

Physics 155 General Relativity

**Homework 3**

Assigned Wed Jan 22, 2020

Due Wed Jan 29, 2020 in the Phy 155 HW box (across from rm. 114 physics) by 3pm

Please hand in your homework on paper, with the pages numbered and your name clearly marked on each page.

3.1) Carroll Chapter 2, exercise 7

3.2) Consider the 2d metric given by

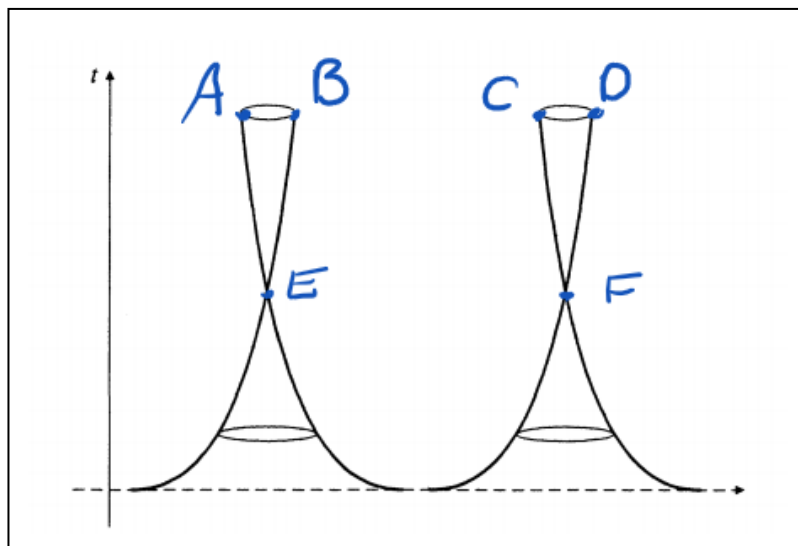
$$ds^2 = -v^2 du^2 + dv^2 \quad (0.1)$$

It turns out this space is none other than the 2d Minkowski space with metric

$$ds^2 = -dt^2 + dx^2 \quad (0.2)$$

Show that this is the case by finding coordinate transformations  $x(v,u)$  and  $t(v,u)$  which take the metric in Eqn. (0.1) into the form in Eqn. (0.2).

3.3) Consider Fig. 2.22 in Carroll and the discussion surrounding it in the book.



- Show mathematically that Carroll's statement that "light cones are tangent to the singularity" is true. (You may start with Carroll's solution for  $t(x)$  for the light cone.)
- Sketch the figure, and add curves showing the light cones for events A, B, C and D.
- Which (if any) of the events A, B, C, D, E and F are out of causal contact?