# Zadatak 3 iz FIZIKALNE KOZMOLOGIJE 2008/09

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Robertson-Walker metrika dana je u koordinatama $(t, r, \theta, \phi)$ s

$$ds^2 = dt^2 - a(t)^2 \left( \frac{dr^2}{1 - kr^2} + r^2(d\theta^2 + \sin^2\theta\, d\phi^2) \right)$$

gdje je $k$ konstanta $(\pm 1, 0)$.

1. Izračunajte sve neiščezavajuće komponente Christoffelovog simbola, $\Gamma^\alpha_{\mu\nu}$.

2. Koristeći definiciju Riemannovog i Ricci tenzora,

$$R^\alpha_{\ \beta\mu\nu} = \partial_\mu \Gamma^\alpha_{\beta\nu} - \partial_\nu \Gamma^\alpha_{\beta\mu} + \Gamma^\alpha_{\mu\sigma}\Gamma^\sigma_{\beta\nu} - \Gamma^\alpha_{\nu\sigma}\Gamma^\sigma_{\beta\mu}$$

$$R_{\mu\nu} = R^\lambda_{\ \mu\lambda\nu} = \partial_\lambda \Gamma^\lambda_{\mu\nu} - \partial_\nu \Gamma^\lambda_{\lambda\mu} + \Gamma^\lambda_{\lambda\sigma}\Gamma^\sigma_{\mu\nu} - \Gamma^\lambda_{\nu\sigma}\Gamma^\sigma_{\lambda\mu}$$

pokažite da je

$$R_{tt} = -3\frac{\ddot{a}}{a} \quad , \quad R_{rr} = \frac{a\ddot{a} + 2\dot{a}^2 + 2k}{1 - kr^2}$$

$$R_{\theta\theta} = r^2(a\ddot{a} + 2\dot{a}^2 + 2k)$$

$$R_{\phi\phi} = r^2(a\ddot{a} + 2\dot{a}^2 + 2k)\sin^2\theta$$

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