Summary of Unit Three

Different Types of Time:
Coordinate Time, Proper Time, and the Spacetime Interval

Physics II
Special Relativity

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http://tiny.cc/RelativityAtCOA

Coordinate Time

- Measured by an observer in an inertial reference frame.
- Relativity (light speed = c = $3x10^8$m/s in all reference frames) leads us to conclude that:
- **Coordinate time is frame dependent!**
- Time is not absolute!
- Symbol for coordinate time interval: Δt

Spacetime Interval

- Time interval between two spacetime events measured by an inertial clock that is present at both events.
- There is one and only one straight worldline (corresponding to constant velocity) that connects the two events.
- On spatial maps, the spacetime interval is analogous to distance.
- Symbol: Δs

Proper Time

- Time interval between two spacetime events measured by a clock (not necessarily inertial) that is present at both events.
- Value depends on the worldline taken by the clock as it moves from one event to the other.
- On spatial maps, proper time is analogous to path length.
- Symbol: $\Delta\tau$

The Spacetime Interval and Proper Time are Different

- In general, $\Delta s \neq \Delta \tau$
- The Hafele and Keating clocks-on-airplane experiment (1971) confirms that proper time and the spacetime interval are not the same.

Distance and the Spacetime Interval are Special

- Distance and spacetime are independent of our choice of coordinate system or reference frame.
- They thus measure something deeply real—an aspect of the world that does not depend on our arbitrary choices.
- Distance formula: $d = \sqrt{\Delta x^2 + \Delta y^2}$
- Is there a formula for the spacetime interval?
- Yes … that's the topic of Unit 4!