3.6.1.3. The Spectrum in One *Direction*

The idea is that all active energy linked to the concept of ***subton*** state modes provides a continuous ***spectrum*** of angular frequencies $\omega \in\mathbb{R}$ as a *proper finite*[152] ***quality*** in physics.

Such a ***spectrum*** of the circle oscillators is complementarily related to a ***direction*** *FORWARD* with an associated development parameter $t \in\vec{\mathbb{R}}$ as a growing ***quantity***, as evidenced in all the above intuition and understanding.

Such a ***direction*** is indicated as a vector $\widehat{\vec{\omega}} \parallel \vec{\omega} = \vec{\omega}/\omega$, pointing into the future.

The vector $\widehat{\vec{\omega}}$ is the internal auto-norm ***direction***, hence $|\widehat{\vec{\omega}}| \equiv 1 \Rightarrow \omega_{\text{int}}{=}1 \Rightarrow \phi{=}t$, while the vector $\vec{\omega}$ is the external normed ***direction*** for us, where we put $|\widehat{\vec{\omega}}| \equiv 1 \Rightarrow \phi = \omega t$, with the external angular frequency ***quantity*** $\omega[\widehat{\omega}]$, $\omega \in\mathbb{R}$ relative to our norm $\widehat{\omega} \equiv 1[\widehat{\omega}]$ for the concept.

The transformation from our norm to the autonomous norm (3.187) is $\widehat{\vec{\omega}} \leftarrow\!\parallel\!\rightarrow \omega\widehat{\vec{\omega}}$.

From our frequency standard $\widehat{\omega} \equiv 1[\widehat{\omega}]$ we can choose an appropriate reference frequency $\omega_c[\widehat{\omega}]$ for the ***spectrum*** of our ensemble object.

We see the carrier generator ω_c as the reference source for the system chronometer $\{t_c\}$ $[\widehat{\omega}^{-1}]$.

For your intuition of a local ***spectrum*** chronometer time t_c to be counted as the developing parameter for the phase $\phi = \omega t_c$ of all angular frequencies $\forall\omega \in\mathbb{R}$ in the ***spectrum***, see (3.255) from (1.81) in section 1.7.7. and later II. 4.1.4.2.

It is not t_c, that is the cause of the activity, but rather that ***entity*** Ψ that creates ***subtons*** including a carrier generator ω_c as a chronometer $\{t_c\}$.

A philosophical banality: The creation is the cause. Question: What ***entities*** Ψ creates in physics? (Temperature)

The phenomenon we conceptually represent is an ***active spectrum*** $\forall\,\Psi_{\vec{\omega}} \in \Psi$, wherein each angular frequency $|\vec{\omega}|{=}\omega$ is populated by ***subtons*** $\psi_{\pm\vec{\omega}\perp\odot} \subseteq\Psi_{\vec{\omega}} \subset\Psi_{\omega}$ constituting an a priori basis for the ***primary quality*** we call development.

My main contention claim is that development has ***direction***. (A synthetic judgement.)

This ***direction*** goes through or together with a transversal plane propagating at the speed of light c.

The development 'speed' depends solely on the angular frequency energy ω in the circle oscillator.

Here in this intelligible crawl, we limit ourselves to **one**[153] common ***direction*** $\mathbf{e}_3$ for all ***subtons*** in the ***spectrum*** of $\forall\omega \in\mathbb{R}$, given by $\mathbf{e}_3{=}\widehat{\vec{\omega}} = \vec{\omega}/\omega = \vec{\omega}_c/\omega_c$ in the way that all $\forall\vec{\omega} \parallel \mathbf{e}_3$ and all the autonomous normed $\forall\widehat{\vec{\omega}} \parallel \vec{\omega}$ are called a ***primary quality of first grade***.

