3.3.5. Frequency Scaling of the Circle Oscillator

In section 3.1.3 we went from the *classic* ***quantity*** q_ω of the oscillator (3.1) to ***field quantity*** q by multiplying with $\sqrt{m\omega/\hbar}$ defined (3.2), whereby we eliminated m in (3.4), but has retained ω as the characteristic intrinsic ***quantity***. At (3.170) we argued that the kinetic energy flowing *FORWARD* is equivalent to the kinetic energy rotating in a circle oscillation $T_\omega = \hbar\omega \sim m_\omega c^2$, as an effective internal angular inertia, which we call $m_\omega \sim \hbar\omega/c^2$.

As we count $\hbar = c^2 = 1$, we get the multiplication factor $\omega \sim \sqrt{m\omega/\hbar}$.

In this way by intuition, we have one *classic* space-time dimension as the ***quality***, which possesses the ***quantity*** $q_\omega \sim c\, q/\omega$. For the radius dimension of the circle oscillator, we therefore introduce the scaling transformation

$$\rho_\omega = \frac{1c}{\omega}\rho. \tag{3.181}$$

Here it will be necessary to define how we measure the angular frequency ω.

We need an angular frequency standard ω_0 as measured in a conventional frequency measure in combination with a timing standard, e.g., $[\mathrm{Hz}] \sim [\mathrm{s}^{-1}]_{\mathrm{periode}} \leftrightarrow$ 1/second, as a frequency standard. or alternative the frequency energy in $[\mathrm{eV}/(\hbar{=}1)]$ as usual in Particle Physics.

3.3.5.2. Examples of Commonly Used Reference Clocks Seen as One Circle Oscillator

The angular frequency norm for one second is one turn in a circle that lasts 2π seconds $\sim 6.2831853[\mathrm{s}]$ by measuring $\hat{\omega}[\mathrm{s}^{-1}] = 1[\mathrm{Hz}/2\pi] = 1[\mathrm{radian}\cdot\mathrm{s}^{-1}]$ for this clock that gives the development information parameter of one radian per second.

The radius of this ideal simple reference circle oscillator as a clock is then

$$1/\hat{\omega}_{[\mathrm{s}^{-1}]} = \quad 1[\mathrm{s}]c = 299{,}792{,}458[\mathrm{m}]. \tag{3.182}$$

The normal circular one-second clock of $1[Hz]$, $f = 2\pi\omega$ have a classical information radius

$$\mathrm{radius}_{1[Hz]} = \frac{1c}{2\pi[Hz]} \approx 47{,}713{,}452\ [m]. \tag{3.183}$$

The most common clock angular frequency unit used in quantum mechanics is electron volts, which has the norm

$$\hat{\omega}_{[\mathrm{eV}]} = 1\left[\frac{\mathrm{eV}}{\hbar}\right] = 0.2418\cdot 10^{15}\left[\frac{\mathrm{s}^{-1}}{\hbar}\right] = \frac{1c}{197.3[\mathrm{nm}]\hbar}, \quad \text{for } \boxed{\hat{\omega} = 1[\mathrm{eV}] \text{ for } \hbar = c^2 = 1}. \tag{3.184}$$

Having a radius $\overset{\odot}{\bar{r}}_{\hat{\omega}[\mathrm{eV}]} = \frac{1c}{\hat{\omega}_{[\mathrm{eV}]}} = 197.3[\mathrm{nm}]$ and a wavelength $\lambda = 2\pi \overset{\odot}{\bar{r}}_{\hat{\omega}[\mathrm{eV}]} = 1239.7[\mathrm{nm}]$, which is an infrared wavelength for normal light (visible wavelengths are from 380-750[nm]).

3.3.5.3. The Relative Reference for the Circle Oscillator and the Autonomous Norm

In the ***relativistic quantum mechanics*** as above section 3.3.4, we most often set $\hbar = c^2 = 1$.

From an intrinsic frequency normal $\hat{\omega}$, that by definition of course is normed $\hat{\omega} \equiv 1$ and a ***direction*** $\vec{1}_{\mathrm{ref}}$, which magnitude is measured as 1 radian in $\hat{\omega}$, i.e.

$$\left|\vec{1}_{\mathrm{ref}}\right| = 1[\mathrm{radian}] = 1[\hat{\omega}^{-1}]. \tag{3.185}$$

From this, any frequency energy $\omega > 0$ is conceivably excited as a circle oscillator with the rotation vector (⮤ We hide negative frequency energies in $-\omega = \omega_- < 0$.)

$$\vec{\omega} = \pm\omega\vec{1}_{\mathrm{ref}}. \tag{3.186}$$

We can for one excitation choose between two different normalizations:

- The frequency normal with any ***direction*** $\vec{\hat{\omega}} = \hat{\omega}\vec{1}_{\mathrm{ref}}$, where then $\left|\vec{\hat{\omega}}\right| = 1$, and
- Autonomous normalization for the excitation $\vec{\mathbf{1}}_{\mathrm{auto}} = \widehat{\vec{\omega}}$, which therefore is ***one quantum*** $\vec{\mathbf{1}}$.

