Lecture 32 Blackboard #2

**Velocities**

\[ \begin{align*}
\text{Example: Man on Train} & \\
\text{Train} & \quad \text{Man} & \\
V' = V & \quad \Delta x = 15 \text{km} & \\
V = 10 \text{km/h} & \quad \Delta x = 5 \text{km} & \\
V' = 15 \text{km/h} & \quad \Delta x = 20 \text{km} & \\
V = 20 \text{km/h} & \\
\end{align*} \]

**Galilean Transformations**

\[ \begin{align*}
\frac{d}{dt} & = \frac{d}{dt} \\
\frac{d}{dt} & = \frac{d}{dt} \\
\text{Acceleration is absolute.} & \\
\end{align*} \]

If \( \frac{d^2}{dt^2} \neq 0 \), then \( \frac{dV}{dt} = 0 \)!

\[ \begin{align*}
\text{Light: Theory \& Wave} & \\
\text{Young (1801-1829)} & \\
\text{Wave Phenomenon} & \\
\text{Interference Effects} & \\
\text{D. Polarization} & \\
\text{Light Wave} & \rightarrow \text{Sound Wave} & \\
\text{Sound needs medium (fluid) to propagate.} & \\
\text{Maybe light needs a medium} & \\
\quad - \text{luminiferous ether} & \\
\text{Speed through medium should be independent of velocity of source.} & \\
\end{align*} \]
**Stellar Absorption**

- By Bessel in 1826
- Use parallax to measure distance to nearest stars
- Know distance of Earth's orbit
- Parallax = $2\pi / 946 \times 10^6$ arc"  
  - $y = 2\pi / 946 \times 10^6 = 0.34 \times 10^{-5}$"  
  - $L = 1$ light-year

**Light Speed**

- Light Speed = $c$
- Earth's Velocity = $V$
- $V = \frac{2\pi \times 1.5 \times 10^8}{365 \times 24 \times 3600}$

**Explain Absorption**

- Star directly overhead
- If earth at rest light goes straight down
- Earth moving at $V$
- Need to tilt telescope to keep light from hitting sides!

**Other Notes**

- In a model, a velocity vector starts moving out a cone, where $v = 41$" arc
- Exp: Project Agreement! Either not changed with earth!
Lecture 32 Blackboard #4

Explain Aberration
- Star seems to move backward.
- If earth at rest light goes straight down.
- Earth moving: NEED TO TILT TELESCOPE TO KEEP LIGHT FROM HITTING SIDE'S!!

Michelson-Morley
- Sound: medium = air
- Light: medium = ether
- Propagation
- Electromagnetic waves: disturbances and travel through space.

f: frequency of oscillation
T: period of oscillation
w: angular frequency
λ: wavelength
v: speed of light
C: speed of light in vacuum

In Merced velocity increases
Star travels out a cone with

Separation = L
Separation = L

f

Earth moves with velocity v
Round trip A→B→A

Time: A→B \( t_1 = \frac{x}{c-v} \)
B→A \( t_2 = \frac{x}{c+v} \)
Effect of earth's motion
Delay motion of light
Δt = t_1 + t_2 - 2t_0
= \left[ \frac{1}{v/c} + \frac{1}{1/v/c} - 2 \right]
Explain measure $\lambda/\lambda_0$.

- Align earth $v$ along $M_1$.

$$T_1 = \frac{\lambda}{c} \left[ 1 + \frac{v^2}{c^2} \right]$$

$$l = \text{length of each arm}.$$