We let the chronometer $\{t_c\}$, which gives the development parameter $t_c = \phi_c/\omega_c$ and measures out the angular carrier phase $\phi_c{=}\,\omega_c t_c$ by the carrier ω_c; also measure out the extension $x_3 = ct_3$ of all in A created ***subtons***

(3.285) $$^{A}\big|\psi_{\pm\vec{\omega}\perp\odot}(\varphi)\big\rangle = {}^{A}\odot_{\perp\vec{\omega}}2\tilde{r}(\rho)e^{\pm i\varphi} = \odot_{\perp\vec{\omega}}2\tilde{r}(\rho)e^{\pm i\omega(t_{c,A}-\,t_3)},$$

for $\forall\rho{\ge}0$, $\forall t_3{\in}\big[0,t_{c,A}\big]$, and where $\varphi = \omega\big(t_{c,A}-t_3\big)+\theta = |\vec{\omega}|\big(t_{c,A}-t_3\big)+\theta$ for each angular frequency $\omega \in\mathbb{R}$ in the ***spectrum***.

The extensions parameter $t_3 \in \{t_c\} \subset \vec{\mathbb{R}}_+$ is of the same ***quality*** as the chronometer time $t_c[\widehat{\omega}^{-1}]$ and measured as a ***quantity*** $t_3[\widehat{\omega}^{-1}]$ from this by the carrier frequency $\vec{\omega}_c[\widehat{\omega}]$.

The extension coordinate $x_3{=}-ct_3$ is by this measured continuous from the ***spectral*** transmitter A.

For each frequency in the ***spectrum***, we write the beam extension in one ***direction*** $\mathbf{e}_3$ as a macroscopic state mode, as a field W created in A of a certain amplitude

[152] *Proper finality* is rooted in the problem of the ultraviolet catastrophe. We have the idea of Planck frequency $1.22{\cdot}10^{28}$eV as the limit. The most energetic gamma particle reported observed $16{\cdot}10^{12}$eV. Opposite we have $\omega = 0 \Rightarrow$ eternity, therefore $\omega \neq 0$.

[153] There is a myriad of different ***directions***. Here we look only in one ***direction***. It remains to a later chapter, what number of linearly independent ***directions*** we can find configuring natural space in physics.

(3.286) $$\big|\psi^{\text{macro}}_{\Sigma\pm\omega\mathbf{e}_3\perp\odot}(t_c,x_3)\big\rangle_{\text{A}} \rightleftharpoons W^{\text{helix}}_{\pm\omega,\text{A}}(\,t_c,x_3) = \boldsymbol{A}_{\text{A}}\boldsymbol{A}_{\text{loss}}(x_3)\big(e^{\pm i(\omega t_c+k_3x_3)}\big)_{\mathbf{e}_3} = \boldsymbol{A}_{\text{A}}\boldsymbol{A}_{\text{loss}}(ct_3)\big(e^{\pm i\omega(t_c-t_3)}\big)_{\mathbf{e}_3},\quad k_3{=}\,\omega/c.$$

The constant transmitting amplitude of this field has proportionality $\boldsymbol{A}_{\text{A}}{\sim}\sqrt{N_{\text{A}}}$, since power is proportional to the number $N_{\text{A}}(\omega)$ of ω ***subtons*** created per radian $\phi_c{=}\,\omega_c t_c$ from the chronometer$\{t_c\}$. The chronometer-independent field is written as $\tilde{q}(\omega,x_3) = \boldsymbol{A}_{\text{A}}\boldsymbol{A}_{\text{loss}}(x_3)$ or simply $\tilde{q}(\omega) = \boldsymbol{A}_{\text{A}}$, that is as a function of the ***direction*** $\mathbf{e}_3$,

(3.287) $$|\tilde{q}(\omega)|^2_{\text{A},\mathbf{e}_3} = \big|W^{\text{helix}}_{\pm\omega,\text{A}}(t_c,0_3)\big|^2_{\mathbf{e}_3} = \hbar\omega N_{\text{A},\mathbf{e}_3}(\omega) = I_{\text{A}}(\omega,\mathbf{e}_3),$$ for the intensity.

This is the ***power spectrum*** from transmitter A. Here only in one ***direction*** $\mathbf{e}_3$.

