

LIGO Astro Problems

Problem #1. Find the equation of motion in the metric $g = \text{diag}(1 + 2\phi/c^2, -1, -1, -1)$, where ϕ is a function of the spacial coordinates. Assume slow velocities and $\phi/c^2 \ll 1$. Hint: derive Christoffel symbols for the given metric and use the geodesic equation.

Problem #2. How many neutron stars fit in the area of

- A. the city of Irkutsk
- B. lake Baikal?

Problem #3. Find the gravitational wave signal from two black holes in the noisy data. Template of the signal is given. Interferometer data contains 100 arrays but only one of them has the signal. Hint: use template matching technique to compute SNR for each data sample.

Problem #4. Derive the gravitational wave signal from two orbiting black holes. Assume the period of rotation is 1 hour, mass of each black hole is 10 solar masses, distance to Earth is 100Mpc and the plane of rotation is parallel to the plane of observation. Hint: compute the quadruple moment of this binary system.