Errata for *Atmospheric Lidar Fundamentals* 9781316518236

Chapter 2

p.14, in lines 14, replace, "(i.e., independent of atom's motion), in other words" by ". In other words, it is independent of"

Chapter 3

p.21, in line 10, replace "(see (B1) of [3.3])" by ", as given in (A.14)". Also, in line 2 from bottom, replace "given as (B1) and (B2) in [3.3]." by "given as (A.14), and (B2) in [3.3]."

p.23, in line 24, "(A.8)" should be "(A.8.a)".

p.23, the symbol "A_{Ff}" in line 24, in (3.6) and two in the text below (3.6) be changed to "A_{mf}".

p.29, in line 5, delete "$|f>$" in "any of the allowed $|f>$ states"

p.32, at the end of line 2 after (3.17), replace "$\mathscr{D}^{\pi}_{ff'F\Sigma}(-\hat{z};\hat{e}')$" by "$\mathscr{D}^{\pi}_{ff'F\Sigma}(-\hat{z};\hat{e}')$".

p.33, in line 8, replace "as given in (B.6.b)" by "as given in (B.7.b)". And in lines 24-25, replace "the numerical results of Table 3.1 were published in [3.11], where the value of $\alpha_{43} = 0.100$ in the upper-right entry was misprinted as – 0.509." by "the numerical results of Table 3.1 and Table 3.2.b were published in [3.11] as Tables 3 and 4, in which the values of –0.0509 in the upper-right entry of Table 3 and of –0.400 in the lower-left numerical entry in Table 4 have been corrected as 0.100 and –0.360 here, respectively."

p.35, in Table 3.2.b, the upper-left entry, "$a\ ^5D_3, \left(\sum_{j'} \right)$" should be "$\left(a\ ^5D_3, \sum_{j'} \right)$". And line 2 from bottom, replace 'fluorescence intensity (3.14)" by "fluorescence intensity (3.12)".

p.41, 3 lines after 3.5.1, replace "$|F,\mu>$" by "$|f,\mu>$". And in Eq. (3.24), replace "$\frac{A_{Ff} g_F}{g_f + g_F}$" by "$\frac{A_{Ff} g_F}{g_f + g_F}$".

Chapter 4

p.52 line 2 above Section 4.1, replace "only evaluate" by "and can evaluate the induced dipole moment $\vec{p} \bullet \hat{e}'$ directly from" then put a comma after $Tr\left[\rho^{(1)}\ \vec{p} \bullet \hat{e}'\right]$

p.60, in first line, replace "with (A9) of [5.3]" by "with (A9) of [4.5]"

p.62, in (4.12.b), the "ω_1" in the denominator of the second term should be "ω"

p.66, in (4.16.c), the "$J-2$" in the 3-j coefficient should be "J"

p.68, in five lines below (4.18), "(4.14.e)" should be "(4.17.e)"

p.70, in line 6 after (4.19.a), replace "and $\sigma_\pi^C = \sigma_\pi^P + 0.75\sigma_\pi^{DP}$" by "$\sigma_\pi^{RR} = 0.75\sigma_\pi^{DP}$ and $\sigma_\pi^R = \sigma_\pi^P + \sigma_\pi^{DP}$, respectively as backscattering Cabannes, rotational Raman and Rayleigh scattering"

p.72, in (4.20.c), both expressions "$\mathcal{N}\alpha\left(1-\frac{\mathcal{N}\alpha}{3\mathrm{e}_0}\right)^{-1}$" should be "$\frac{\mathcal{N}\alpha}{\mathrm{e}_0}\left(1-\frac{\mathcal{N}\alpha}{3\mathrm{e}_0}\right)^{-1}$"

p. 88, lines 6-7, replace "thermal conductivity, K," by "thermal conductivity, κ,"

p. 89, line 2 after (4.27), replace "$x = \frac{2\pi\Delta\nu}{\mathrm{Kv}_0}$" by "$dx = \frac{2\pi d\nu}{\mathrm{Kv}_0}$"

p. 91, in lines 15, 14 and 12 from bottom, the *y* values for 0, 5 and 10 km should be 0.590, 0.367 and 0.215, respectively, as correctly printed in Table 4.5.

