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Errata for the text X-Rays and Extreme Ultraviolet Radiation: Principles and Applications, by David Attwood and Anne Sakdinawat (Cambridge University Press)

p.5. $\Im = (5.034\text{x}10^{15} ph/sec) P[W] \lambda[nm]$is a useful expression for conversion from power in Watts to photon flux, where the brackets indicate insertion of only the numerical value, e.g., if P = 305 Watts then P[W] = 305, and if λ = 1.31 nm then λ[nm] =1.31.

p.42. Add below Eq.(2.39): where $|S|$ is the intensity, I, typically in units of w/cm^2. See numerical formulas below at the errata for p.60.

p.43. Eq.2.43 is clearly for the scalar electric field, E(r,t), as is the equation just above it.

p.60. Add Eq.(3.41), $\theta_c = \sqrt{2\delta}$. For convenience, also add the following three 'practical equations', $\overline{I} = 1.327x10^{-3} E_0^2 [\text{V/cm}] W/cm^2$ or $I = 1.327\text{x}10^{13} E^2[\text{V/Å}]\ W/cm^2$ and

$E_0 = 2.745x10^{-7}\sqrt{I[\text{W/cm}^2]}\text{V/Å}$

p.110. Useful to add DOF = ±½(λ/NA^2) Eq.(10.45); NA=nsinθ ≈ sinθ (p.474) ; For an Airy pattern D_{FWHM} = 0.515 λ/NA (p.484).

p.145. Reference 15 should be dated 1977. To reference 16 add E.S. Gluskin et al., "The Study of the Helical Undulator Parameters Installed in the Storage Ring VEPP-2M as a Source of X-Ray Microscopy and holography", p. 336 in X-Ray Microscopy (Springer-Verlag, Berlin, 1983/84).

p.161. In Figure 5.9 the central cone half-angle should be $\theta_{cen} = 1/\gamma^* \sqrt{N}$.

p.162. Eq.(5.9), $\lambda' = \lambda_u/\gamma$

p.169. Remove [cos] below Eq.(5.18b).

p.171. Eq.(5.28), add a + sign after K^2/2. Also note, for consistency of usage in this text, that in Eq.(5.29b) and the text above, E[kev] should be replaced by $\hbar\omega$[keV].

p.173. Eq.(5.30), add a + sign after K^2/2.

p.176. Eq.(5.33), (1 + K^2/2) in the denominator.

p.176. Eq.(5.34), dΩ' in the denominator.

p.178. Eq.(5.37), dP in the numerator (no ')

p.179. Five lines below the Fig. 5.20 caption, N_e = …, and above Eq.(5.39), …= $\bar{I}N\lambda_u/ec$.

p.180, 181. Eq.(5.40a) and Table 5.5, $[JJ]^2 \equiv \left\{ J_{(n-1)/2}(x) - J_{(n+1)/2}(x) \right\}^2$, where $x = nK^2/4(1+K^2/2)$. For n = 1, …

p.193. Last line of the footnote, it should be… $+\lambda^2/4\pi$…

p.195. If the photon beam phase space is near diffraction limited, as with DLSRs, σ_x and σ_y may be sufficiently small that a term involving θ_{cen} must be added. See online slide 5.45 at www.cambridge.org/xrayeuv , and related discussions in online slides 5.53 to 5.54.

p.200. Mid-page, e recall Eq.(5.23a): , remove the 'a'. Several lines lower, Eq.(5.23b) should be Eq.(5.24)

p.202, 203. The sin2ω't' and sin3 ω't' terms should be negative in Eqs.(5.71 and 5.72), as well as the un-numbered equations between them. In line 3 the trig identity used should be for sin(α-β). In line 9, the trig identity should be sinαcosβ.

p.203. Change the last sentence on the page to: For small K, harmonic power within the central radiation cone scales as $P_{cen,n} \sim n^n K^{2n}$.See online slides 5.36-5.37 for calculations of harmonic power. www.cambridge.org/xrayeuv , click "Resources" then "Supporting Material" Do this twice).

p.206-209. See online slides 5.52-5.56 for the calculation of coherent power and harmonic coherent power when σ_x and σ_y are sufficiently small that a term involving θ_{cen} must be added. www.cambridge.org/xrayeuv , click "Resources" then "Supporting Material" Do this twice).

p.224. Chapter 5, reference 18, Quitmann.

p.226. Add the 1D, linear theory result (not saturation). Also see errata p. 227 and p.247 below.

$$\Delta\omega/\omega\big|_{FWHM} = 1/2\pi N_G = 1/2\pi(L_G/\lambda_u) = 2\sqrt{3}\rho_{FEL}$$

p.227, 247. See online slide # 6.39 where a 1D, constant gain calculation of FEL spectral bandwidth yields the result $\Delta\omega/\omega\big|_{FWHM} = 1/2\pi N_G = 1/2\pi(L_G/\lambda_u) = 2\sqrt{3}\rho_{FEL}$, where $N_G \equiv L_G/\lambda_u$ is the number of undulator cycles in one gain length. Note that result is for constant gain. At saturation the FEL bandwidth will be broader than this

p.237. Below Eq.(6.10), $[JJ]^2 \equiv \left\{J_{(n-1)/2}(x) - J_{(n+1)/2}(x)\right\}^2$, where $x = nK^2/4(1+K^2/2)$. For $n = 1$, …

p.247. See correction above for p.227 regarding $\Delta\omega/\omega\big|_{FWHM} = 1/2\pi N_G = 1/2\pi(L_G/\lambda_u) = 2\sqrt{3}\rho_{FEL}$ Also note that two lines above Eq.(6.45a) the text should refer to (σ_ω/ω) and to ρ_{FEL}.

