The Global Solution from the Geometric Theory of Fields

Ulrich Bruchholz*

16 November 2005†

It could be well possible that this solution is already known. However, it is not taken as valid in this case. The solution is supported by recent observations. Since the solution cogently follows from the geometric theory of fields [1], the geometric theory is supported too.

Taking into consideration a constant part of the Riemannian curvatures, one has to extend each component of the Riemann (curvature) tensor for

$$R_{\mu\nu\sigma\tau} \longrightarrow R_{\mu\nu\sigma\tau} - K_\circ \cdot (g_{\mu\sigma}g_{\nu\tau} - g_{\mu\tau}g_{\nu\sigma}) \qquad (1)$$

[2]. All field equations keep valid that way.

The geometric theory of fields says that distributed masses and charges do not exist. If we disregard electromagnetism, Einstein's gravitation equations are simplified to

$$R_\mu^\nu = -3K_\circ\delta_\mu^\nu \quad . \qquad (2)$$

With spherical coördinates

$$x^1 = r \quad , \quad x^2 = \theta \quad , \quad x^3 = \varphi \quad , \quad x^4 = \mathrm{j}ct \quad , \qquad (3)$$

*Dipl.-Ing. *Ulrich Bruchholz*, http://www.bruchholz-acoustics.de
†from older notes, with supplement from 16 February 2007

the time-independent and central symmetrical solutions with $K_\circ$ become

$$g_{22} = \frac{g_{33}}{\sin^2\theta} = r^{*2} \quad , \quad g_{44} = 1 - K_\circ r^{*2} \quad , \quad g_{11} = \frac{(\frac{\partial r^*}{\partial r})^2}{1 - K_\circ r^{*2}} \quad , \tag{4}$$

the rest 0. As well, r^* is an *arbitrary* function of r.

If we demand isotropic spatial hypersurfaces, i.e.

$$g_{11} = \frac{g_{22}}{r^2} = \frac{r^{*2}}{r^2} \quad , \tag{5}$$

follows

$$r^* = \frac{r}{1 + \frac{K_\circ}{4} r^2} \quad , \tag{6}$$

respectively

$$g_{11} = \frac{g_{22}}{r^2} = \frac{g_{33}}{r^2 \ \sin^2\theta} = \frac{1}{(1 + \frac{K_\circ}{4} r^2)^2} \quad ,$$
$$g_{44} = (\frac{1 - \frac{K_\circ}{4} r^2}{1 + \frac{K_\circ}{4} r^2})^2 \quad . \tag{7}$$

As first consequence follows $K_\circ \geq 0$, that means the constant curvature cannot be negative, respectively, the space-time has a space-like curvature radius. With it (according to [2]), the second consequence consists in it, that an isotropic hypersurface (not the space-time !) is close in itself, like the surface of a sphere.

Now, we select isotropic hypersurfaces, that may change in time but shall have the same clock course at all places, with the transformation conditions

$$g'_{11} = \frac{(\frac{\partial r^*}{\partial r'})^2}{1 - K_\circ r^{*2}} + (\frac{\partial x^4}{\partial r'})^2 \cdot (1 - K_\circ r^{*2}) = (\frac{r^*}{r'})^2 \quad ,$$
$$g'_{14} = \frac{\frac{\partial r^*}{\partial r'} \frac{\partial r^*}{\partial x^{4'}}}{1 - K_\circ r^{*2}} + \frac{\partial x^4}{\partial r'} \frac{\partial x^4}{\partial x^{4'}} \cdot (1 - K_\circ r^{*2}) = 0 \quad ,$$
$$g'_{44} = \frac{(\frac{\partial r^*}{\partial x^{4'}})^2}{1 - K_\circ r^{*2}} + (\frac{\partial x^4}{\partial x^{4'}})^2 \cdot (1 - K_\circ r^{*2}) = 1 \quad , \tag{8}$$

in which $r^{'}$, $x^{4'}$ are coördinates for the new hypersurfaces.
These conditions lead to the simple partial differential equation

$$1 - K_\circ r^{*2} - (\frac{r^{'}}{r^*})^2 (\frac{\partial r^*}{\partial r^{'}})^2 = (\frac{\partial r^*}{\partial x^{4'}})^2 \quad . \tag{9}$$

The third consequence is $\frac{\partial r^*}{\partial x^{4'}} \neq 0$, that means such hypersurface *must* change in time. With other words, a time-independent hypersurface involves different clock courses.

The setup

$$r^* = p(r^{'}) \cdot q(x^{4'}) \tag{10}$$

results in

$$\mathsf{d}x^{4'} = \frac{\mathsf{d}q}{[-K_\circ q^2 + \frac{1}{p^2} - \frac{r^{'2}}{p^4}(\frac{\partial p}{\partial r^{'}})^2]^{\frac{1}{2}}} \quad . \tag{11}$$

Under the condition

$$1 - \frac{r^{'2}}{p^2}(\frac{\partial p}{\partial r^{'}})^2 > 0$$

follows

$$\frac{K_\circ^{\frac{1}{2}} r^*}{[1 - (\frac{r^{'}}{p})^2 (\frac{\partial p}{\partial r^{'}})^2]^{\frac{1}{2}}} = \cosh[(-K_\circ)^{\frac{1}{2}}(x^{4'} - x_\circ^{4'})] \quad . \tag{12}$$

With

$$p = \frac{r^{'}}{1 + \frac{K_\circ}{4} r^{'2}} \quad \text{and} \quad x_\circ^{4'} = 0 \tag{13}$$

(close hypersurfaces) follows

$$r^* = \frac{r^{'}}{1 + \frac{K_\circ}{4} r^{'2}} \cosh(K_\circ^{\frac{1}{2}} ct) \quad . \tag{14}$$

With it, the universe expands exponentially. Any superposed gravitation could affect this result. However, recent observations contradict a relevant influence by gravitation. Possibly, the constant curvature could be greater than supposed up to now.

