

The Seven Ideas That Shook the Universe (by N. Spielberg, B. Anderson) :

Physics
Concepts
Methods
Questions
Laws
&
7 Ideas

Physics

- not only collection and classification of the material world (structure) but also the understanding of natural phenomena (interaction). Example: solar system and atoms.
- (1) matter and motion; (2) search for order and pattern

Concepts

- energy,
- relativism-absolutism,
- order-disorder,
- determinism-uncertainty

Methods

- mathematical (analytical and numerical),
- experimental

Questions

- the nature of universe (origin, evolution, fate);
- building blocks of matter;
- fundamental forces

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1. The earth is not the center of the universe.
--- Copernican astronomy ---

Other contributions of Copernicus:

relative motion
and simplicity

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2. The universe is a mechanism that operates according to well-established rules: Newtonian physics.

cause and effect(causality),
determinism(predestination),

free will

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3. Energy drives the mechanism: the energy concepts

- can change forms,
- must be conserved,
- can be exchanged

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4. The mechanism runs in a specific direction: entropy and probability

Energy is convertible between different forms but there are limitations on the convertibility, this gives an overall time-sequential order of past events in the universe.

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5. The facts are relative, but the law is absolute: relativity

Einstein seeks what are invariant from all points of view.
e.g. light speed is invariant then space and time are not absolute but intertwined.

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6. You can't predict or know everything: quantum theory and the limits of causality.

- No sharp picture of the microscopic world, what is the true nature of the universe, need new way to describe atoms etc. .
- transistor, laser, microwave oven, radar communication, super strong alloy,
- chemistry

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7. Fundamentally, things never change: conservation principles and symmetry.
- The ultimate building blocks of matter, quarks, interact with particles .
 - Other conserved quantities(other than energy) in accord with specific conservation principles or symmetry affect the interactions .