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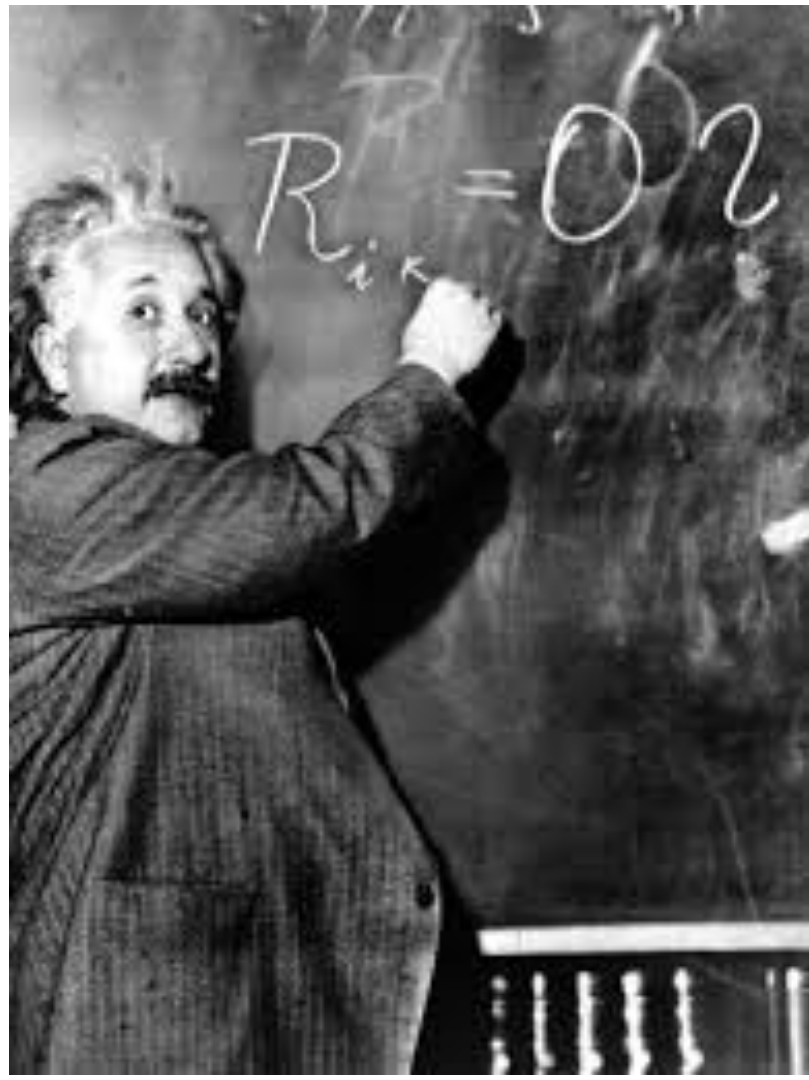
Pasword: **2024guest@CEAS**

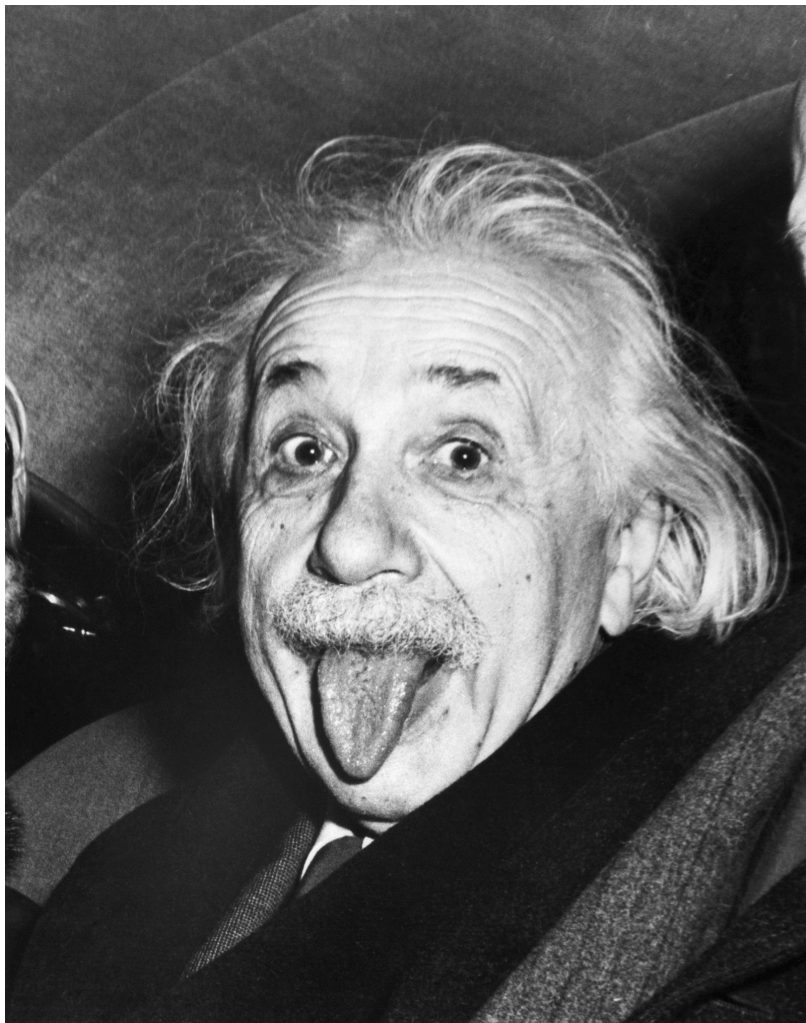
Go to:

https://github.com/ianpajohnsonSBU/WISE_computing_heavens

And download today's files

Black Holes .|





>>



What Are Black Holes?

How are black holes formed?

How were they discovered?

What theory are they based on?

What are they made of?

What phenomena can they cause?

+ More...

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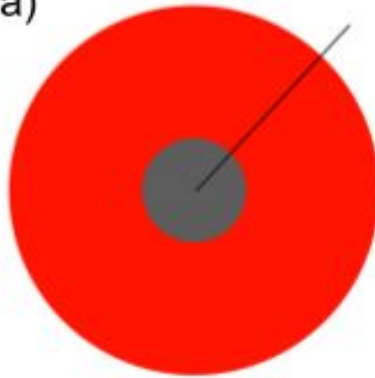
What are they made of?

What phenomena can they cause?

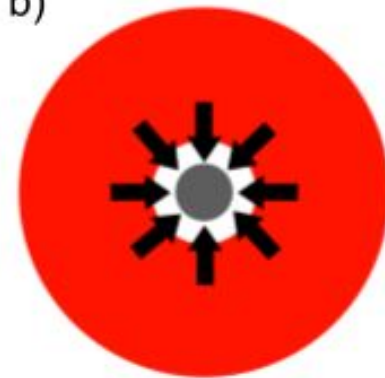
+ More...

Groups!

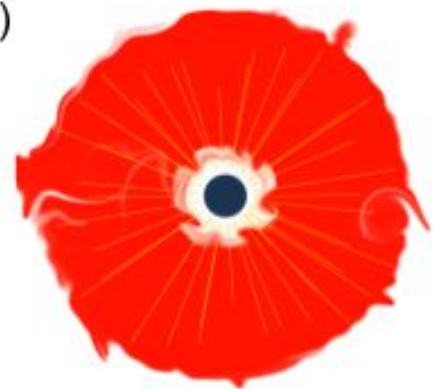
a) **Inner Core**



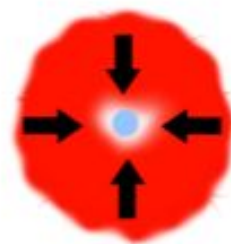
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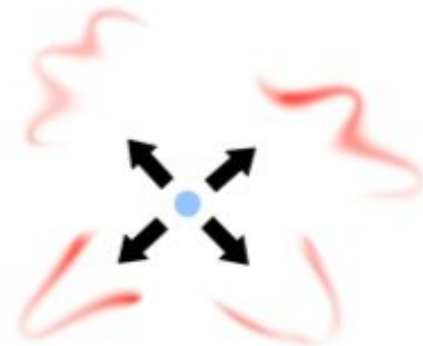
c)



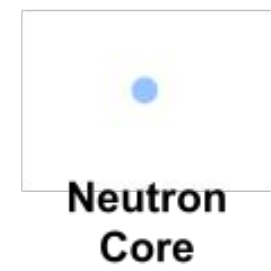
d)



