A Natural Mass Unit Hidden in the Planck Action Quantum

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0.138% above the neutron and 0.276% above the proton baryon mass a natural mass unit μ can be identified by extrapolating dimensionless Planck units $h = c = 1$ to the System of Units (SI). Similar to quantum measurements that determine h it is only necessary to relate the unit kinetic particle energy to the quantum energy of a photon having a unit wavelength. Connecting both energies and shifting the units, the inverse ratio of length units evolves proportional to the square of velocity units since both are proportional to the energy unit. With this connection the measurement of h becomes an indirect light velocity measurement and measurement of μ and shows that nonzero action and mass quanta corresponds to a finite light velocity c. As already shown, these sequential baryon mass differences (typical mass deficits of strong interaction) including the electron mass can be recovered within measurement error (some ppm) by simple relations obtained from bosonizing a massive Dirac equation.

Introduction. Assume that masses can't be divided below a fundamental mass limit. In contrast to the mass scale μ, energy $E_\mu = \mu c^2$ is related to the length and time scale either by massless photon properties like wavelength or frequency or the kinetic energy of massive particles with velocity dependency $E_{kin} \approx \frac{1}{2}\mu v^2$, $v \ll c$. The interaction between photon waves and quantum particles allows to assign to a fundamental mass μ a fundamental wavelength called the Compton wavelength $\lambda_\mu = \hbar/\mu c$. This is a fundamental quantum relation defining the Planck action quantum $\hbar$, where the quantum relation $E = \hbar\omega = \hbar c/\lambda$ relates the distance unit to the energy unit via $\hbar$. Now we will extrapolate dimensionless Planck units $\hbar = c = \lambda_1 = 1$ to the System of Units (SI) by introducing the human artificial SI velocity unit $v = u$ and length unit $\lambda = \lambda_u$.

Particle–wave coupling. In the previous work we have assigned Planck units to the background (photon) fluctuation level $2\overline{V} = 1$ with characteristic Planck unit length $\lambda_1 = q^2\lambda_\mu = 1$, $q^{-2}E_\mu = 1$ or

$$E_\mu = \frac{hc}{\lambda_\mu} = q^2 2\overline{V} = q^2, \tag{1}$$

where q^2 will be a constant characterizing the particle energy with respect to a photon energy at Compton wavelength. Interesting applications can be found in [1] and [2], where the proportionality constant

$$q^2 = \frac{1}{12\pi^2} \tag{2}$$

is a fundamental wave–to–particle (soliton) coupling constant part of the fine structure constant and known as Fadeev-Bogomolny bound. To recover the fundamental baryon mass scale hidden in the Planck constant, we will shift the Planck velocity units to human artificial velocity units based on SI length and arbitrary mass units.

Uncovering the hidden mass. While the mean background and particle energies scale with the square of the wave velocity, the SI unit energy scales with the square of the unit velocity u (in SI E_u =1J = 1kg m^2/s^2)

$$\frac{2\overline{V}}{E_u} = \frac{c^2}{u^2} = \Xi^2, \quad \Xi = 299792458\,. \tag{3}$$

Practical applicability of the SI system motivates to expect a unit velocity $0 < u \ll c$ with $\Xi = c/u \gg 1$. According to well known fundamental quantum relations, particle and photon energies can be compared via Compton and photon wavelengths that refer to the light velocity. Planck length units demand that the 1-dimensional quantum energy of waves coupling to particles E_μ is inversely proportional to the wavelength, especially to the Compton wavelength with

$$\frac{E_\mu}{E_u} = \frac{\lambda_u}{\lambda_\mu}\,. \tag{4}$$

λ_u = 1m is clearly the reference (wave)length and part of the SI units that constitute $\hbar$. As a result, the fundamental wavelength extrapolated from Planck units is with eq.(1) - eq.(4) exactly given by [1]

$$\lambda_\mu = \frac{\lambda_u}{q^2\Xi^2} \approx 1,31777... \cdot 10^{-15}\mathrm{m}\,. \tag{5}$$

Eq.(5) provides for the basic soliton mass μ via Compton relation $\mu = h/(c\lambda_\mu) = q^2\Xi^2 h/(c\lambda_u)$. Realized in SI units the value is

$$\mu = \frac{\hbar}{c}\frac{\Xi^2}{6\pi\mathrm{m}} \approx 1.67724... \cdot 10^{-27}\mathrm{kg}\,, \tag{6}$$

that is 1.001382 times the neutron and 1.002762 times the proton mass [3], where

$$\lambda_1 = q^2\lambda_\mu = \hbar c/(2\overline{V}) = q^2\lambda_\mu = |c^{-2}|/(2\pi)\mathrm{m}\,. \tag{7}$$

