

The $\text{Slq}(2)$ Extension of the Standard Model II

Abstract

Our $\text{SLq}(2)$ extension of the standard model is constructed by replacing the elementary field operators, $\Psi(x)$, of the standard model by $\hat{\Psi}_{mm'}^j(x)D_{mm'}^j$ where $D_{mm'}^j$ is an element of the $2j + 1$ dimensional representation of the $\text{SLq}(2)$ algebra, which is also the knot algebra. The allowed quantum states (j, m, m') are restricted by the topological conditions

$$(j, m, m') = \frac{1}{2}(N, w, r + o)$$

postulated between the states of the quantum knot (j, m, m') and the corresponding classical knot $(N, w, r + o)$ where the (N, w, r) are (the number of crossings, the writhe, the rotation) of the 2d projection of the corresponding oriented classical knot. Here o is an odd number that is required by the difference in parity between w and r . There is also the empirical restriction on the allowed states

$$(j, m, m') = 3(t, -t_3, -t_0)_L$$

that holds at the $j = \frac{3}{2}$ level, connecting quantum trefoils $(\frac{3}{2}, m, m')$ with leptons and quarks $(\frac{1}{2}, -t_3, -t_0)_L$. The so constructed knotted leptons and quarks turn out to be composed of three $j = \frac{1}{2}$ particles which unexpectedly agree with the preon models of Harrari and Shupe. The $j = 0$ particles, being electroweak neutral, are dark and plausibly greatly outnumber the quarks and leptons. The $\text{SLq}(2)$ or (j, m, m') measure of charge has a direct physical interpretation since $2j$ is the total number of preonic charges while $2m$ and $2m'$ are the numbers of writhe and rotation sources of preonic charge. The total $\text{SLq}(2)$ charge of a particle, measured by writhe and rotation and composed of preons, sums the signs of the counterclockwise turns (+1) and clockwise turns (-1) that any energy-momentum current makes in going once around the knot. In this way the handedness of the knot reduces charge to a geometric concept similar to the way that curvature of spacetime encodes mass and energy. According to this model, the leptons and quarks are $j = \frac{3}{2}$ particles, the preons are $j = \frac{1}{2}$ particles, and the $j = 0$ particles are candidates for dark matter. It is possible to understand q as a simple deformations parameter or as the ratio e/g of the electroweak to the gluon coupling constants.