Chapter 5

p. 95, two lines after Fig. 5.1, replace "*n* (kmol^{-1})," by "*n* (kmol m^{-3}),"

Chapter 6

p. 116, in line 6, replace "[6.20; 6.14]" by "[6.15; 6.20]"

p.118, at the end of the line after (6.8.d), replace "as" by ", following (8) and (7) of [6.19], as"

p. 122, in line 7 from bottom, "can measure at and near the strongest absorption line" should read as "can be made to lase at and near the strongest water vapor absorption line"

p, 130, Equation (6.11.c) should be:

$\Delta\mathcal{N}(r+\Delta r/2) \approx \frac{1}{\Delta\sigma^A\Delta r}\left[\frac{\sqrt{N_{off}(r+\Delta r)+B^{\Delta r}}}{N_{off}(r+\Delta r)} + \frac{\sqrt{N_{on}(r)+B^{\Delta r}}}{N_{on}(r)}\right]$. And at the end of the page, "$\Delta\mathcal{N}_{O_3}(5km;) = 3.25\times10^9 m^{-3}$" should be "$\Delta\mathcal{N}_{O_3}(5km) = 3.93\times10^{14} m^{-3}$".

p.131, in the first line, "error of $\left(\Delta\mathcal{N}_{O_3}/\mathcal{N}_{O_3}\right) = 2.14\times10^{-8}$. This much" should be "error of $\left(\Delta\mathcal{N}_{O_3}/\mathcal{N}_{O_3}\right) = 2.57\times10^{-3} \approx 0.26\%$. This". And in line 2, delete the word "clear".

Chapter 7

p.138, in line 20, delete "the following:"

p.148, in line 9 after Fig. 7.4, replace "[6.19; 6.23]" by [6.19; 6.22]".

p. 154, in line 10 from bottom, replace "along with an added term for initial pressure (IP) uncertainty in $\delta T_4(z_i)$." by "and with and without an added term for initial pressure (IP) uncertainty, respectively for $\delta T_4(z_i)$ and $\delta T_{2,3}(z_i)$, with $B=0$ for $\delta T_2(z_i)$."

p.155, in lines 9 -12 after (7.8), replace "For the curves in Fig. 7.5(b) the values for δT_2, δT_3 δT_4 are $B=0$, $B=3600$, and $\delta p_b(z_n+\Delta z/2)=0$, and B = 3600, respectively. The resulting temperature uncertainties, on the same order as those in Fig. 7.5(b), and wit $\delta p_b(z_n+\Delta z/2)=0.5p_c(87\ km)$, are," by "The values $(B, \delta p_b(z_n+\Delta z/2))$ in the curly bracket of the expression for $\delta T(z_i)$, (7.7.e) are, respectively $(0,0), (3600,0),$ and $(3600, p_c(87\ km))$ for δT_2, δT_3 and δT_4. The resulting five temperature uncertainties shown in Fig. 7.5(b) are,"

p.159, in the 3rd line above (7.10.c), replace "(with $\eta_1+\eta_2=1$)" by "(often with the condition $\eta_1+\eta_2=1$)"

p.159, in two lines below (7.10.c), replace "the single-photon uncertainty of the lidar measurement." by "the single-photon measurement/counting uncertainty."

p.164, in figure caption of Fig. 7.9 (b), add "of the RASC lidar" after "to mimic BS5 and BS4a+BS4b"

p. 171, line 3, "(4.27)" should be "(7.11.c)".

p.177, in line 2 above (7.14.b), replace "$F_i^n(\nu)$ is a filter with" by "$F_i^n(\nu)$ is the $i-$th filter normalized to".

p. 180, in lines 7-8 from bottom, replace "PMT3/PMT4" by "PMT4/PMT3".

p. 185, in 3rd line above (7.17.a), replace "variance, σ_ν^A, which is" by "associated $\Delta\nu_{HWHM}$,"

p. 186, in line 13 after Fig. 7.19, replace "Since the FWHM of the AVF" by "Since the HWHM of the AVF"

p. 193, line 11 from bottom, replace "[7.19]" by "[7.12]"

p.194, line 8 from bottom, replace "the mean Doppler shift, $\overline{\nu_D}$,…" by "the mean Doppler shift, ν_D,…"

p.199, in line 7, replace "laser-shape function" by "laser line-shape function"

p. 207, in line 8 of the 2nd paragraph, replace "lower the baseband optical field Doppler shift, ν_D, to" to "lower the carrier of the Doppler shift, ν_D, from an optical frequency to". And replace the last sentence in the 2nd paragraph by "At the same time, it brings complications from the optical field (i.e., noise related to spatial coherence and speckle modulation) into the photocurrent in the RF range. "

p. 212, at line 3 from bottom, "Eq. (3.23)" should be "Eqs. (3.23)"

p. 213, in the line below (7.30.b), replace "with $\sigma_i^{\pi}(\nu_L, T, V)$" by "with $\sigma^{\pi}(\nu_L, T, V) \equiv d\sigma^{\pi}_{fF\Sigma} / d\Omega = \sum_i \sigma_i^{\pi}(\nu_L, T, V)$"

p. 215, in Table 7.5(b), the order of entry for column $B^{(2)}_{fFf'}$, from top down should be (2,2), (2,1), (1,2) and (1,1). And all the empty entries should be zero like in Table 7.5(c).