Supplement

from 16 February 2007

The last notes refer to the coördinates at zero-time. However, the observer with his scales does not increase with the hypersurface. With it, we have to introduce observer-related coördinates. That are with the solution according to equ. (14)

$$r^{''} = r^{'} \cdot \cosh(K_\circ^{\frac{1}{2}} ct) \quad , \qquad x^{4''} = x^{4'} = \mathsf{j}ct \quad . \tag{15}$$

With it, coördinates and metrics become

$$r^{'} = \frac{r^{''}}{\cosh(K_\circ^{\frac{1}{2}} ct)} \quad , \qquad r^{*} = \frac{r^{''}}{1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)}} \quad , \tag{16}$$

$$\frac{\partial r^{'}}{\partial x^{4''}} = \frac{\mathsf{j} K_\circ^{\frac{1}{2}} r^{''} \sinh(K_\circ^{\frac{1}{2}} ct)}{\cosh^2(K_\circ^{\frac{1}{2}} ct)} \quad , \qquad \frac{\partial r^{'}}{\partial r^{''}} = \frac{1}{\cosh(K_\circ^{\frac{1}{2}} ct)} \quad , \tag{17}$$

$$\frac{r^{*}}{r^{'}} = \frac{\cosh(K_\circ^{\frac{1}{2}} ct)}{1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)}} \quad , \tag{18}$$

$$g^{''}_{44} = 1 + (\frac{\partial r^{'}}{\partial x^{4''}})^2 \cdot (\frac{r^{*}}{r^{'}})^2 = 1 - \frac{K_\circ r^{''2} \tanh^2(K_\circ^{\frac{1}{2}} ct)}{(1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)})^2} \quad , \tag{19}$$

$$g^{''}_{11} = (\frac{\partial r^{'}}{\partial r^{''}})^2 \cdot (\frac{r^{*}}{r^{'}})^2 = \frac{1}{(1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)})^2} \quad , \tag{20}$$

$$g^{''}_{22} = \frac{g^{''}_{33}}{\sin^2\theta} = r^{*2} = \frac{r^{''2}}{(1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)})^2} \quad , \tag{21}$$

$$g^{''}_{14} = \frac{\partial r^{'}}{\partial r^{''}} \, \frac{\partial r^{'}}{\partial x^{4''}} \cdot (\frac{r^{*}}{r^{'}})^2 = \frac{\mathsf{j} K_\circ^{\frac{1}{2}} r^{''} \tanh(K_\circ^{\frac{1}{2}} ct)}{(1 + \frac{K_\circ}{4} \, \frac{r^{''2}}{\cosh^2(K_\circ^{\frac{1}{2}} ct)})^2} \quad . \tag{22}$$

What have the formulae to say ?

First, the observer sees that the curvature radius of the *hypersurface* increases with the time. This special curvature radius is minimal and identical with the curvature radius of the space-time at $t = 0$. However, there is a "horizon" asymptotically approximating to $r'' = K_\circ^{-\frac{1}{2}}$, that is the curvature radius of the space-time. The area "behind the horizon" is invisible. In return, the observer sees "the begin of the world" at the "horizon". With it, the visible area does not increase, and the included "matter" vanishes more and more. Also, it looks as though the space did move from observer to "horizon". But such view is irrelevant, because space is not defined to move. (Space around a spin does not move too. A body can move.)

With equ. (16), the curvature vector of the unmoved body's world-line results around the observer approximately in

$$k^1 \approx K_\circ r'' \quad , \qquad k^2 = k^3 = 0 \quad , \qquad k^4 \approx 0 \quad . \tag{23}$$

That means a force to the (unmoved) body with its mass away from observer. This is to take into consideration for equations of motion. However, it is irrelevant for energy questions, because one had to fasten the bodies. Who should do it ?

This world model supports the assumption that antimatter has negative time, because it is symmetrical. Matter dominates for $t > 0$, antimatter for $t < 0$. It is the complementary world.
The author abstains from any speculations, what may be at $t = 0$, if pure radiation, or a balance of matter and antimatter, or what else.

The Geometric theory of fields raises an interesting aspect: The changes of the global structure go also into the structures of the particles. That means, no particle can be absolutely stable. If particles come into existence at different times (say differences of billions of years), the integration constants like mass must differ.
A comparable idea is suggested by Manfred Geilhaupt [3], who takes mass as time-dependent variable instead of integration constant.

References :

[1] Bruchholz, U.:

http://bruchholz.psf.net , http://UlrichBruchholz.homepage.t-online.de ,

with further references.

[2] Eisenhart, L. P.: Riemannian Geometry.

Princeton: University Press, 1949.

[3] Who takes interest in Quantum Thermodynamics may look for references at Geilhaupt, M.: http://www.fh-niederrhein.de/~physik07/index.html .