Experiments drive ideas
Ideas drive experiments

Field :

Moving electric and magnetic Charges created forces.
crucial Connections were discovered between Electricity and Magnetism.
Magnetic Field has an actual existence outside the magnet.
(the Contour of iron filings) – the field persists in vacuum.

In Newtonian System, fields for example gravitational
or magnetic fields were not required to have any
such physical existence.
(they could be immaterial like lots of nature-)
Faraday through his experiments convincingly demonstrated
that fields existed physically and somehow
they could propagate through space.
Maxwell – demonstrated the behavior of EM phenomena through
his equations. Calculated the speed of transmission.
and discovered that it is of light.
Maxwell's Equation and Faraday's Fields – outside the
Newtonian System. – did not behave like billiard balls!

These Energy Carrying fields – outside Common Sense.
Lorentz- Interaction between fields and particles.

- Role of Aether — Newton himself had speculated
about aether – to explain all actions
at a distance. – gravitation, magnetism,
propagation of light. Sigh a vacuum

Motion of the earth through the aether – (aether wind)
Velocity of light measured by Michelson and Morley (1887)
↓ Special Thy of Relativity } · Four dimensional Space-time Continuum
General Thy of Relativity } · Mass-energy equivalence $E = mc^2$

Either the aether hind did not exist or there was something very odd about light
- Newtonian picture radically incomplete

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The Planck Constant h – quantum hypothesis Oct. 1900

" To-day, I have made a discovery as important as that of Newton" Planck.

Energy is emitted only as a series of 'quanta' or packets. They are very small, nevertheless separate. Newtonian Mechanics based on the assumption that energy emission has a continuous process. (Common Sense also) the smallness does not apply at the level of Small.

- Planck came to this idea – as a way of solving a mathematical equation – to accord the ~~truth~~ UV catastrophe

not from any specific experiment or intuition

What has to emerge from quantum theory – there is a reality outside the human scale

- Our perception can never be quite right

deception – seeing is believing

⇒ Newton's "truth" was true for people-sized perception

" It is wrong to think that the task of physics is to find out how nature is. Physics concerns what we can say about nature"

(1) only certain energy states. – only certain orbits.
(2) Limit to causality – we cannot know when orbit will emit next
(3) epistemological limit also – a frontier beyond which knowledge is not possible.

(4) our observations affect the world.
(5) Complementary – wave / particle