p. 220, in line 8, replace "result of Rayleigh scattering." by "result of Rayleigh-Mie scattering, as in (7.32.b)."

p. 220, in line 17, replace "or downward, attenuation" by "or downward attenuation,"

p. 231, in line 8, replace "and $\mathcal{N}_{Na}(r_R)$ using Rayfit" by "and $\mathcal{N}_{Na}(r)$ using Rayfit".

p.233, "7.5.3 Scientific Contributions and Future Challenges of Narrowband LIF Lidars" should be bold.

p. 247, in line 9 of the 2nd paragraph, change "thus background noise," to "thus received background light,".

p.251, Replace the two sentences after (8.3) that opens "The RMS …" by
"Let us presume a mirror that has a surface roughness of $\lambda/4$, meaning any location on that surface has an offset from an ideal reference surface that falls within a uniform distribution about that ideal surface between $+\lambda/8$ and $-\lambda/8$. The RMS wavefront error for such a mirror is $\Phi = 0.073$, and the resulting Strehl ratio is 0.81, which is generally considered to be "acceptable image quality" for astronomical applications."

p. 253, in the caption of Fig. 8.4, replace "$D \geq 1.5 d_L$" by "$D \geq d_L$".

p. 259, in line 8 after Table 8.3, replace "Nevertheless, careful spectral" by "Nevertheless, for nighttime detection, careful spectral". And in the paragraph for 8.4.4, replace "BW=0.375/Δτ, " by "BW=0.44/Δτ (see p.199 for discussion), " , "bandwidth of 375 MHz" by "bandwidth of 440 MHz", and "bandwidth of about 11 MHz" by "bandwidth of about 13 MHz".

p.263-4, replace "$D_n(r)$" by "$D(r)$" in "$D_n(r)$ [8.9, 8.10]", line 2 above (8.7.b), in (8.7.b) and in (8.7.c).

Chapter 8

p.266, replace "https://youtu.be/dIRG2J7nrxw" to "https://youtube/dIRG2J7nrxw"

Appendix A

p. 269, in line 9 from bottom, replace "emission induced" by "emission from a state excited"

p. 271, in line 6, replace ", leading to:" by ", as given in (3) of [A.6], leading to:"

p.271, Replace "A_{ki}" in the first line of (A.7) by "$A_{m_k i}$", and add "$A_{m_k i} =$" to the beginning of line 2 of (A.7).

p.271, Replace "A_{ki}" in (A.8.a) and in the line after (A.8.a) by "$A_{m_k i}$". Add below (A.8.a), the sentence "Notice that $A_{m_k i}$ and (A.7) and (A.8.a) are respectively the same as $A_{m_k i}$ and (3) in [A.6]."

p. 272, Replace "A_{ki}" in the third line after (A.9) and that in (A.10) by "$A_{m_k i}$".

p. 273, in line 6, replace "(A.1)" by "[A.1]".

p. 273, Replace, "$w_{ik} =$", "$w_{ki} =$" and "$g_i w_{ik} = g_k w_{ki}$" in (A.12) by "$w_{m_i k} =$", "$w_{m_k i} =$" and , "$g_i w_{m_i k} = g_k w_{m_k i}$" respectively.

p. 273, Replace "$\sigma_{ik} = \dfrac{\hbar \omega_{ki} w_{ik}}{I}$" in line 3, "$= \dfrac{4\pi^3}{3e_0 h\lambda} \dfrac{S_{ki}}{g_i} g\left(\nu - \nu_{ki}\right)$" in line 4, and

"$g_i w_{ik} = g_k w_{ki} \rightarrow g_k \sigma_{ki} = g_i \sigma_{ik} \rightarrow \sigma_{ki} = \dfrac{\pi \omega_{ki}}{3e_0 \hbar c} \dfrac{S_{ki}}{g_k} g\left(\omega - \omega_{ki}\right) = \dfrac{4\pi^3}{3e_0 h\lambda} \dfrac{S_{ki}}{g_k} g\left(\nu - \nu_{ki}\right)$" in line 5 of (A.13) by "$\sigma^A = \sigma_{m_i k} = \dfrac{\hbar \omega_{ki} w_{m_i k}}{I}$", "$\sigma^A = \dfrac{4\pi^3}{3e_0 h\lambda} \dfrac{S_{ki}}{g_i} g\left(\omega - \omega_{ki}\right) = \dfrac{2\pi^2}{3e_0 h\lambda} \dfrac{S_{ki}}{g_i} g\left(\nu - \nu_{ki}\right)$" and

"$g_i w_{m_i k} = g_k w_{m_k i} \rightarrow g_k \sigma_{m_k i} = g_i \sigma_{m_i k} \rightarrow \sigma_{m_k i} = \dfrac{g_i}{g_k} \sigma^A = \dfrac{\pi \omega_{ki}}{3e_0 \hbar c} \dfrac{S_{ki}}{g_k} g\left(\omega - \omega_{ki}\right) = \dfrac{2\pi^2}{3e_0 h\lambda} \dfrac{S_{ki}}{g_k} g\left(\nu - \nu_{ki}\right)$", respectively.