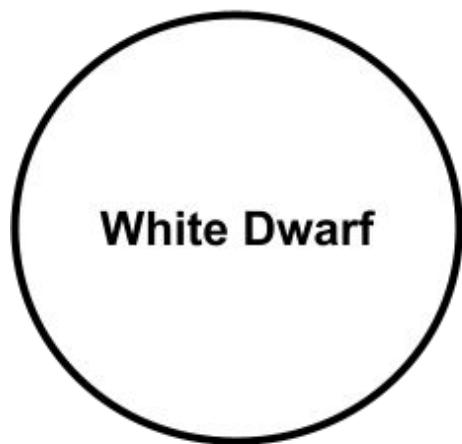
e)



f)



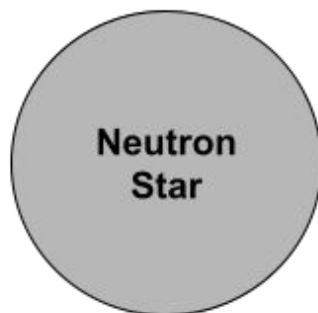
$M < 1.4$ Solar Masses
 $R \sim 7000$ km



White Dwarf

Electron
Degeneracy

$M \sim 1.4$ Solar Masses
 $R \sim 10$ km



**Neutron
Star**

Neutron
Degeneracy

$M > 2.5$ Solar Masses
 $R \sim 30$ km

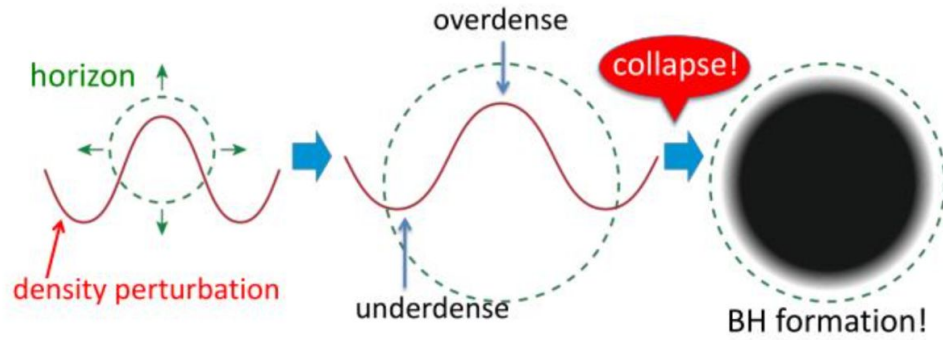
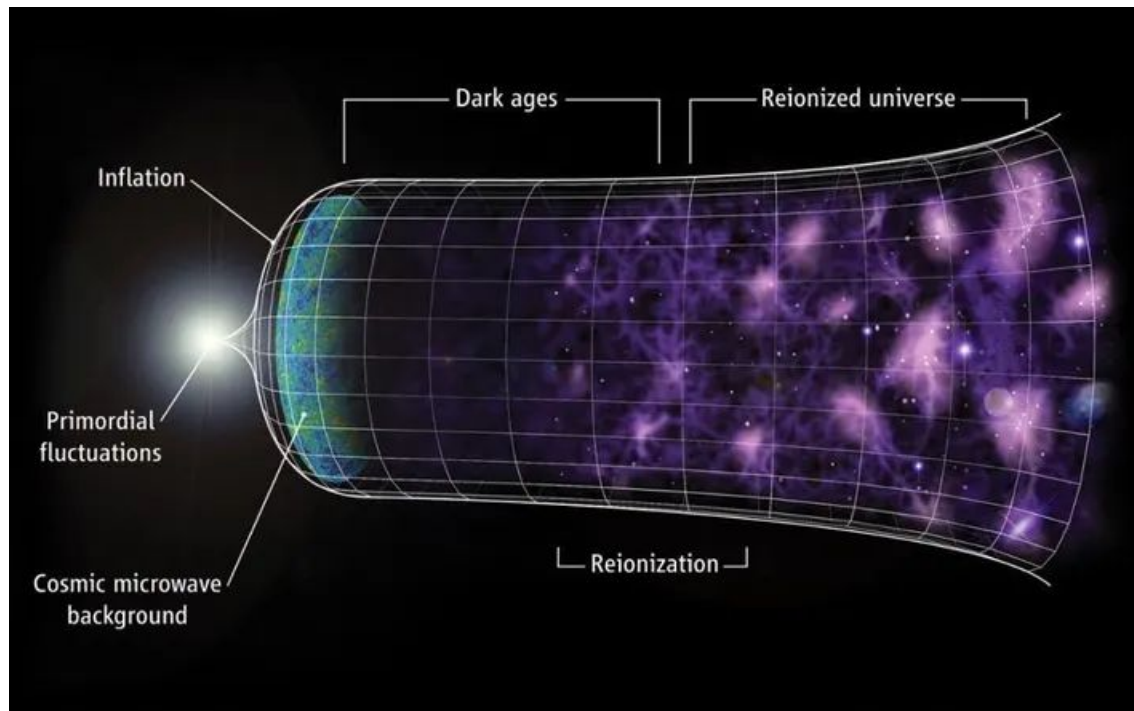


