Physics 102 - January 29, 2014

Last Time

Human Experience, Human Brains

nature of Science

religion

Art

Methodology has Systematic revision based on observation and new insights

Observations must be reproducible!

No room for Ambiguity

This paper describes the measurement of collective flow for charged particles in Au+Au collisions at $\sqrt{s_{NN}} = 130$ GeV using the PHOBOS detector at the Relativistic Heavy Ion Collider (RHIC). An azimuthal anisotropy is observed in the charged particle hit distribution in the PHOBOS multiplicity detector. This anisotropy is presented over a wide range of pseudorapidity (η) for the first time at this energy. The result here, averaged over momenta and particle species, is observed to reach 7% for peripheral collisions at mid-rapidity, falling off with centrality and increasing $|\eta|$. Data are presented as a function of centrality for $|\eta| < 1.0$ and as a function of η, averaged over centrality, in the angular region $-5.0 < \eta < 5.3$. These results call into question the common assumption of longitudinal boost invariance over a large region of rapidity in RHIC collisions.

ugh!

What is space?

fabric where we measure where things are

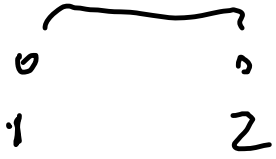
What is Time?

fabric where we measure when things are

Position

$x \equiv$ position along x-axis

$x_2 - x_1 = \Delta x$



change in x

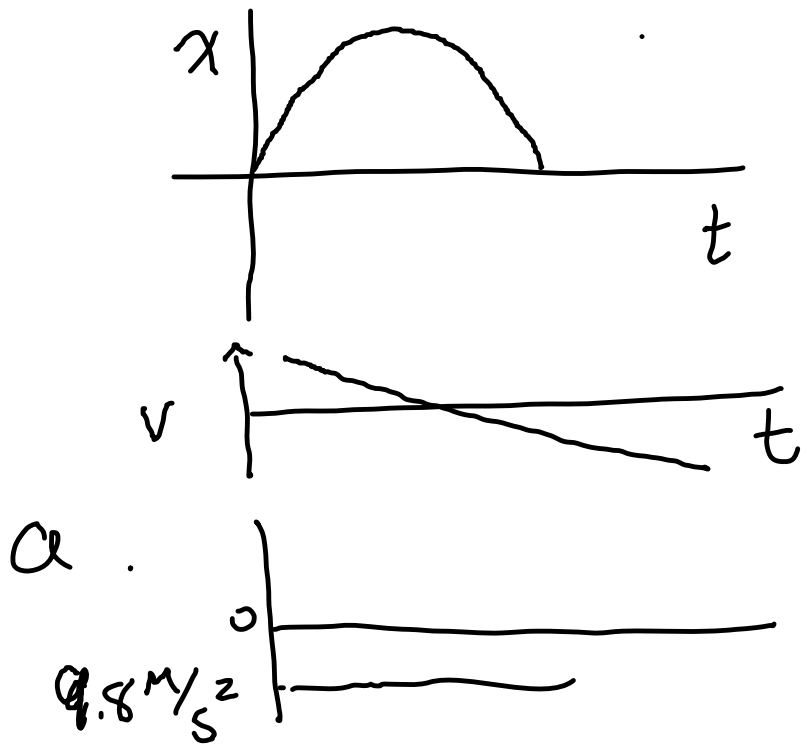
$time \equiv t$

Speed $\frac{\Delta x}{\Delta t} = v$

Velocity contains directional information

$\frac{v_2 - v_1}{\Delta t} = a \equiv$ acceleration

$x, v, a, t \Rightarrow$ kinematic variables



$F = ma$

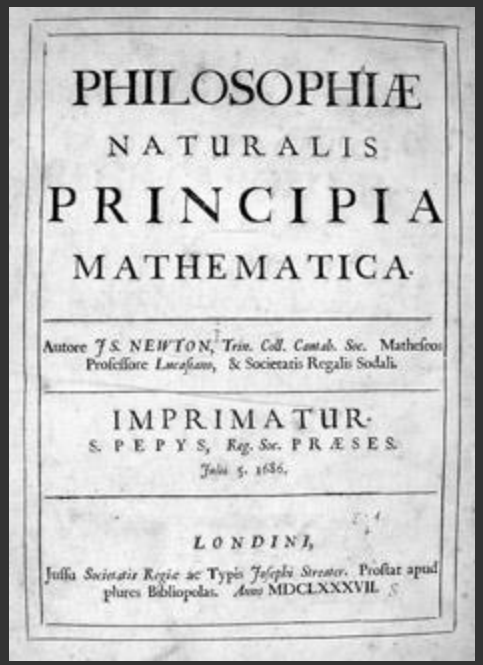
Sir Issac Newton

1643-1727

Born in Lincolnshire, England

Cambridge University

Philosophie Naturalis Principia Mathematica



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

Autore *J S. NEWTON*, *Trin. Coll. Cantab. Soc.* Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Junii 5. 1686.

