

# PHY132S - Relativity

## Class 1 - March 23, 2009

Overview: Einstein - 2 theories of relativity

① "Special" (1905): observers in uniform relative motion  
[ $\sim 2$  weeks]

② "General" (1916): observers in any state of relative motion, including relative acceleration. Will also be a theory of gravity.  
[ $\sim 1$  week]

§37.2 Chapters 5 & 7:

number of assumptions about nature of space & time

All motion is relative (Galileo)

Acceleration is absolute

Recall (Chapter 5)

Inertial Reference Frames: (IRF)

Newton's 1<sup>st</sup> Law true.

~ non-accelerating frame

Relative to what?

IRF: stationary relative to  
absolute space  
or

uniform motion in a straight  
line wrt absolute space.

"with  
respect  
to"

§37.3 19<sup>th</sup> c: must be a  
medium for light  
"ETHER"

Similar to absolute space  
Presumably, ether stationary  
wrt "fixed stars"

$E \& M$ :  
speed of light  $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$   
 $= 3 \times 10^8 \text{ m/s}$

$= 1,079,253,000 \text{ km/hr}$

Is  $E \& M$  only valid in frames  
stationary wrt ether?

Einstein (1905) NO!

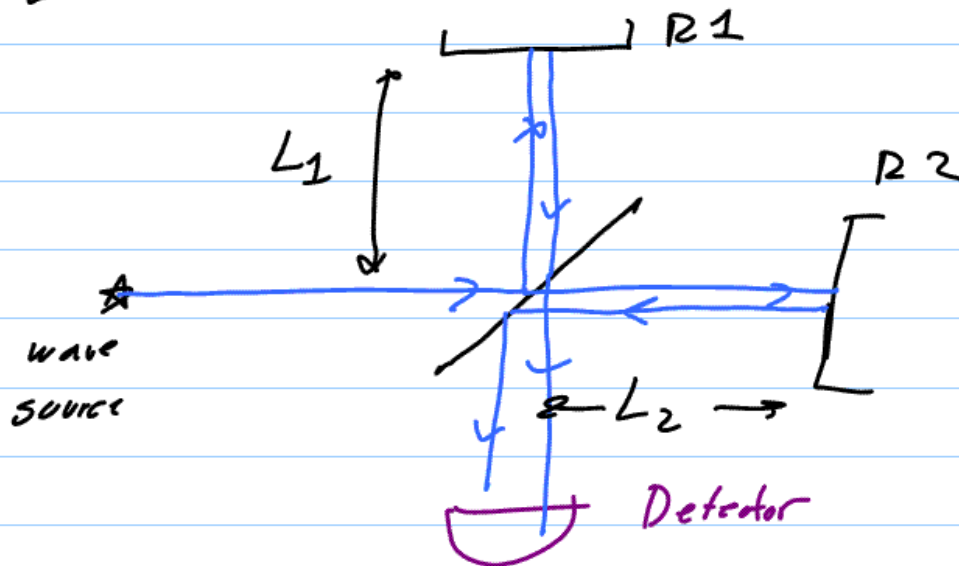
$E \& M$  valid in all inertial  
reference frames

$\therefore$  Speed of light is  $c$   
in all IRF.

All of Special Relativity.

SCN § A

Michelson Interf.



$$\boxed{L_1 = L_2}$$

$t_1$ : time splitter to  $R_1$   
back to splitter

$t_2$ : time splitter to  $R_2$   
back to splitter

$t_1 = t_2$ : constructive  
interference

Interf stationary wrt air

Wind  $L \rightarrow R$  speed  $v$

$c =$  speed of sound wrt air

$$\frac{t_1}{t_2} = \sqrt{1 - \frac{v^2}{c^2}} \neq 1$$

Light Interf. on surface of  
Earth.

$c$  = speed of light wrt ether

"Ether wind" on surface of Earth.

$v$  might be as large as  
 $3 \times 10^4$  m/s.

Michelson-Morley (1887)

measure  $v_{\text{ether}}$

result: ZERO