**Black
Hole**

Singularity

Chandrasekar
Limit

TOV
Limit



Black Holes Are General Relativity

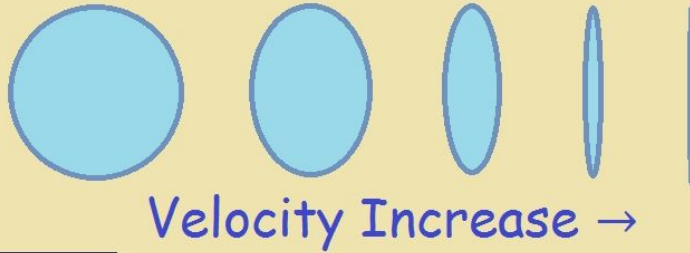
But what is relativity?

Newtonian Relativity -> *Special Relativity* ->
General Relativity



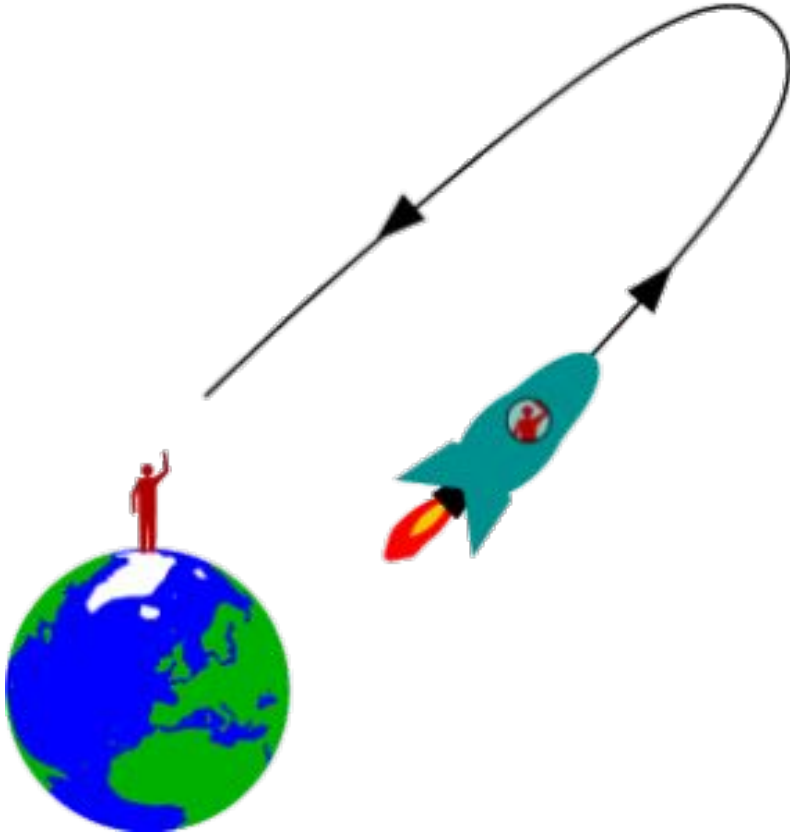
Special Relativity

Length Contraction



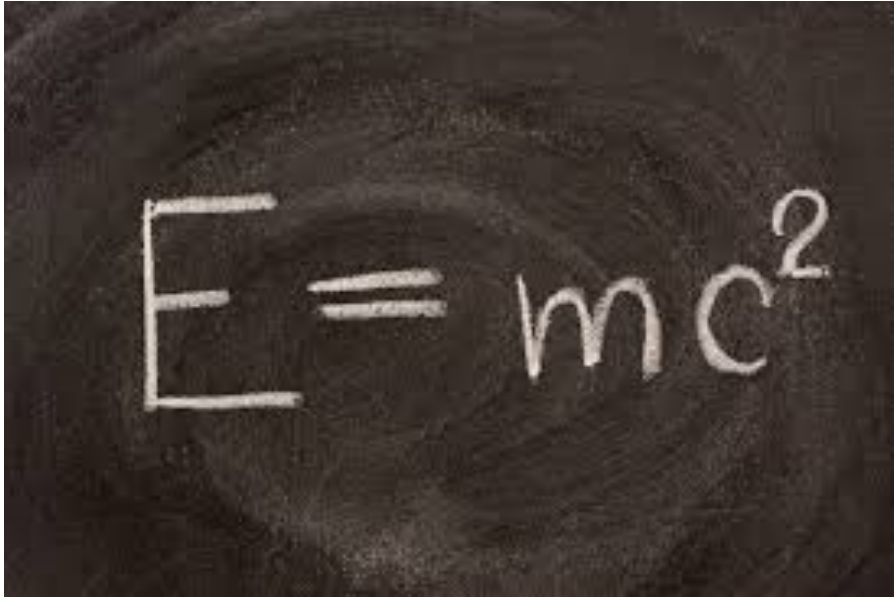
