf	p. 14-5, Line 124	a scale factor in curved spacetime. Euclid does not describe curved spacetime,	a scale factor in curved space. Euclid does not describe curved space,
Ch14ExpandUniverse170331v1.pdf	p. 14-13, Box 4, left column	a galaxy formed at t_{emit} = 0.7 billion years ago?	a galaxy formed at t_{emit} = 0.7 billion years?
Ch14ExpandUniverse170331v1.pdf	p. 14-24, Line 515	in Figure 7.	in Figure 6.
Ch15Cosmology170510v1.pdf	p. 15-0, Line 4	Roberson-Walker	Robertson-Walker
Ch15Cosmology170510v1.pdf	p. 15-11, Line 370	In Query 9 you showed	In Query 2 you showed
Ch15Cosmology170510v1.pdf	p. 15-23, Query 10, part D	From Figure 1, show that Einstein's model is unstable	From Figure 2, show that Einstein's model is unstable
Ch15Cosmology170510v1.pdf	p. 15-31, equation (54)	$-\int_{t_0^t} \frac{dt'}{a(t')}$	$-\int_{t_0}^{t} \frac{dt'}{a(t')}$
Ch16GravWaves171018v1.pdf	p. 16-3, Line 93	to describe this waves	to describe these waves
Ch16GravWaves171018v1.pdf	p. 16-5, Line 135	is about 10^{-21} x $100^{1/2} = 10^{-23}$	is about 10^{-23} x $100^{1/2} \approx 10^{-22}$
Ch16GravWaves171018v1.pdf	p. 16-5, Line 137	10^{-21} x 4 x 10^{3} = 4 x 10^{-18} meters	10^{-22} x 4 x 10^{3} = 4 x 10^{-19} meters
Ch16GravWaves171018v1.pdf	p. 16-8, Line 240	decreases as the inverse *r*-separation	decreases as the inverse square of the *r*-separation
Ch16GravWaves171018v1.pdf	p. 16-9, Lines 268-269	measures the changing interference of light waves round-trip *time delays*sent down the two legs of the detector.	measures the changing interference of light waves due to the different round-trip *time delays* for light beams sent down the two legs of the detector.
Ch16GravWaves171018v1.pdf	p. 16-9, Line 272	detector along	detector is along

Ch17SpinBH200224v1.pdf	p. 17-5, Query 2, part B	R_{max}	R_{min}
Ch17SpinBH200224v1.pdf	p. 17-6, equation (11), first term on right hand side	... $- \omega^2 R^2)$	... $- \omega^2 R^2) dT^2$
Ch17SpinBH200224v1.pdf	p. 17-9, Line 250	Equations (17) and (18) plus (9) lead	Equations (17) and (18) plus (3) and (9) lead
Ch17SpinBH200224v1.pdf	p. 17-11, Line 294	In Query 2 you showed	In Query 1 you showed
Ch17SpinBH200224v1.pdf	p. 17-12, Line 317	singulariy	singularity
Ch17SpinBH200224v1.pdf	p. 17-17, Line 435	equation (40) in Section 1.10	equation (41) in Section 1.10
Ch17SpinBH200224v1.pdf	p. 17-17, Figure 6	Equations (36), (37), and (38) show	Equations (32), (33), and (34) show
Ch17SpinBH200224v1.pdf	p. 17-20, equation (52)	Phythagoras	Pythagoras
Ch17SpinBH200224v1.pdf	p. 17-32, Line 758	the fourth term	the third term
Ch17SpinBH200224v1.pdf	p. 17-32, Line 759	This term does not contain dT, but it does	This term does contain dT, and it does
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-2, Line 77	Equation (103) for E/m in Section 17.9 and equation (110) for L/m	Equation (104) for E/m in Section 17.9 and equation (111) for L/m
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-3, equation (15)	(15)q	(15)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-4, Line 112	angular momentum equation (110)	angular momentum equation (111)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-16, Line 361	expressions for $dT/d\tau$ and $d\Phi/d\tau$	expressions for $dT/d\tau$ and $d\Phi/dT$

