Errata for
Fundamentals of Radio Astronomy; Observational Methods

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Correction to Printings before 2021:

Chapter 2:

1.page 35, first paragraph of Section 2.1.5, near the end of the fifth line, in the units of I_λ, the "Hz^{-1}" should be deleted, so that set of units at the end of the line are:
W nm^{-1} m^{-2} sr^{-1}

2. page 37, in Answers, in the last line of number 1, the power of 10 should be changed from −14 to −17, so that the line reads:
$= 1.20 \times 10^{-17}$ W m^{-2} Hz^{-1} sr^{-1}.

Chapter 3:

3. page 89, in the three lines at the bottom of page:
-delete the colon and line break after "where"
-all lines should be left-justified, and
-add a period after "respectively".
The text after the equation should read:
where A_δ and A_0 are the collecting areas of the telescope with and without surface errors, respectively.

Chapter 4:

4. page 174, 2nd footnote, at end:
change "158 pp./" to "pp. 174"

Appendix IV

5. page 295: Equation IV.3 should not contain the "ϕ" and should have a period at the end, The equation should read

$$y = A\cos(kx - \omega t) + B\sin(kx - \omega t). \qquad (IV.3)$$

Corrections to Printings before 2018:

Table of Contents

correction TOC.1 p. ix. Change the title of Appendix VI from "Convolution Theorem" to "Wiener-Khinchin Theorem"

Chapter 1

correction 1.1 in QUESTIONS AND PROBLEMS, question 11.a. (p. 30): The angular size of the Sun is missing a degree symbol. This line should read:

a. Equation 1.6 (the angular diameter of the Sun is 0.533°)

Chapter 2

correction 2.1 Equation 2.8 (p. 45, Section 2.2): The last"=" sign and the following term should be deleted. This equation should read:

$$\langle E_{\mathrm{ph}} \rangle = 2.70\ k\mathrm{T} = (3.73 \times 10^{-23}\ \mathrm{J\ K}^{-1})\ T \qquad (2.8)$$

correction 2.2 p. 64. 2nd full paragraph, 5th line: Change the three sentences starting with "In Figure 2.11, we depict snapshots of ..." and ending with "...y-component decreases." to read as follows

In Figure 2.11, we depict snapshots of the electric field vector of an electromagnetic wave propagating to the left in which the electric field components oscillate out of phase. The wave starts at the right end, where the y-component of the electric field is at its maximum, while the x-component is momentarily zero. As the wave moves to the left, the x-component grows while the y-component decreases.

correction 2.3 Figure 2.11 (p. 65, Section 2.7): The axes are (incorrectly) a left-handed coordinate system. A corrected figure is shown below.

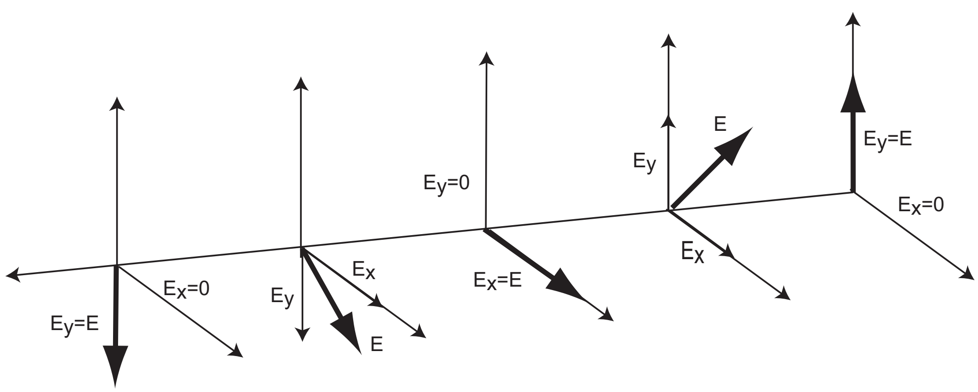

FIGURE 2.11 In an electromagnetic wave propagating to the left, electric field components in the x- and y-directions oscillate out of phase, causing the total electric field vector to rotate around the direction of propagation.

Chapter 3

correction 3.1 p. 114, last paragraph, first line: "(the Convolution Theorem)" should be changed to "(the Wiener-Khinchin Theorem)".