This produces a juxtaposition of parallel interpretation $\vec{\omega} \parallel \widehat{\vec{\omega}}$, namely that

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$$\widehat{\vec{\omega}} \leftrightarrow \vec{\omega} = \omega\vec{1}_{\mathrm{ref}} = \omega\,\hat{\omega}\vec{1}_{\mathrm{ref}} = \omega\,\vec{\hat{\omega}}_{\mathrm{ref}} = \omega\vec{\hat{\omega}} \leftrightarrow \vec{\mathbf{1}}_{\mathrm{auto}}, \qquad \widehat{\vec{\omega}} = \widehat{\vec{\omega}}_{\mathrm{ref}} = \vec{1}_{\mathrm{ref}}. \tag{3.187}$$

We determine the excited ***entity*** Ψ_ω to the angular frequency energy ω with our reference $\hat{\omega}$, and get a relative ratio to the autonomous judgment $\left|\widehat{\vec{\omega}}\right| \equiv 1$ of the ***quantity*** ω.

The normal use of a frequency standard $\hat{\omega}$, $\hat{\omega} \equiv 1[\hat{\omega}]$, (e.g. (3.184)) for an excited ***entity*** $\Psi_{\pm\omega}$ in physics with angular frequency energy ω, which fundamental ***quantum*** provides a ***direction quality*** $\widehat{\vec{\omega}} \coloneqq \vec{\mathbf{1}}_{\mathrm{auto}}$, which we scale by ω to a ***quantitative direction*** from the reference vector $\vec{\omega} = \omega\vec{1}_{\mathrm{ref}}$ that for us defines the objective spatial ***direction*** of $\Psi_{\pm\omega}$. The spatial magnitude of ***directional*** unit vector $\left|\vec{\hat{\omega}}\right| = 1[\hat{\omega}^{-1}]$ is measured with the unit for the corresponding information development parameter $t = |\phi|/\omega$.

Just as the ***direction*** in intuition can be viewed autonomously normed $\widehat{\vec{\omega}} \coloneqq \vec{\mathbf{1}}_{\mathrm{auto}}$, the polar (ρ, θ) radius coordinate ρ is viewed as isotropic in the transversal plane with this unit norm.

Thereby the radial coordinate is scaled from the unitary rotation per (3.181) $\rho_\omega = \frac{1c}{\omega}\rho$

The unitary circle group $\odot = \{\theta \to e^{i\theta} | \forall\theta \in \mathbb{R}\}$ then has a radius in an everyday measure

$$\overset{\odot}{\bar{r}}(\vec{\omega}) = \frac{1c}{\omega} = \frac{299792458[ms^{-1}]}{\omega[s^{-1}]} = \frac{\lambda}{2\pi}, \quad \odot\perp\vec{\omega}, \quad \omega = |\vec{\omega}|. \tag{3.188}$$

This is expressed from the measure of an angular frequency energy ***quantity*** $\omega[\hat{\omega}]$.

We then have, that the fundamental radius of the excited physical ***entity*** $\Psi_{\pm\vec{\omega}}$ is $\frac{1c}{\omega} = \frac{\lambda}{2\pi}$ measured with the unit $[\hat{\omega}^{-1}]$ for the information development parameter t.

Hence, the speed around the transversal unitary circle $\odot$ is just: $c_\odot = \omega\overset{\odot}{\bar{r}}(\vec{\omega}) = \omega\, c/\omega = 1c$.

3.3.5.4. Scaling of the Frequency Energy in The Propagation

The relationship between energy and the angular frequency is $\hbar$, often set to one $\hbar$=1.

We again look at a single ***quantum*** $\vec{\mathbf{1}}_{\mathrm{auto}}$ of ***direction***

- A ***quantum*** of angular momentum $\vec{L}_3^{\pm} = \pm\hbar\widehat{\vec{\omega}} = \pm\hbar\vec{\mathbf{1}}_{\mathrm{auto}}$ from the transversal plane.
- A ***quantum*** of angular frequency energy $\hbar\omega = \hbar|\vec{\omega}| = \hbar\omega\left|\vec{\hat{\omega}}\right|$ with ***direction*** $\vec{\hat{\omega}}$.
- A ***quantum*** of power as flowing energy into the future $\hbar\,\vec{\omega}/\hat{\omega} = \hbar\omega\,\vec{\hat{\omega}}/\hat{\omega} = \hbar\omega\vec{\hat{\omega}} = \hbar\vec{\omega}$, measured per unit $[\hat{\omega}^{-1}]$ of the development parameter $t = |\phi|/\omega$, which produces an information dimension into the past. (A ***quantum*** of power for each creation)
- And we will see, this is also just one ***quantum*** of momentum $\frac{\hbar}{c}\vec{\omega}$ throughout space.

In all, we have the *FORWARD* momentum with the ***quality one direction***, all parallel, $\vec{\hat{\omega}} \parallel \vec{\omega} \parallel \widehat{\vec{\omega}} = \vec{\mathbf{1}}$; but this looks different in different unit systems.

Later below in chapter II. 4.4 etc. we call such a ***direction*** a ***primary quality of first grade*** (***pqg*-1**) or a 1-vector ***direction***, what in meaning of René Descartes would call extension space ***direction***.

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