Ch18CircleOrbitsSpin170905v3.pdf	p. 18-16, Line 362	orbits in in Section	orbits in Section
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-18, Line 411	(Comment 7, Section 1.11)	(Comment 8, Section 1.11)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-19, Line 428	equations (32) through (37)	equations (31) through (38)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-24, Line 572	equations (31) for E/m and (32) for L/m	equations (32) for E/m and (31) for L/m
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-26, equation (66), denominator of right hand side	$2r^3(r-3M)^{3/2}$	$2r^{3/2}(r-3M)^{3/2}$
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-29, Figure 12	two Type 4 (retrograde) circular orbits from (37)	two Type 4 (retrograde) circular orbits from (38)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-31, Line 702	$d\|E\|/dr > 0$	$dE/dr < 0$
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-33, Figure 15	*(The caption of this figure might be misleading.)*	*As implied at the beginning of Section 18.8, this figure shows the number of stable orbits only for Type 1 and Type 4 orbits, for which the map energy is positive outside the event horizon. If we include Types 2 and 3, regions F, G, and H correspond to ZERO, TWO, and FOUR stable orbits, respectively.*
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-35, Line 777	the wristwatch time $\Delta\tau_{\text{far}}$ for	the wristwatch time $\Delta\tau_{\text{rec}}$ for
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-35, Line 780	the wristwatch time lapse $\Delta\tau_{\text{far}}$ for	the wristwatch time lapse $\Delta\tau_{\text{rec}}$ for

Ch18CircleOrbitsSpin170905v3.pdf	p. 18-35, Line 784	the wristwatch time $\Delta\tau_{\mathrm{far}}$ between	the wristwatch time $\Delta\tau_{\mathrm{rec}}$ between
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-37, Line 830	equations (75) through (76)	equations (75) through (77)
Ch18CircleOrbitsSpin170905v3.pdf	p. 18-37, Line 833	equations (75) through (76)	equations (75) through (77)
Ch19OrbitingSpin180113v1.pdf	p. 19-2, Line 68	$d\Phi/d\tau$	$d\Phi/dT$
Ch19OrbitingSpin180113v1.pdf	p. 19-2, Line 69	$d\Phi/d\tau$	$d\Phi/dT$
Ch19OrbitingSpin180113v1.pdf	p. 19-3, Line 85	${V_L}^{+}$	${V_L}^{-}$
Ch19OrbitingSpin180113v1.pdf	p. 19-3, Line 87	${V_L}^{-}$	${V_L}^{+}$
Ch19OrbitingSpin180113v1.pdf	p. 19-14, Line 344-345	the the	the
Ch19OrbitingSpin180113v1.pdf	p. 19-15, Table 19.3, row 4, column 2	2.789 126 311	2.789 126 311 M
Ch19OrbitingSpin180113v1.pdf	p. 19-15, Table 19.3, row 4, column 3	3.092 447 193	3.092 447 193 M
Ch19OrbitingSpin180113v1.pdf	p. 19-15, Table 19.3, row 4, column 4	2.262 034 177	2.262 034 177 M
Ch19OrbitingSpin180113v1.pdf	p. 19-20, Line 480	Yet Figure 5 clearly shows	Yet Figure 7 clearly shows
Ch19OrbitingSpin180113v1.pdf	p. 19-21, Figure 8, labels of horizontal and vertical axes	horizontal: (R/M) sin Φ vertical: (R/M) cos Φ	horizontal: (R/M) cos Φ vertical: (R/M) sin Φ
Ch19OrbitingSpin180113v1.pdf	p. 19-22, Line 518	sigularity	singularity
Ch19OrbitingSpin180113v1.pdf	p. 19-24, Line 528	$r_2 = 0.17076M$	$r_1 = 0.17076M$
Ch19OrbitingSpin180113v1.pdf	p. 19-25, Line 602	the the black hole	the black hole

