Introduction to Modern Physics

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- Modern physics is a set of developments that emerged around 1900
- This led to the development of the Theory of Relativity and Quantum Theory
- Some theories of classical physics which helped develop modern physics, include:
  - Newton's law of mechanics, which describes interactions among microscopic particles
  - Maxwell's equations, which unify electricity and magnetism
  - The laws of thermodynamics
- In the early 20^{th} century, two theories emerged:
  - Special Theory of Relativity (1905) — Einstein
  - Quantum Theory (1900) — Planck
- Classical Relativity
  - A theory of relativity provides a mathematical basis for expressing physical laws in different frames of reference
  - The mathematical basis is called a transformation
  - Ex. Two observers, O, who is still, and O', who is moving, are at rest in their own frames of reference (FOR). Relative velocity is defined as $\overline{u}$. For this course, an inertial FOR will be used, meaning Newton's law holds, where $v = 0$, or constant, unless $\overline{F} \neq 0$. O and O' observe the same event.
    - Four quantities describe this event for O: x, y, z, t
    - For O', these quantities are: x', y', z', t'
    - Assuming postulate: $t = t'$
      - Also, at $t = 0$, the two origins coincide
    - To find x' from x, this would become $x' = x - ut$

* y' and z' remain equal to y and z, respectively
* This is defined as a Galilean Transformation
* As velocity is the first derivative, this yields $\begin{cases} v_x = \dfrac{dx}{dt} \\ v_y = \dfrac{dy}{dt} \\ v_z = \dfrac{dz}{dt} \end{cases}$ and $\begin{cases} v_{x'} = v_x - u \\ v_{y'} = v_y \\ v_{z'} = v_z \end{cases}$

  for O and O', respectively
* This means the acceleration components are all equal