Errata for first printing

Page 23, Table 2.1, last sentence of item 4.B starting with "this is expected ...": Remove this sentence—this is invalidated as based on our recent solution to the related problem; find updated discussion in our new publications.

Page 83, Figure 5.7d: Replace $\dot{u}_{\mathrm{r}}$, $f(\dot{u}_{\mathrm{r}})$ and u_{r}, by $\dot{u}$, $f(\dot{u})$ and u.

Page 84, Eq. (5.27), also second term in Eq. (5.33): Replace "u_q" by "$u_{q\mathrm{r}}$, where $u_{q\mathrm{r}} = (u_q - u_{s'}) + (u_q - u_{s''})$, $u_{s'}$ and $u_{s''}$ being the displacements of the vacuuon oscillators on the right and left."

In Eq. (5.29) and in the two lines above Eq. (5.29): Replace "u_q" by "$u_q - u_{s'}$", and "u_{r}" by "$u_{s'} - u_q$". Cf. Appendix A6.2B in this Errata.

Page 85, Eq. (5.34): Replace "$\sqrt{\frac{\beta_q}{\mathfrak{M}_q}}$", by: "$\Omega$." Add: "The equation of motion is solved in Appendix 6.2 in this Errata. For now we only apply an existing knowledge that for small displacement the oscillation of the vaculeon oscillator in normal coordinate is harmonic, and thus write down the equation of motion as $\frac{d^2\mathcal{U}_{qn}}{dT^2} + \Omega_q^2\mathcal{U}_{qn} = 0$, Eq. (5.33b)."

Page 85, LHS of Eq. (5.35): Replace u_q by $\mathcal{U}_{qn}$.

Page 85, second line from bottom: Replace "(5.33) has ..." by "(5.33b) has ...".

Page 86, Eq. (5.36): Replace "Ω_{r}" by "Ω". See further Appendix 6.2A in this Errata.

Page 96, Eq. (6.5): Replace "$\sum_{X_s}\sum_{\Omega} A_{\Omega s}$" by "$\frac{2\pi}{\sqrt{N_{bL}}}\sum_s\sum_K$".

Page 97, Eq. (6.6): Replace "u_{r}" by "$u_{\mathrm{r}}^K(X_s,T)$".

Eq. (6.7): Replace "$u_{\mathrm{r}}(T)$" by "$u_s(X,T)$".

Eq. (a) and Eq. (6.9): Replace "$u_{\mathrm{r}}(T)$" in the first term by "$\sum_s u_s(X_s,T)$", and "$u_{\mathrm{r}}(T)$" in the second term by "$\sum_{s,K} u_{\mathrm{r}}^K(X_s,T)$".

Page 98: Replace the last paragraph, starting from line 2 from bottom ("Following the above ..."), with discussion in Appendix A6.2B in this Errata.

Page 99, Eq. (6.13): Replace "A_{r}" by "A", and "Ω_{r}" by "Ω".

Pages 101-102 (Sec. 6.5): Remove Eqs. (a), (b), and Eq. (6.18a). Use Eq. (6.18b) or (F.15) only. Remove the line after Eq. (6.18b) on page 102.

Page 103: Replace the content from Eq. (6.25) to Eq. (6.27) by Appendix 6.2B in this Errata.

Page 108, Eq. (6.39a): Replace "$X^2 + Y^2 + Z^2$" by: "$X\hat{X} + Y\hat{Y} + Z\hat{Z}$".

Page 111, Eqs. (a), (c) and (d): Replace the equations by: "$\Omega = \Omega_q$", "$A_{\mathrm{r}}(=A) = A_q$" and "$A = A_q$".

Page 112: Remove Eqs. (6.49a) and (6.49c). Use Eqs. (6.49b) and (6.49d) only.

Page 113, in Eq. (6.54b), in the line above Eq. (6.54b), and in Eq. (6.55b): Replace "$\frac{1}{2\pi K}$" by "b".

Page 114, RHS of Eq. (6.56): Remove the last expression.

Page 117, Eq. (6.63) and in the second line above: Replace "$\frac{1}{2\pi K}$" by "b".

Page 117, Eqs. (6.64), (6.67) and (6.69): Replace "$\frac{\Omega^3}{c}(=\frac{K^3}{\mu_0\epsilon_0})$" by "$\frac{\Omega^2}{2\pi b}$".

Page 118, Eq. (6.70): Replace "$\frac{1}{\epsilon_0 b}$" by "$\frac{\mu_0}{2\pi}$".

Pages 231-234, Appendix E: Replace "$A_{q'}$" by "A_q". In the second paragraph: Remove the discussion starting from second line after Eq. (E.1).

Pages 243-4, Appendix I, Eqs. (I.1), (I.2), (I.4), (I.8), (I.10), (I.12): Replace "∇" by "$\boldsymbol{\nabla}$".

Page x (About Contributors), second paragraph, line 2 from bottom: Replace "co-developed" by "co-authored".

Appendix to Sec. 6.2: The Forced Oscillation of Vacuum by Nature

6.2A. Oscillation frequency of the medium versus driving frequency of the vaculeon source It is established in classical wave mechanics that, for an ordinary coupled oscillator system subjecting to a driving force, the initial total oscillation includes a forced oscillation and free oscillation; when reaching a so-called steady state after a sufficiently long time, with the free oscillation being damped off, only the forced oscillation will sustain. For the coupled vacuuon oscillator system, we will be mainly concerned with its applications in the formation of material particles in stationary states (Chapters 7-8), which fall on the steady state, forced oscillation case. Besides, even initial state is in question, a free oscillation would be essentially absent given the vacuuons have a zero rest inertia.

