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Corrigendum

Corrigendum to "Supervariable Approach to the Nilpotent Symmetries for a Toy Model of the Hodge Theory"

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In the article titled "Supervariable Approach to the Nilpotent Symmetries for a Toy Model of the Hodge Theory" [1], two equations (i.e., equations (51) and (52)) have been written incorrectly and there are some typing errors in the mathematical expressions that have been incorporated in the text after equation (50). Thus, we are sending, herewith, the correct version of the text after equation (50) and the next paragraph till equation (52). The rest of the paper is correct and there are no errors. The correct text after equation (50) is given below.

By exploiting the (anti-)co-BRST symmetry transformation (4), it can be checked that the above expressions do match with (49) (which is also equivalent to expressions given in (5) in terms of the auxiliary variable $b(t)$). From the above equations, it becomes transparent that the nilpotency of (anti-)co-BRST charges is deeply connected with the nilpotency ($s_{(a)d}^2 = 0$) of (anti-)co-BRST symmetry transformations as well as the nilpotency (${\partial_\theta}^2 = 0, {\partial_{\bar\theta}}^2 = 0$) of the translational generators ∂_θ and $\partial_{\bar\theta}$ along the Grassmannian directions of this $(1, 2)$-dimensional supermanifold. For instance, if we consider $Q_d = -is_d[\dot{C}\bar{C} + i\dot{\lambda}\dot{b}]$, it is clear that $s_d Q_d = i\{Q_d, Q_d\} = 0$ because of $s_d^2 = 0$ and the basic definition of a generator of a given transformation. Furthermore, from the suitable expressions from (48), it is very evident that $\partial_{\bar\theta} Q_d = 0$ due to ${\partial_{\bar\theta}}^2 = 0$ which, in turn, implies that ${Q_d}^2 = 0$. Such kind of arguments can be given for the nilpotency of Q_{ad} as well. Geometrically, the equation $Q_d = -i(\partial/\partial\bar\theta)[\dot{F}^{(d)}\bar{F}^{(d)} + i\dot{\Lambda}^{(d)}\dot{b}(t)]|_{\theta=0}$ implies that the co-BRST charge Q_d is already equivalent to the translation of a composite supervariable $(\dot{F}^{(d)}\bar{F}^{(d)} + i\dot{\Lambda}^{(d)}\dot{b}(t))$ along the $\bar\theta$-direction of the supermanifold. Thus, any further translation along $\bar\theta$-direction produces a zero result because of the fermionic (${\partial_{\bar\theta}}^2 = 0$) nature of $\partial_{\bar\theta}$. Similar explanation for the nilpotency of the suitable expression for Q_{ad} can be given in the language of nilpotency (${\partial_\theta}^2 = 0$) of the translational generator ∂_θ along θ-direction.

Now we dwell a bit on the geometrical meaning of the absolute anticommutativity of the (anti-)co-BRST charges Q_{ad} in the language of the translational generators (∂_θ and $\partial_{\bar\theta}$) along the Grassmannian directions of the supermanifold. Let us take the first example as

$$Q_d = i\frac{\partial}{\partial\theta}\left[\dot{\bar{F}}^{(d)}\bar{F}^{(d)}\right]\Bigg|_{\bar\theta=0} \equiv is_{ad}\left[\dot{\bar{C}}\bar{C}\right]. \qquad (51)$$

It is self-evident that $s_{ad}Q_d = 0$ because of the nilpotency ($s_{ad}^2 = 0$) of s_{ad} and $\partial_\theta Q_d = 0$ because of the nilpotency (${\partial_\theta}^2 = 0$) of the translational generator ∂_θ. However, if we take the definition of the generator for the transformation s_{ad}, then, $s_{ad}Q_d = i\{Q_d, Q_{ad}\} = 0$ due to the nilpotency ($s_{ad}^2 = 0$) of s_{ad} which in turn implies the absolute anticommutativity of the (anti-)co-BRST charges $Q_{(a)d}$. If we operate by $\partial_{\bar\theta}$ on (51), we should get $\partial_{\bar{\theta}} Q_d = 0$. However, it leads to the following explicit expressions:

$$\begin{aligned} \frac{\partial}{\partial \bar{\theta}} Q_d &= 0 = i \frac{\partial}{\partial \bar{\theta}} \frac{\partial}{\partial \theta} \left[\dot{\bar{F}}^{(d)} \bar{F}^{(d)} \right] \\ &\equiv \frac{i}{2} \left(\partial_\theta \partial_{\bar{\theta}} + \partial_{\bar{\theta}} \partial_\theta \right) \left[\dot{\bar{F}}^{(d)} \bar{F}^{(d)} \right]. \end{aligned} \quad (52)$$

References

[1] D. Shukla, T. Bhanja, and R. P. Malik, "Supervariable approach to the nilpotent symmetries for a toy model of the hodge theory," *Advances in High Energy Physics*, vol. 2016, Article ID 2618150, 13 pages, 2016.