

1- [Poisson 2.3.7] Consider a congruence of radial, marginally bound, timelike geodesics of schwarzschild spacetime. Find their expansion.

2- (a) Show that in Kerr black hole the stationary limit surface is timelike everywhere except at its poles.

(b) are event horizons at  $r_{\pm}$  Killing horizons?

3- Show that the horizon area for a Kerr black hole is given by

$$A = 4\pi(r_+^2 + a^2)$$

(Hint: Calculate induced metric on the horizon over  $\{\theta, \phi\}$  where  $r = r_+$  and integrate the induced volume element.)

4 - By computing  $R^{\alpha\beta\gamma\delta}R_{\alpha\beta\gamma\delta}$  for Kerr black hole, show that  $\Delta = 0$  is just a coordinate singularity but is truly singular at  $\rho^2 = 0$ .