So what have we done? We have introduced a SI velocity unit u and length unit λ_u such, that the shift in energy unit is given by the Ξ^2 for arbitrary mass units. Consequently, the Planck action quantum $\hbar$ carries both, a fundamental Planck unit particle mass μ and the shift of geometric units. It turns out, that a measurement of $\hbar$ in SI units is equivalent to a light velocity measurement in SI units and not to a particle size measurement! Since the Planck scale mass unit can also be taken as the SI mass unit, the ratio λ_u/λ_μ is proportional to the energy unit shift Ξ^2. Knowing h and c allows to approach fundamental particle masses near μ. With this connection the measurement of $\hbar$ becomes an indirect light velocity measurement and shows that a nonzero action quantum $\hbar$ corresponds to a finite light velocity.

Detailed values from Bosonization. Performing a bosonization of a massive Thirring/Dirac equation, the dual partnership of fermions necessary for bosonization (where the electron is the central bosonization bridge) results in particle masses that reproduce the masses of proton, neutron, and electron within measurement error in the ppb range (10^{-9}). To obtain fundamental particle properties the topological current of bosonization q related to dimensional shifts [4] split into the two "orthogonal" left and an right-handed parts q_L and q_R, respectively, where the coupling energy of soliton particles with respect to the Planck reference energy $2\overline{V}$ scales like q^4 [1, 2]. Some small algebra regarding coupled and decoupled partner currents provides for

$$\begin{aligned} q^2 = q_R^2 + q_L^2, \quad \alpha q_L = \kappa q_R, \quad q_\mu = q/\sqrt{\kappa^2+\alpha^2}, \\ q_{e-} = q_R q_L/q_\mu, \quad q_{p+}^4 = (q_L^4 - q_R^4)\gamma^4, \\ q_n^4 = q_L^4/(1-\kappa^2/\alpha^2), \quad q_m^4 = q_n^4(\kappa^2/\alpha^2)\,, \end{aligned} \tag{8}$$

where q_{e-}, q_{p+}, q_n, and q_m are the electron, proton, neutron, and small neutral currents, $\gamma = 1/\sqrt{1-\alpha^2}$ [2]. Coupling currents and correspondent energy eigenvalues can be normalized to dimensionless parameters $\xi_x = q_x/q = k_x/k_\mu$ that correspond to the linear ratio of measured particle Compton wavenumbers given by

$$E_x = \hbar\omega_x = \hbar c k_x = \hbar\xi_x\omega_\mu = \hbar\xi_x c k_\mu\,, \tag{9}$$

with respect to the reference soliton Compton wavenumber $k_\mu = 2\pi/\lambda_\mu$. $\kappa = 1/1836.117..$ and $\alpha = 1/137.03600..$ are iteratively determined exact coupling constants, see [2, 5]. A ratio between κ and α different from unity denotes a left-right spin–asymmetry.

The charge–to–mass ratio of protons depends always on the nuclear context. There are some indications, that the most likely charge–to–mass ratio of a fundamental baryon, the reduction of baryon masses with respect to μ, and the reduction of the expected vacuum permittivity could be related to nuclear binding energies and (QED) screening effects [1, 3, 6].

Conclusion. Extrapolating Planck units the ratio λ_u/λ_1 evolves proportional to the energy unit shift c^2/u^2 with invariant mass unit. As a consequence, the System of Units provides for a fundamental Compton wavelength λ_μ that allows to uncover a fundamental baryon mass hidden in $\hbar$ since the invariant Planck mass unit as a fundamental quantum mass is always part of the Planck action quantum h.

[1] B. Binder, *Bosonization and Iterative Relations Beyond Field Theories* (2002); PITT-PHIL-SCI00000944.

[2] B. Binder, *With Iterative and Bosonized Coupling towards Fundamental Particle Properties*; corrected version; UniTexas mp-arc 03-1.

[3] B. Binder, *Soliton Compton Mass from Auto–parametric Wave–Soliton Coupling*; UniTexas mp-arc 02-475; corrected version.

[4] B. Binder, *Higher-Dimensional Solitons Stabilized by Opposite Charge*; PITT-PHIL-SCI00000918, UniTexas mp-arc 02-499.

[5] B. Binder, *Berry's Phase and Fine Structure* (2002); PITT-PHIL-SCI00000682.

[6] B. Binder, *Soliton Coupling Driven by Phase Fluctuations in Auto-Parametric Resonance*; UniTexas mp-arc 02-473.