Ch19OrbitingSpin180113v1.pdf	p. 19-28, Line 679	Equations (48), (96), and (97)	Equations (48), (49), (96), and (97)
Ch19OrbitingSpin180113v1.pdf	p. 19-32, equation (74)	$v_{b,x,ring}$	$v_{x,ring,b}$
Ch19OrbitingSpin180113v1.pdf	p. 19-35, Line 887	the the	the
Ch19OrbitingSpin180113v1.pdf	p. 19-39, Line 966	the the	the
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-4, Line 98	M/r	M/b
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-5, equation (20)	$\left(\frac{M}{b}\right)\left(\frac{r\,H^2}{R}\right)\left[1-\omega\,b \pm \beta\,F_{\text{spin}}(a,b,r)\right]$	$\left(\frac{M}{b}\right)\left(\frac{R}{r\,H^2}\right)\left[1-\omega\,b \pm \beta\,F_{\text{spin}}(a,b,r)\right]$
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-5, equation (22)	$\mathrm{A}^2(a,b,r)\left(\frac{dr}{dT}\right)^2 = \left(\frac{M}{b}\right)^2 - \left[\frac{V^{\pm}(a,r)}{M}\right]^2$	$A^2(a,b,r)\left(\frac{dr}{dT}\right)^2 = \left(\frac{M}{b}-\frac{V^{+}(a,r)}{M}\right)\cdot\left(\frac{M}{b}-\frac{V^{-}(a,r)}{M}\right)$
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-6, equation (23)	$\left[\frac{V^{\pm}(a,r)}{M}\right]^2 \equiv \frac{M^2}{R^2}\left(\frac{rH}{R}\right)^2 \pm \frac{2M^2\omega}{R}\left(\frac{rH}{R}\right) - M^2\omega^2$	$\frac{V^{\pm}(a,r)}{M} \equiv M\omega \pm \frac{M}{R}\left(\frac{rH}{R}\right)$
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-6, Lines 110-113	Equation (22) tracks the *r*-motion of a light flash in the equatorial plane: The first term on the right side is a	Equation (22) tracks the *r*-motion of a light flash in the equatorial plane: The effective potential $V^{\pm}(a,r)$ on the right side

		function of *b* but not a function of *a* or *r*, while the second term—the square of the effective potential—is a function of *a* and *r*, but not a function of *b*.	is only a function of a and r; it is *not* a function of b.
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-6, Line 115	any given value of $(M/b)^2$ in (22)	any given value of (M/b) in (22)
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-6, Line 117	If $(M/b)^2$ is less than $(V^+/M)^2$ but greater than $(V^-/M)^2$,	If (M/b) is less than (V^+/M) but greater than (V^-/M) ,
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-6, Line 122	reduce to equations (25) and (26) in Section 11.3,	reduce to equations (24) and (25) in Section 11.4,
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-7, Line 133	$(M/b)^2$ in Figure 1	(M/b) in Figure 1
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-7, Line 138	back hole	black hole
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-7, Line 157	belong to the prograde and retrograde knife-edge orbits	belong to the retrograde and prograde knife-edge orbits
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-8, equation (24)	$b^+ = \frac{1}{V^+_{max}} = \frac{1}{V^+(r^+_{\text{knife edge}})}$ prograde knife-edge orbit	$\frac{b^+}{M} = \frac{M}{V^-_{min}} = \frac{M}{V^-(r^+_{\text{knife edge}})}$ retrograde knife-edge orbit

Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-8, equation (25)	$b^- = \frac{1}{V^-_{max}} = \frac{1}{V^-(r^-_{\text{knife edge}})}$ retrograde knife-edge orbit	$\frac{b^-}{M} = \frac{M}{V^+_{max}} = \frac{M}{V^+(r^-_{\text{knife edge}})}$ prograde knife-edge orbit
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-8, equation (26)	$b^\pm_{\text{critical}} = \left(r^\pm_{\text{knife edge}} + 3M\right)\left(\frac{r^\pm_{\text{knife edge}}}{4M}\right)^{1/2}$	$b^\pm_{\text{critical}} = \mp\left(r^\pm_{\text{knife edge}} + 3M\right)\left(\frac{r^\pm_{\text{knife edge}}}{4M}\right)^{1/2}$
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-8, equation (27)	$r^+_{\text{knife edge}} = 4M\cos^2\Psi^\pm$ where $\Psi = \frac{1}{3}\arccos\left(\mp\frac{a}{M}\right)$	$r^\pm_{\text{knife edge}} = 4M\cos^2\Psi^\pm$ where $\Psi^\pm = \frac{1}{3}\arccos\left(\pm\frac{a}{M}\right)$
Ch20OrbitsOfLightAroundSpinningBH170906v1.pdf	p. 20-8, Line 167	the visual size $(b^+_{\text{critical}} + b^-_{\text{critical}})$	the visual size $(-b^+_{\text{critical}} + b^-_{\text{critical}})$
Ch21TravelThroughTheSpinningBH170831v1.pdf	p. 21-7, Line 148	to to	to