Chapter 4

correction 4.1 p. 151: In the text just before Equation 4.26 the reference to Equation 4.160 should be to Equation 4.16.

correction 4.2 p. 157: Replace the entire second paragraph with the following

To make a map, we want to measure T_A for each direction that we point the telescope, so that we get antenna temperature as a function of position, that is, $T_A(\theta, \phi)$. Strictly speaking, the map that we produce is the correlation of the normalized beam pattern and the source intensity. Radio astronomers often say that the observed map is the beam pattern *convolved* with the true sky intensity (or brightness) distribution, even though this is, to be precise, a correlation. However, for a symmetric beam pattern, in which $P_{\mathrm{bm}}(\theta-\theta_0, \phi-\phi_0) = P_{\mathrm{bm}}(\theta_0-\theta, \phi_0-\phi)$, which is most often the case, there is no difference between a correlation and a convolution. We will follow the standard convention in radio astronomy and refer to this as a convolution. The effect of a convolution is to smear out the true intensity distribution over an area the size of the telescope's beam. For a given source size, convolution with a smaller beam has a smaller effect on the map. This is, essentially, a statement about resolution.

correction 4.3 p. 158, The second full paragraph should read:
If we analyze the total detected power for each beam position we will infer an intensity as a function of θ that looks like that shown in Figure 4.5.

correction 4.4 Figure 4.5 (p. 159, Section 4.5.1). The diagonal lines at the left and right sides should be arced lines ($\propto \theta^2$). A correct figure is shown below

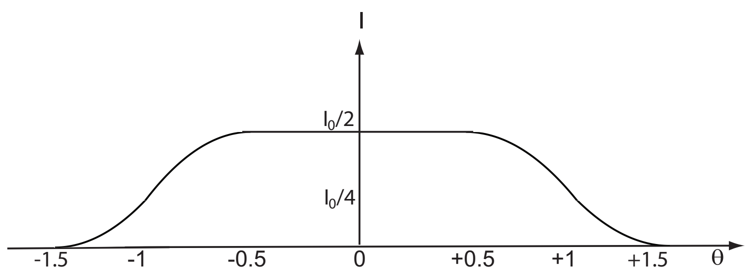

FIGURE 4.5 Resultant map obtained observing the double triangle source with the square beam shown in Figure 4.3.

correction 4.5 In QUESTIONS AND PROBLEMS, question 4.13 (p. 179): There are two ways to solve this problem which yield conflicting answers. To correct this ambiguity, the question should be reworded as follows:

13. A 32.0-m telescope with aperture efficiency of 0.620 is used to map a source at 6.00-cm wavelength, which is later learned to be a point source. The resulting image is of a circular feature with a Gaussian profile of FWHM of 7.40 arcmin.

Appendix VI

correction VI.1 p. 313: Change the title of this Appendix from "Convolution Theorem" to "Wiener-Khinchin Theorem."

correction VI.2 p. 313: This whole page should be changed to read as follows.

THE WIENER-KHINCHIN THEOREM STATES that the Fourier transform of the autocorrelation function is the power spectrum.

The Fourier transform of a correlation of two functions can be shown to be equivalent to the product of the Fourier transforms of the two functions. Mathematically, this is given by

$$F(a) \times F(b) = F(a * b)$$

where: $a * b$ represents the correlation of functions a and b, and $F(a)$ represents the Fourier transform of function a. If the correlation is to occur over the time domain, then the correlation $h(\tau)$, of the functions $a(t)$ and $b(t)$, is defined by

$$h(\tau) = \int a(t)b(t-\tau)dt$$

where the independent variable, τ, is called the *delay*. An *autocorrelation* is the correlation of a function with itself.

Applying this to $E(t)$, the electric field entering the spectrometer (see Section 3.5.2), the autocorrelation function (ACF) is

$$ACF[E(\tau)] = \int E(t)E(t-\tau)dt.$$

and by taking the Fourier transform, we have

$$F\left(ACF[E(t)]\right) = F[(E(t)] \times F[E(t)],$$

By the Wiener-Khinchin Theorem this equals the power spectrum $P(\nu)$. In a digital spectrometer the power spectrum is obtained by calculating $F[(E(t)] \times F[E(t)]$.