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On reconstruction procedure for special spherically-symmetric metrics in scalar-Einstein-Gauss-Bonnet model: the Schwarzschild metric test

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The 4d gravitational model with real scalar field φ , Einstein and Gauss-Bonnet terms is considered. The action contains potential term $U(\varphi)$ and Gauss-Bonnet coupling function $f(\varphi)$. For a special (static) spherically symmetric metric $ds^2 = (A(u))^{-1} du^2 - A(u)dt^2 + u^2 d\Omega^2$ with $A(u) > 0$ ($u > 0$ is a radial coordinate) we verify and correct the so-called reconstruction procedure suggested by Nojiri and Nashed. This procedure presents certain implicit relations for $U(\varphi)$, $f(\varphi)$ which lead to exact solutions to the equations of motion for a given metric governed by $A(u)$. Here we apply the procedure to (external) Schwarzschild metric with gravitational radius 2μ and $u > 2\mu$. Using “no-ghost” restriction (i.e. reality of $\varphi(u)$) we find two family of $(U(\varphi), f(\varphi))$. The first one gives us the Schwarzschild metric defined for $u > 3\mu$ and the second one describes the Schwarzschild metric defined for $2\mu < u < 3\mu$ (3μ is the radius of photonic sphere). In both cases potential $U(\varphi)$ is negative.

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