Home assignment 2, Gravitation & Cosmology, 2009
To be handed in Friday, December 11

1.a. The German astronaut Thomas Reiter has spent almost 6 months aboard the ISS. Calculate the accumulated difference in elapsed time on the ISS and on earth after this period of time.

  b. Are general relativistic effects significant for time-keeping in the GPS system?

  2. Consider a toroidal surface embedded in flat three-dimensional euclidean space. With (ρ,ϕ,z) being standard cylindrical coordinates and a/b being the radius of the torus/tube, it can be parametrised as $(\rho,\phi,z) = (a + b\cos\theta,\phi,b\sin\theta)$. Calculate the curvature scalar. Comment on the sign of R for different points on the torus. Finally, determine all Killing vectors in this space.

 3 Prove that for a given space-time with a Killing vector $\xi^\mu(x)$, the scalar $\xi^\mu P_\mu$ is a constant of the motion for a freely falling particle.