Gen Relativ Gravit (2007) 39:705–706
DOI 10.1007/s10714-007-0410-x

ERRATUM

# Teleparallel versions of Friedmann and Lewis-Papapetrou spacetimes

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Received: 2 November 2006 / Accepted: 30 January 2007 /
Published online: 20 March 2007


## Erratum to: Gen Relativ Gravit 38:1735–1745 DOI 10.1007/s10714-006-0354-6

Some minor errors have been observed which led to a change in the final result. Correcting these errors simplifies the results.

Recently, we have investigated [1] the teleparallel versions of the Friedmann models as well as the Lewis-Papapetrou solution. The tetrad and the torsion fields are obtained for both spacetimes. The tensor part of the torsion tensor of the Weitzenböck connection is given by

$$t_{\lambda\mu\nu} = \frac{1}{2}(T_{\lambda\mu\nu} + T_{\mu\lambda\nu}) + \frac{1}{6}(g_{\nu\lambda}V_\mu + g_{\nu\mu}V_\lambda) - \frac{1}{3}g_{\lambda\mu}V_\nu, \tag{1}$$

where $\lambda,\ \mu,\ \nu = 0, 1, 2, 3$. When we take the variations of the indices of $t_{\lambda\mu\nu}$ in Eq. (1), there occurred some errors which affect the tensor part. If we correct these errors, the non-zero components of the tensor part, for the Friedmann models, will change to

$$t_{010} = \frac{1}{3f_\kappa(\chi)}\{1 - f'_\kappa(\chi)\} = t_{100}, \tag{2}$$

The online version of the original article can be found at http://dx.doi.org/10.1007/s10714-006-0354-6.

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$$t_{001} = -2t_{010}, \tag{3}$$
$$t_{212} = \frac{1}{6}a^2 f_\kappa(\chi)\{1 - f'_\kappa(\chi)\} = t_{122}, \tag{4}$$
$$t_{221} = -2t_{212}, \tag{5}$$
$$t_{313} = \frac{1}{6}a^2 f_\kappa(\chi)\{1 - f'_\kappa(\chi)\}\sin^2\theta = t_{133}, \tag{6}$$
$$t_{331} = -2t_{313}, \tag{7}$$

instead of those given by Eqs. (32)–(39) in [1].

Also, an error of minus sign has been found in Eq. (48) which affects the rest of the part. Inserting this minus sign, the corrected version of Eq. (48) is given by

$$A^{(1)} = \frac{1}{3h}\{g_{00}T^0{}_{32} + g_{02}(T^2{}_{32} - T^0{}_{30})\}, \tag{8}$$

where $h = \sqrt{-g} = \rho e^{(\gamma-\psi)}$. When we use this corrected form, the axial-vector becomes

$$\mathbf{A} = \frac{-1}{3\rho}e^{3\psi-\gamma}(\omega'\hat{e}_\rho + \dot{\omega}\hat{e}_z) \tag{9}$$

instead of Eq. (51) in [1]. This shows that when $\omega$ is a function only of $z$, the axial-vector will stand along the radial direction, i.e.,

$$\mathbf{A} = \frac{-1}{3\rho}e^{3\psi-\gamma}(\omega'\hat{e}_\rho). \tag{10}$$

If $\omega$ is a function of $\rho$ only then it is given by

$$\mathbf{A} = \frac{-1}{3\rho}e^{3\psi-\gamma}(\dot{\omega}\hat{e}_z), \tag{11}$$

i.e., the axial vector will lie along $z$-direction. For $\omega$ to be constant, the axial-vector vanishes identically, i.e.,

$$\mathbf{A} = 0. \tag{12}$$

The spin precession of the Dirac particle in torsion gravity will also be simplified to

$$\frac{d\mathbf{S}}{dt} = \frac{1}{2\rho}e^{3\psi-\gamma}(\omega'\hat{e}_\rho + \dot{\omega}\hat{e}_z) \times \mathbf{S} \tag{13}$$

and the corresponding extra Hamiltonian will be

$$\delta H = \frac{1}{2\rho}e^{3\psi-\gamma}(\omega'\hat{e}_\rho + \dot{\omega}\hat{e}_z).\sigma. \tag{14}$$

## Reference

1. Sharif, M., Jamil Amir, M.: Gen. Rel. Gravt. **38**, 1735 (2006)