LONDINI,
Juſſu *Societatis Regiæ* ac Typis *Joſephi Streater*. Proſtat apud plures Bibliopolas. *Anno* MDCLXXXVII.

Optics, mechanics, gravitation, calculus

Sir Issac Newton

1643-1727

Newtonian physics

Newtonian universe

Includes everything but …

Electromagnetism

Quantum mechanics

Mechanics of extreme velocities or extreme density


PHILOSOPHIÆ
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LONDINI

Newton's Laws

I: Law of Inertia

A body persists in its state of motion unless acted on by an external net force.

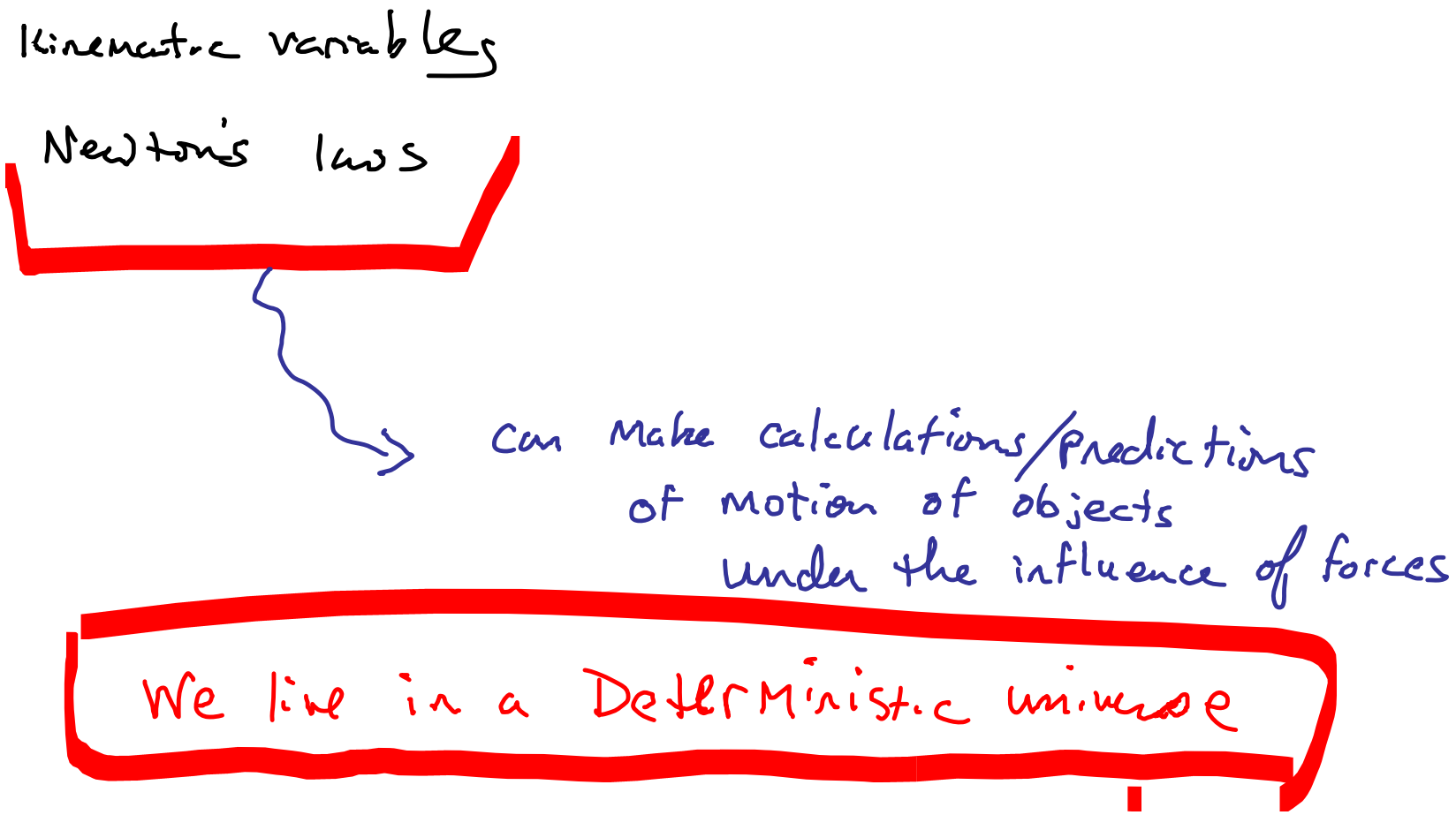
II: Force Law

The acceleration of an object is proportional to the net force applied to it and inversely proportional to the mass of the object

$$\Sigma \vec{F} = m\vec{a}$$

III Law of Action and Reaction

For every action there is an equal and opposite reaction


Kinematic variables
Newton's laws
can Make calculations/predictions
of motion of objects
under the influence of forces
We live in a Deterministic universe