$$L = L_0 \sqrt{1 - \frac{v^2}{c^2}}$$

Moving Clocks Run Slow

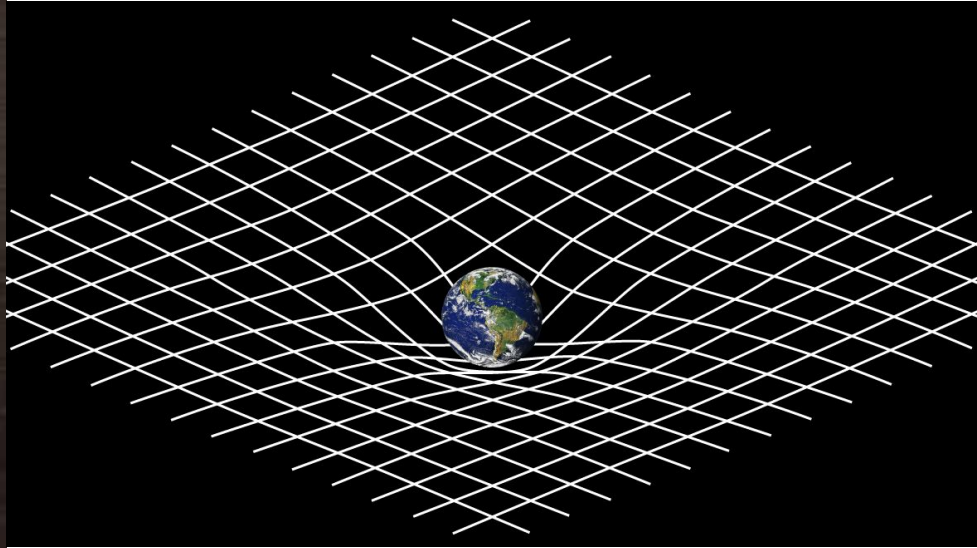




Expand the Model



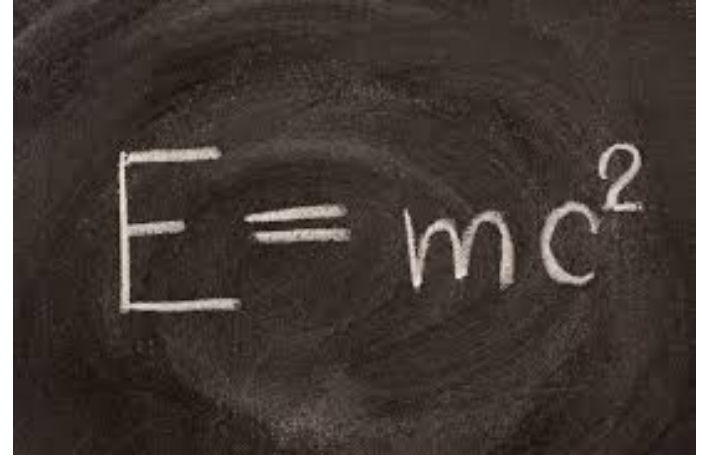
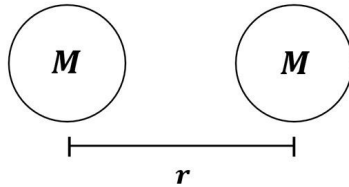
A chalkboard with the equation $E = mc^2$ written in white chalk. The chalkboard is dark and has some faint, circular patterns in the background.