Furthermore, it may be induced based on observations, on the scattering of electromagnetic waves by charged particles in particular, combined with theoretical analysis which we present in a separate publication, that the oscillation of the vacuuon oscillators would plausibly assume the driving frequency Ω_q:

$$\Omega = \Omega_q \qquad (A6.2.1)$$

We here only supply one argument that (A6.2.1) should hold given the vacuuon oscillators have a mass produced only dynamically and in direct proportion to the driving frequency Ω_q.

6.2B. Displacement amplitude of the vacuum versus vaculeon source As an alternative to the traditional treatment which will yield a amplitude which increases when nearing resonance frequency, we here establish a relationship between A and A_q concretely for the specific source, an oscillatory (vaculeon) charge driven by its own spontaneous kinetic energy, which is itself an oscillator in the chain. Consider the source is at location $X_s = sb$ in the place of the regular site of a vacuuon oscillator, s, and has a harmonic displacement $u_q(X_s, T) = A_q e^{i(Ksb-\Omega_q T)}$. For $\Omega_q = \Omega$, this writes:

$$u_q(X_s, T) = A_q e^{i(Ksb-\Omega T)} \qquad \text{(a)}$$

Ignoring any source-vicinity effect, the displacements of the vacuuon oscillators in contact with the source, at X_{s-1} and X_{s+1}, are given by the earlier solution for regular sites: $u_{s-1} = Ae^{i(K(s-1)b-\Omega T)}$, $u_{s+1} = Ae^{i(K(s+1)b-\Omega T)}$. In the nearest-neighbor representation, the source makes at any time the displacements $u_q - u_{s-1}$ and $u_{s+1} - u_q$ relative to its neighbors. The chain, through the direct contacting neighbors to the source, will tend to restore the source back to its equilibrium. For small displacement each force obeys the Hooke's law, with β_q the force constant for the source–vacuuon-chain interaction; accordingly the total force writes:

$$F_{qRt} = -\beta_q(u_q - u_{s-1}) - \beta_q(u_{s+1} - u_q) = -\beta_q[2u_q - u_{s-1} - u_{s+1}] \qquad \text{(b)}$$

With the explicit functions for the displacements, (b) writes $F_{qRt} = -\beta_q A_q e^{i(Ksb-\Omega T)}[2 - \frac{A}{A_q}(\cos Kb - i\cos Kb + \cos Kb + i\cos Kb)] = -\beta_q A_q e^{i(Ksb-\Omega T)} 2[1 - \frac{A}{A_q}\cos Kb]$.

Substituting in it with (a), we have

$$F_{qRt} = -\beta_q u_q 2[1 - \frac{A}{A_q}\cos Kb] \qquad (A6.2.2)$$

With (A6.2.2), the Newtonian equation of motion for the source, $\mathfrak{M}_q \frac{d^2u_q}{dT^2} - F_{qRt} = 0$, thus writes:

$$\mathfrak{M}_q \frac{d^2u_q}{dT^2} + \beta_q u_q 2[1 - \frac{A}{A_q}\cos Kb] = 0 \qquad (A6.2.3)$$

From (a) we have $\frac{d^2u_q}{dT^2} = -\Omega^2 u_q$; with this in (A6.2.3) we have $-\mathfrak{M}_q\Omega^2 u_q + \beta_q u_q 2[1 - \frac{A}{A_q}\cos Kb] = 0$. Eliminating the common u_q, reordering we have

$$\Omega^2 = \frac{\beta_q}{\mathfrak{M}_q} 2[1 - \frac{A}{A_q}\cos Kb] \qquad (A6.2.4)$$

But $\Omega^2 = 4\Omega_{\rm r}^2 \sin^2\left(\frac{Kb}{2}\right) = \frac{\beta_{\rm r}}{\mathfrak{M}_b}[1 - \cos Kb]$ as given after Eq. (a) of Sec. 6.4., the solution from the regular regions of the chain, where $\Omega_{\rm r}^2 = \frac{\beta_{\rm r}}{\mathfrak{M}_b}$. Canceling Ω^2 between this and (A6.2.4), we have $\frac{\beta_q}{\mathfrak{M}_q}[1 - \frac{A}{A_q}\cos Kb] = \frac{\beta_{\rm r}}{\mathfrak{M}_b}[1 - \cos Kb]$. Sorting, the above gives

$$A = A_q \frac{1 - \frac{\Omega^2}{2(\beta_q/\mathfrak{M}_q)}}{1 - \frac{\Omega^2}{2\Omega_N^2}} = A_q \frac{1 - \frac{(\beta_{\rm r}/\mathfrak{M}_b)4\sin^2\frac{Kb}{2}}{2(\beta_q/\mathfrak{M}_q)}}{1 - 2\sin^2(Kb/2)} \qquad \text{(c)}$$

For waves in the continuum region, there is $Kb << 1$, and thus $\sin^2(Kb/2) << 1$. Further assuming $\frac{(\beta_{\rm r}/\mathfrak{M}_b)}{\beta_q/\mathfrak{M}_q}$, if > 1, is not significantly greater than 1, then the second term in the numerator is $\frac{(\beta_{\rm r}/\mathfrak{M}_b)4\sin^2\frac{Kb}{2}}{2(\beta_q/\mathfrak{M}_q)} << 1$. So to a good approximation (c) reduces to

$$A = A_q \qquad (A6.2.5)$$