Read Unit 3 (*SRQM by Ruler&Compass*) thru page 28. Study Lecture 25-26

Space-time and per-space-time

Lorentz-Minkowski space-time (or per-space-time) coordinate system graphs (similar to the ones made in class for $u=\frac{3}{5}c$)
are attached and available on-line. Let 1 inch squares correspond to *(light-sec., sec.)* in space-time *(x,ct)* or to the per-space-time units *(light-Hz, Hz)* on a (cκ,υ) graph. Space-time graphs for the problems below require ±5 values for space and time. Graphs can be flipped so either Lighthouse or else Ship can have square (rest frame) axes. You should do one of each.

NOTE: For this assignment it is recommended you follow the Newtonian graph convention: +x-to-the-right and +ct-down. This conforms to the animations on two of our main relativity web apps: *Pirelli Relativity Challenge* and *RelativIt*. Follow these links to go to them directly:
> http://www.uark.edu/ua/pirelli/html/lighthouse_scenarios.html
> http://www.uark.edu/ua/modphys/markup/RelativItWeb.html?scenario=22
> http://www.uark.edu/ua/modphys/markup/RelativItWeb.html?scenario=24

Space-time Terrorism

1 (a) Complete the following happening tables using the Lorentz transformation between ship space-time coordinates (x',ct') and lighthouse coordinates (x,ct) given that the ship is traveling from right to left at a speed of $u=\frac{3}{5}c$ and passes the lighthouse at *t=0=t'*. Calculate answers needed below by algebra and then make a $u=\frac{3}{5}c$ plot to check the results.

Ship emits light	Explosion #1	Explosion #2	Explosion #3
x = 3 litesec.	x =	x = -1 litesec.	x =
t = -5 sec.	t =	t = -1 sec.	t = 1 sec.
x' =	x' = -1 litesec.	x' =	x' = -3 litesec.
t' =	t' = -3 sec.	t' =	t' =

Draw the space-time paths of light waves emitted right and left from explosions #1 and #2 on the space-time graph and answer the following questions.
> If lighthouse broadcasts 100 Mhz what υ does ship tune to receive it at *t=-1*? ____MHz at *t=+1*? ___Mhz

(a)   What is rapidity of ship relative to lab ρSvsL=_____? … lab relative to ship ρLvsS=_____?
(b)   When does light from explosion #1 hit the lighthouse? _____(Lighthouse time)
(c)   When does light from explosion #1 hit the lighthouse? _____(Ship time)
(d)   When does light from explosion #2 hit the lighthouse? _____(Lighthouse time)
(e)   When does light from explosion #2 hit the lighthouse? _____(Ship time)
(f)   Draw paths of fragments from explosions #1 and #2 for fragment speed c/2 or -c/2 relative to the ship.

B.I.G.A.N.N. Investigates

2 Explosions in problem 1 lead to an investigation by B.I.G.A.N.N. (Bureau of Intergalactic Aids to Navigation at Night) .

(a) When does the first fragment from explosion #1 hit the lighthouse? _____(Lighthouse time)
(b) When does a second fragment from explosion #1 hit the lighthouse? _____(Lighthouse time)
(c) When does a fragment from explosion #1 hit the ship? _____(Ship time)
(d) When does a fragment from explosion #2 hit the ship? _____(Ship time)
(e) When does a fragment from explosion #2 hit the Lighthouse? _____(Lighthouse time)
(f) …lighthouse says 1st fragment goes _____c using addition formula of rapidity ρFvsL=ρFvsS+ρSvsL and of velocity:

(g) …lighthouse says 2nd fragment goes _____c

> The authorities of BIGANN have spotted a causal (as opposed to acausal) connection between all the explosions. To whom does it point?
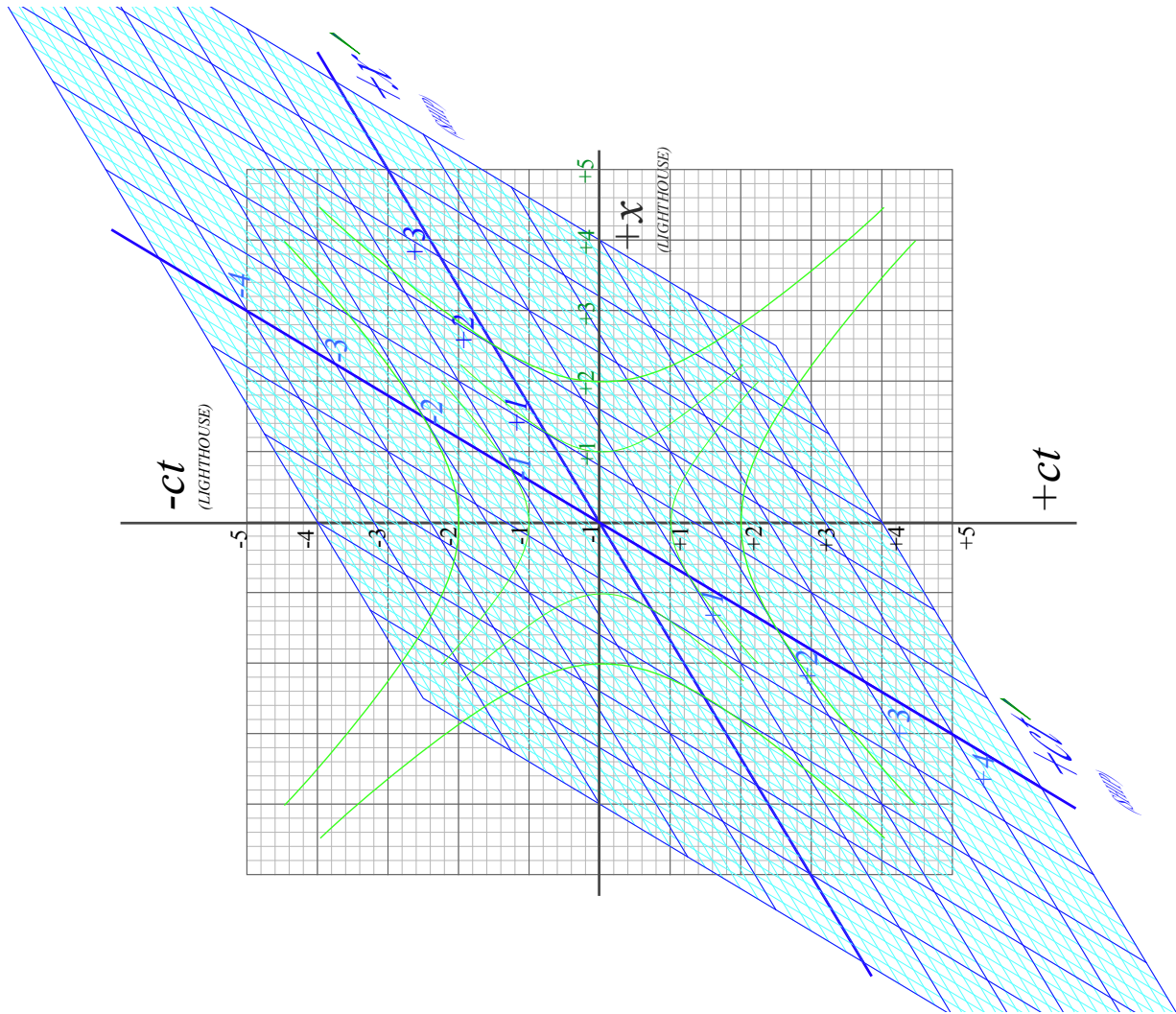
Better version of Lighthouse-square graph available in class or online.
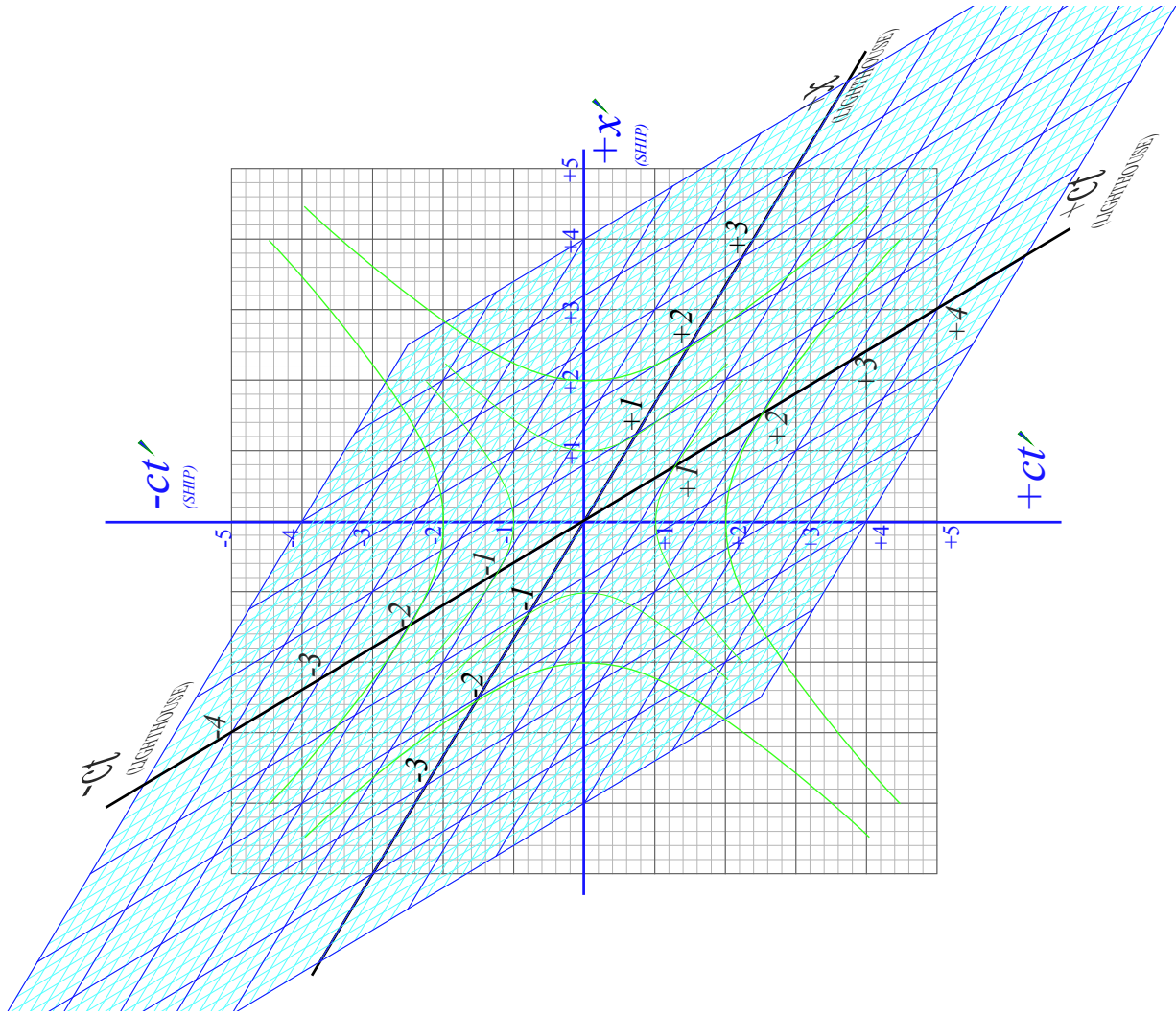
Better version of Ship-square graph available in class or online.