Why Does $E = mc^2$ Lead Us to Black Holes?

Universal Gravitational Potential Energy

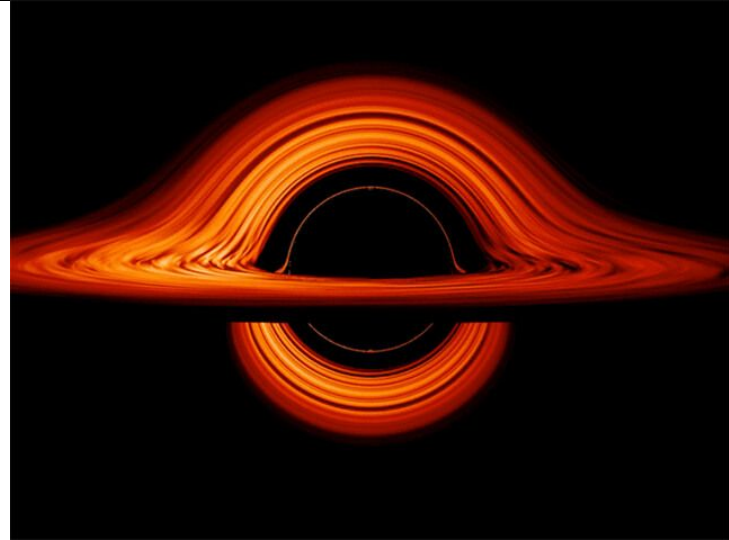
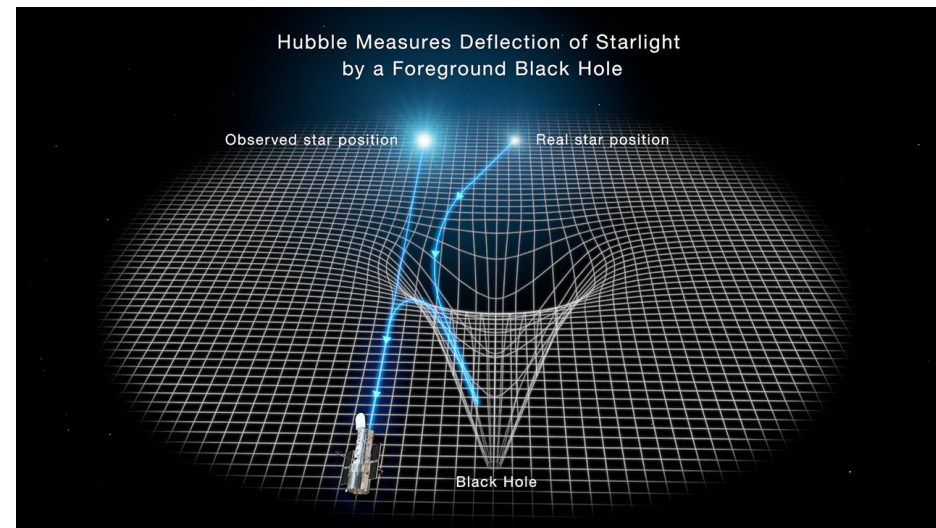
$$U_G = -G \frac{M_1 M_2}{r}$$

