In Principle

How principles shape physical theory

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This one goes out to all the homies.

Contents

Chapter 1

Classical Mechanics

Classical mechanics is the physics of the world as we experience it. Go on to explain how the world around us has a certain a pattern of regularity, we will use these observations to formulate principles that later become axioms of a theory that we develop AKA, these axioms are the hypotheses of our scientific theory.

We notice that objects for example can be in different *places*. Two separate places are related by the intuitive notion of a *distance*.

Axiom 1.1: Distance

The **distance** is the measure of [...]. Should this be direction?

Although we could refer exclusively to the distance between objects, it would become extremely difficult to keep track of a collection of anything over a few. Hence, a useful trick is to set an *origin*: a point of no physical significance, but a reference point in space whose distance from all other points is the way in which *position* is defined.

Definition 1.1: Position

The position of any point is its distance from the origin. The vector that encodes position is labeled $\mathbf{q} \in \mathbb{R}^3$. The components of $\mathbf{q}$ are called the coordinates.

Of course, we also know that things *happen*. Indeed, we have an intuitive notion of *after*.

Axiom 1.2: Chronology

There exists an order in which things happen. should this be duration? Needs to be on equal footing as the space

Definition 1.2: Time

The definition of time. Once a temporal origin is chosen, the number that encodes the time is called $t \in \mathbb{R}$.

This is where there is a figure of some trajectory... this also serves as inspo for what comes next

Axiom 1.3: Determinism

Axiom 1.4: Causality

Axiom 1.5: Locality

Notion of a classical trajectory

Corollary 1.1: Equation of Motion

change color to match the axioms.

Bibliography

[1] Hubbard, J. and Flowers, B. H. *Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences* **276**(1365), 238–257 (1963).

[2] Hubbard, J. and Flowers, B. H. *Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences* **277**(1369), 237–259 (1964).

[3] Hubbard, J. and Flowers, B. H. *Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences* **281**(1386), 401–419 (1964).