Abstract

In this paper, I vividly illustrated how to obtain an equation to describe a parallel universe with our universe parameters such as velocity, speed of light, scale factor, and so forth. I did this work by theoretical methods. Moreover, I used the Robertson-Walker metric and metric definition to achieve an equation that is the metric for a parallel universe. I assumed three hypotheses for this scientific project.

1 Introduction

The theory of relativity successfully explains The universe in late-time expansion with the four dimensions that Robertson-walker metric truly elucidates. In the first place, Minkowski geometrize the theory of relativity and defined the time dimension. Also, he used differential geometry and utilized a metric that described a universe with four dimensions it had three spatial dimensions, and one dimension of time. In this paper, I used the theory of relativity structure, and three hypotheses to describe a parallel universe. Furthermore, we can analyze a parallel universe with data from our universe. I mean, we can calculate the expansion rate and acceleration of another universe with ours.

2 The first hypothesis

I assume that all the parallel universes have been started in the same point. I mean, all the universes have been mixed to gather, and the started point and endpoint are the same. There is a possibility that we can see these parallel universes by going to black holes.

3 The second hypothesis

The speed of light is constant and equal in all parallel universes.
4 The third hypothesis

Elapsing time is the same for all the universes Hence, we can write the following equation for two universes:

\[ c^2 dt^2 = \gamma^2 ds_2^2 + \eta^2 ds_1^2 \]  

\( \gamma, \eta \) could be functions of time and space, and \( ds_2^2 \) is the metric of our universe that we can describe with Robertson- Walker metric and \( ds_1^2 \) is a parallel universe. The metric is as follows:

\[ ds_1^2 = c^2 dt^2 - \alpha^2 d\Sigma^2 \]  

5 Mathematical Method application to obtain the metric of a parallel universe

Based equation (1) and (2) we can write down:

\[ c = dt \sqrt{(\gamma^2 \frac{ds_2^2}{dt^2} + \eta^2 \frac{ds_1^2}{dt^2})} \]

\[ cdt = dt \sqrt{(\gamma^2 \frac{ds_2^2}{dt^2} + \eta^2 \frac{ds_1^2}{dt^2})} \]

\[ ds_1^2 = c^2 dt^2 - \alpha^2 d\Sigma^2 \]

\[ \frac{ds_2^2}{dt^2} = c^2 - \alpha^2 \frac{d\Sigma^2}{dt^2} \]

\[ cdt = dt \sqrt{(\gamma^2 \frac{ds_2^2}{dt^2} + c^2 \eta^2 - \eta^2 \alpha^2 \frac{d\Sigma^2}{dt^2}}) \]

\[ cdt = dt \sqrt{(\gamma^2 \frac{ds_2^2}{dt^2} + \eta^2 c^2(1 - \frac{\alpha^2 V_2^2}{c^2}))} \]

\[ c^2 = (\gamma^2 \frac{ds_2^2}{dt^2} + \eta^2 c^2(1 - \frac{\alpha^2 V_2^2}{c^2})) \]

Then, we divide \( c^2 \); thus, the equation is as follows:

\[ 1 = (\gamma^2 \frac{ds_2^2}{c^2 dt^2} + \eta^2(1 - \frac{\alpha^2 V_2^2}{c^2})) \rightarrow ds_2^2 = \frac{\eta^2}{\gamma^2 c^2}(1 - \frac{\alpha^2 V_2^2}{c^2}) dt^2 \]  

Based equation (1):

\[ \gamma^2 = \frac{c^2 dt^2}{ds_2^2} - \eta^2 \frac{ds_1^2}{ds_2^2} \]  

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I apply (4) in (5); thus, we have:

\[ \gamma^2 = \frac{c^2(\frac{\gamma^2c^2}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})}) - \eta^2ds_1^2}{ds_1^2} \]

\[ \gamma^2(1 - \frac{c^4}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})}) = -\eta^2ds_1^2 \]

\[ c^2dt^2 = \gamma^2ds_2^2 + \eta^2ds_1^2 = \frac{c^2dt^2 - \eta^2ds_1^2}{(1-\frac{\alpha^2V_0^2}{c^2})} \]

\[ ds_2^2 = \dot{\theta}^2 = \frac{c^2dt^2 - \dot{\alpha}^2ds_2^2}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})} \]

\[ \frac{ds_2^2}{ds_1^2} = \frac{\gamma^2c^2}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})} \]

\[ \frac{\gamma^2(1 - \frac{c^4}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})})}{(1 - \frac{c^4}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})})} = -\eta^2c^2 + \alpha^2d\Sigma^2 \]

Now we come back to the equation (1)

\[ c^2dt^2 = \gamma^2ds_2^2 + \eta^2ds_1^2 = \gamma^2ds_2^2 + \frac{(c^6 - \alpha^2V_0^2 + \frac{\alpha^4V_4^4}{c^4})}{(1 - \frac{\alpha^2V_0^2}{c^2})}(c^2dt^2 - \alpha^2d\Sigma^2) \]

The metric of equation (1) is as follows:

\[ \dot{g}(X) = \begin{pmatrix} \gamma^2 & 0 \\ 0 & \eta^2 \end{pmatrix} \]

Based the general theory of relativity, there is an equation for determinant of the metric that is as follows:

\[ \nabla_0(\sqrt{-g}) = 0 \]

\[ \frac{\gamma^2c^2}{\eta^2(1-\frac{\alpha^2V_0^2}{c^2})} = 0 \]

\[ \gamma^2\eta^2 + \eta^2\eta^2 = 0 \]

\[ \gamma^2d\gamma^2 + \eta\eta\eta^2 = 0 \]

\[ \frac{\gamma^2d\gamma + \frac{1}{\eta}d\eta}{\gamma} = 0 \]

\[ \ln \gamma = -\ln \eta \rightarrow \gamma \equiv \frac{1}{\eta} \]

Now we have all the coefficients in (1),

\[ c^2dt^2 = \frac{(1 - \frac{\alpha^2V_0^2}{c^2})c^2 + c^6}{c^6 - \alpha^2V_0^2 + \frac{\alpha^4V_4^4}{c^4}}ds_2^2 + \frac{(c^6 - \alpha^2V_0^2 + \frac{\alpha^4V_4^4}{c^4})}{(1 - \frac{\alpha^2V_0^2}{c^2})c^2 + c^6}(c^2dt^2 - \alpha^2d\Sigma^2) \]
Finally, we can describe the metric of a parallel universe with the Robertson-Walker metric:

\[
ds^2 = \left( \frac{c^6 - \alpha^2 V^2 + \frac{\alpha^4 V^2}{c^2}}{1 - \frac{\alpha^4 V^2}{c^2}} \right) c^2 dt^2 - \left( \frac{c^6 - \alpha^2 V^2 + \frac{\alpha^4 V^2}{c^2}}{1 - \frac{\alpha^4 V^2}{c^2}} \right)^2 \left( \frac{c^2 dt^2 - \alpha^2 d\Sigma^2}{c^2 + c^6} \right)
\]

(13)

6 Conclusion

As we understood there is a weird relationship between our universe and the parallel universe. By using equation (13) into the Einstein field equation:

\[
G_{\mu \nu} + \Lambda g_{\mu \nu} = \frac{8\pi G}{c^4} T_{\mu \nu}
\]

(14)

We can calculate the acceleration and Hubble parameter of the parallel universe. Moreover, we can calculate the Friedmann equations in the new universe.

References