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THE BIRTH OF SONO-ASTRONOMY WHEN THE COSMOS DOES THE WAVE



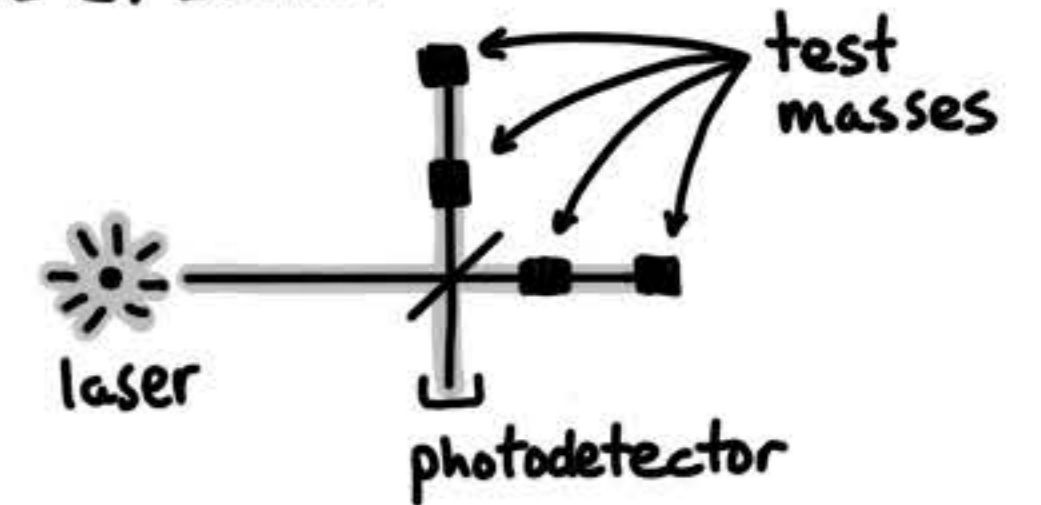
We can hear the universe for the first time!

LIGO

Laser Interferometer
Gravitational wave
Observatory

Fabry-Perot Interferometer
Hanford, WA & Livingston, LA

"We make measurements like this not just for ourselves, but FOR THE SPECIES"



SPACETIME

Albert Einstein
Magister of Spacetime

FLEXIBLE

c IS INVARIANT
SPEED OF LIGHT



THEORIST'S
BUCKET
LIST

1000 years from now?

WAVES



$P(z,t) = P_0 \cos[\omega(t - z/c)]$
SOUND WAVES

EM WAVES

James Clerk Maxwell
Magister of Celeritas



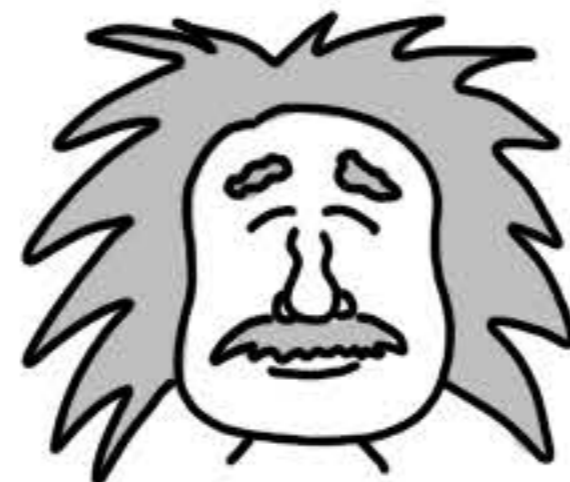
"beeper-cellphone equations"

$$\vec{\nabla} \cdot \vec{D} = 4\pi\rho \quad \vec{\nabla} \times \vec{E} = -\frac{1}{c} \frac{\partial \vec{B}}{\partial t}$$
$$\vec{\nabla} \cdot \vec{B} = 0 \quad \vec{\nabla} \times \vec{H} = \frac{1}{c} (4\pi\vec{J} + \frac{\partial \vec{D}}{\partial t})$$

EM Waves Travel @ c (speed of light)

Photons

EM waves can have HELICITY
(unlike sound)

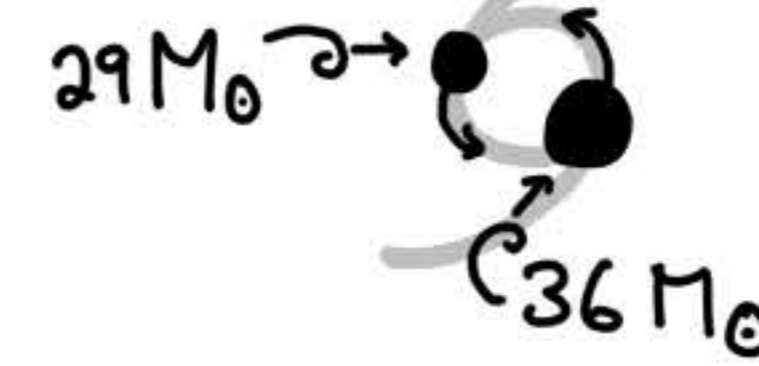


EINSTEIN'S
HAPPIEST THOUGHT



WAVES
of GRAVITY

But Einstein needed the
MATHEMATICAL TOOLS of
GEOMETRY on a CURVED
SURFACE



INSPIRALING
BLACK HOLES

ONE BLACK
HOLE

We "hear" the chirp



BBC WORLD
NEWS



Dr. Gates, you
seem giddy!

Well, yeah!

LIGO is AMAZING (Adv LIGO even more...)

It views a sphere
100 million
light-years
across



Senses the displacement
1000x SMALLER than
a helium nucleus

When originally proposed
to the National Science
Foundation



ARE
THEY
CRAZY?

ARE THEY
CRAZY ENOUGH?!



SONO ASTRONOMY

ARE WE
THERE YET?

NOT READY TO CREATE
SONOGRAMS FROM
G-WAVES YET

FROM
G-WAVES YET

But more
instruments
are coming

Adv LIGO
Adv VIRGO
LIGO Australia
LIGO (Japan)