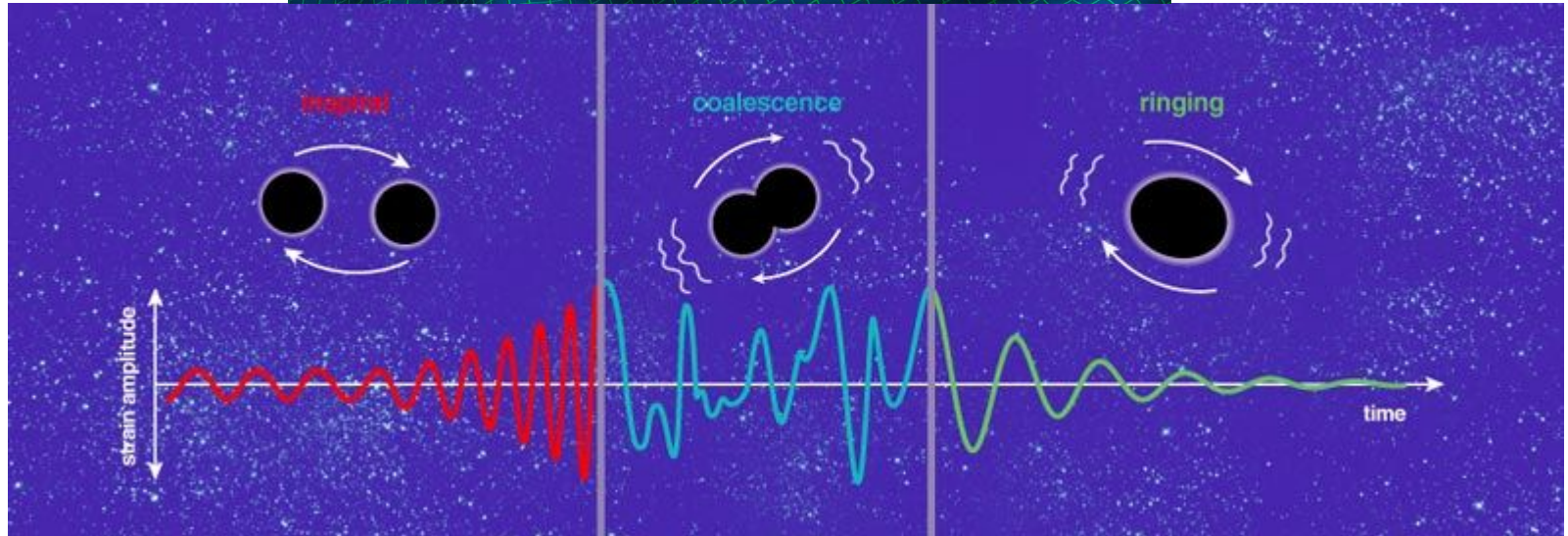
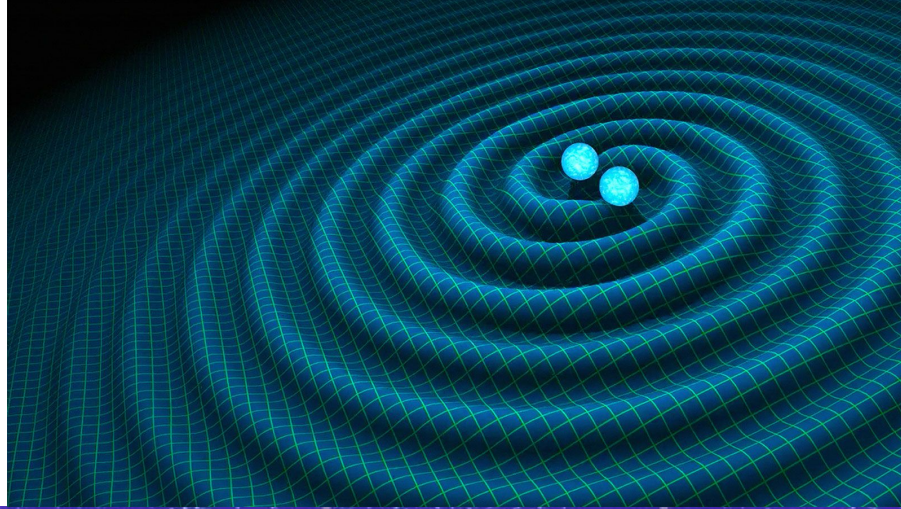


Where Does this Equation Break?

$$ds^2 = \left(1 - \frac{2Gm}{c^2 r}\right) c^2 dt^2 - \frac{1}{\left(1 - \frac{2Gm}{c^2 r}\right)} dr^2 - (r)^2 (d\theta^2 + \sin^2(\theta) d\phi^2)$$

Black Hole Phenomena







Questions?

I would love to clear up any questions or theories people have come up with or heard of! I'll try my best to answer to the best of my knowledge!