p.249. The LCLS electron beam diameter is 2.35σ = 49μm FWHM and its beam divergence is 2.35σ' = 2.2μr FWHM. The Rayleigh range is Z_R = 36 m, assuming $r_0 = \sigma$.

p.259. Middle of second paragraph, High Gain Harmonic Generation (HGHG).

p.265. The repetition rate for the EU XFEL is 4.5 MHz @ 10 Hz. In addition to the 40 mm period undulator there is another at 68 mm, extending coverage to 250 eV (5 nm). First lasing was in 2017.

p.272. Add to reference 44 the citation D. Zhu et al., Rev. Sci. Instr. **85**, 063106 (2014).

p.275. In reference 114 the proper spellings are Bocchetta and Elettra.

p.279 For convenience add these three 'practical equations'

$\mathrm{x}_{\max} = eE_0 / m\omega^2 = 1.947\mathrm{nm} \cdot \lambda\left[800\mathrm{nm}\right]^2 \cdot I^{1/2}\left[5\mathrm{x}10^{14}\mathrm{W/cm}^2\right]$; $I = 1.327\mathrm{x}10^{13}\, E^2[\mathrm{V/\,Å}]\; W/cm^2$

or $\overline{I} = 1.327x10^{-3} E_0^2\left[\mathrm{V/\,cm}\right] W/cm^2$ and $E_0 = 2.745x10^{-7}\sqrt{I\left[\mathrm{W/cm}^2\right]}\,\mathrm{V/\,Å}$

p.279, 287, 289, 291, 292, 296. References: D.E. Spence, P.N. Kean and W. Sibbett, "60 fsec Pulse Generation from a Self-Mode-Locked Ti: sapphire Laser", Optics Lett. **16**(1), 42 (1991); W. Sibbett, A.A. Lagatsky and C.T.A. Brown, "The Development and Application of Femtosecond Laser Systems", Optics Express **20**(7), 6989 (2012).

p.287. $v(t) = -[eE_0/m\omega](\sin\phi - \sin\phi_0)$

p.289. Figure 7.6 cation, line 2, E_L. Nine lines up from bottom, remove 3.17KE = .

p.297. In Eq.(7.13), $2hn_h$

p.328. Eq.(8.25), **E** + **v** x **B .**

p.356. Boxes should be placed around the n_j**v** **(**nonlinear) product term in Eq.(8.123c), and around the triple product term n_j**v•**∇**v** in Eq.(8.123d).

p.356. Above Eq.(8.124a), replace Eq.(8.44) by Eq.(8.123a).

p.377. Fifth line, Table 8.2.

p.383. Fig.8.25, inset, Focal diameter ≈ 80µm.

p.386. Fig. 8.28, inset, 0.53 µm.

p.387. Figure 8.29, labels, 1.06 µm, 0.53µm, 0.35 µm.

p.450. Figure 10.2, Ir @ 7.8mr (0.45°).

p.455. In addition to the given references 10.23 to 10.54, two important references which appear elsewhere should have been repeated in section 10.3, Multilayer Mirrors. Reference 3.34 should be placed prominently here: J.H. Underwood and T.W. Barbee,"Soft X-ray Imaging with a Normal Incidence Mirror", *Nature* **294**, 429 (3 December 1981). Also, with regard to the breakthrough in EUV lithography described here and in Chapter 10: T.W. Barbee, S. Mrowka, and M.C. Hettrick, "Molybdenum–Silicon Multilayer Mirrors for the Extreme Ultraviolet," *Appl. Opt. 24*, 883 (1985).

p.471. Figure 10.20 should show an image distance, q, where θ is currently shown, and θ should be shown as the half-angle from the optical axis to the upper most ray (arrow) pointing towards P.

p.472. In Figure 10.21, just below the zone plate, brackets are missing. The equation should appear as shown in Eq.(10.14) on the previous page.

p.527. Figure 11.7 caption, (2.9 Tesla, 11 keV E_{crit}.

p.531. The Talbot distance is $ZT = 2d^2/\lambda$ .See Wikipedia, "Talbot Effect".

p.533. In the 7^{th} line, the word should be grating

p.557. First line …for printing electronic patterns for computer chips and smart phones.

p.557. Line 9, This mirror plus four others (five in total).

p.558. Fig. 11.29 caption, line six, The collection/mask illumination system consists of five mirrors.

p.559. High throughput manufacturing in 2009.

p.568. In Table A.4, one parsec = 1 au/1 arcsec

p.569 Table A.5Molar volume V_m = 22,413.698

p.625. Group velocity, 65, 350.