Then the variable power of a ray from A at one angular frequency ω can be assigned

(3.288) $$P_{\text{A},\mathbf{e}_3}(\omega,t_c,x_3){=}\,|\tilde{q}(\omega,t_c,x_3)\,|^2_{\mathbf{e}_3}{=}\,\big|W^{\text{helix}}_{\pm\omega,\text{A},\mathbf{e}_3}(t_c,x_3)\,\big|^2{=}\,\hbar|\omega|N_{\text{A},\mathbf{e}_3}(\omega,t_c)\hbar\omega A^2_{\text{loss}}(x_3)$$

The chronometer constant, but frequency-dependent field amplitude from the transmitter A can now be written short as $|\tilde{q}(\omega)| = \sqrt{\hbar|\omega|N_{\mathbf{e}_3}(\omega)}$.

We call the function $\tilde{q}(\omega) \in\mathbb{C}$ of $\omega \in\mathbb{R}$ the complex amplitude ***spectrum***.[154]

Based on the conceptual idea of the inverse Fourier integration of this ***spectrum*** we get the complex ***quantity*** $q(t) = \int_{\mathbb{R}}\tilde{q}(\omega)e^{i\omega t}\,d\omega$, which is an $\mathbb{C}$ integrable function[155] dependent on a development parameter $t \in\{t_c\}[\widehat{\omega}^{-1}]$ of the same ***quality*** and norm $\widehat{\omega} \equiv 1[\widehat{\omega}]$ as the chronometer. Complementary to this, we conclude:

If an objective ***entity*** in physics is attributed a feature ***quantity*** $q(t) \in\mathbb{C}$, that is integrable and dependent on the development parameter $t \in\mathbb{R}$, this ***quantity*** can be dissolved in circle oscillators and integrated over time into a complex Fourier ***spectrum***

(3.289) $$\tilde{q}(\omega) = \tfrac{1}{2\pi}\int_{\mathbb{R}}q(t)e^{-i\omega t}\,d\tau,$$

and these circle oscillators propagate into the future as what we now call ***subtons***.

3.6.2. The Development of Entities in Physics

Transformed ***entities*** Ψ_{A} we intuit as complex ***quantities*** $q_{\text{A}}(t) \in\mathbb{C}$, that are interpreted as functions values of a development parameter $t \in\mathbb{R}$ with the ***quality*** norm unit $[\widehat{\omega}^{-1}]$ for this ***quantity***.

These are generated chronologically in relation to the synchronism of a well-defined carrier time $\{t_c \in\vec{\mathbb{R}}\}$, in which the carrier circle oscillator has an angular frequency $\omega_c[\widehat{\omega}]$, as a real numerical value $\omega_c{\in}\mathbb{R}$, which refers to the angular reference frequency $\widehat{\omega} \equiv 1[\widehat{\omega}]$, from our norm cyclic oscillator clock.

Above, we have stated that the carrier oscillator generates a phase angle $\phi_c = \omega_c t_c$ that directly carries the development parameter $t_c = \phi_c/\omega_c$ for the chronometer $\{t_c\}$.

For the development parameter of the ***entity***, ***quantities*** $q(t)$ are required $t \in \{t_c\}[\widehat{\omega}^{-1}]$.[156]

By integrating this quantity of all development parameter values, we can form an ***amplitude spectrum*** of harmonic oscillators $\tilde{q}_{\text{A}}(\omega) = \frac{1}{2\pi}\int_{\mathbb{R}}q_{\text{A}}(t)e^{-i\omega t}d\tau$.

[154] Mistakenly, this has often been called 'power spectrum', but contrary in (3.288) the power spectrum is $|\tilde{q}(\omega)|^2$. Technically this is no problem, due to the most often used logarithmic decibel scale defined by $P = 10\log(I/I_0) = 20\log(A/A_0)$ for the relative Intensities or Amplitudes. Therefore, the relative ratios are often called the *Power Spectrum* instead of the *Fourier Amplitudes*.

[155] These complex integrable functions in Fourier transformations are described in section 1.7.7 and later below II. 4.1.4.2.

[156] A norm unit $[\widehat{\omega}^{-1}]$ may be seconds [s], and another could be $[\text{eV}^{-1}]$. If you cannot find a suitable carrier norm reference it can be based on the idea $\omega_c{=}\widehat{\omega}$. But often $\widehat{\omega}$ is only a theoretical reference, therefore one needs a real physical carrier reference whose angular frequency, thus defining $\widehat{\omega} = \omega_c/\omega_{c\text{-definition}} = 1$.

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