P, 274, in equation (A.14), "g_f" should be "g_f". In the last line of this page, the symbol for constant intensity should be italic rather than script.

p. 279, in the caption of Fig. A.1, "from (A.18.a) and (A.18.b)" should be "from (A.18.a), (A.18.b) and (A.18.c)"

p.288, in 'A.3.2 Molecular Orbitals and the….', 'A.3.2' should be 'A.3.1'.

p. 294, in last line before A.3.4, replace "[A.17]" by "[A.17] and observed in Fig. 6.5".

p.299, in the line above A.4, replace "Fig. B.2" by "Fig. B.3". And in line 8 from bottom, replace "n (kmol^{-1})" by "n (kmol m^{-3})".

p. 301, in equation (A.24.c), replace "$D = \dfrac{\overline{\overline{\mathrm{v}}}^2}{\lambda_c}$" by "$D = \dfrac{\overline{\ell \mathrm{v}}}{3}$".

Appendix C

p. 317, please add the two paragraphs below before the last paragraph of Appendix C:

It would be a remiss of me without mentioning my appreciation to many colleagues with whom I interacted during my many trips to Japan and China. In June 1994, I attended the international laser radar conference in Sendai, Japan organized by my old friend, Humio Inaba, after which I visited colleagues in Tokyo and Kyoto area who are interested in the MLT science, in particular Toshitaka Tsuda of Kyoto University. Years later, Tosh invited me to attend the symposium on Dynamics and Structure of the Mesopause Region (DYSMER) at Radio Atmospheric Science

Center (RASC) in March 1998. This leads to a rewarding six-month sabbatical at RASC in 1999. During this time, Tosh encouraged me to give a series of lectures on atmospheric lidar and remarked that I should write a book on this topic (finally happened some 23 years later). During this period, I also made a weeklong visit of Akio Nomura's group in Shinshu University, Nagano and attended (along with other lidar scientists worldwide) the 20th Japanese lidar society meeting in Fukui organized by T. Kobayashi. I also had a chance to work with Takuji Nakamura at RASC. This developed into a long-time friendship of scientific collaboration. Takuji later moved to Japanese National Institute of Polar Research (NIPR) in Tachikawa, Japan and invited me as a visiting professor for 3 months in Autumn 2010 and again in Spring 2016, along with a 2-month visit in Spring, 2014. During these visits, I had chances to attend local meetings and to interact with several Takuji's associates at NIPR, as well as Japanese lidar and MLT scientists elsewhere. My wife Lucy and I have had chances to experience and to appreciate Japanese culture and hospitality as well as the natural beauty of Japan in Spring and Autumn.

The week prior to the DYSMEM symposium in 1998, I visited ZhiShen Liu of Ocean University of China (OUC), who visited CSU in 1995 for a year. I was delighted to see an active lidar group in China. I visited them again in 2004 and continued to interact with this group and many Liu's excellent students. As my emphasis switched from troposphere to the MLT, so are my visits in China. Xu JiYao kindly arranged a two-month lecture tour from Sep to Nov 2008, which took me to Wuhan university, University of Science and Technology of China (USTC) and OUC as well as Research Laboratories in Chinese Academy of Sciences in Beijing, Wuhan, Shanghai and HeFe. Since then, I have been visiting these Institutes nearly every other year for a period of about two months, in Oct 2009, Oct-Dec, 2011, Sep-Nov, 2013, Sep-Nov, 2015, and May-June, 2018. These trips have been hosted by Li Tao of USTC, Hu Xiong, and Yang GuoTao of National Space Science Center (NSSC) and Li Fa-Quan of Wuhan Institute of Physics and Mathematics. During these visits, I have had chances to attend lidar and MLT related local and international meetings in China. More rewarding to me is the chance to work with young scientists and graduate students in these Institutes. The fact that most of my visits were arranged in Autumn is also very much appreciated, not only for good weather, but for Lucy and I a chance to visit our relatives during the week of National Holiday in the beginning of October.

Updated on October 09, 3023