Goedel´s notion of idealistic time

Kurt Goedel – Selected Works

Freie Universität Berlin

Goedel´s notion of idealistic time

department of mathematics and computer science
FU Berlin

workshop: Kurt Goedel – Selected Works

docent: Prof. Christoph Benzmüller

consultant: Dr. Oliver Passon

speaker: Thomas Harms

Previously…

- Einstein formulated two postulates:
  - 1st: the laws of physics are the same in all possible inertial reference frames
  - 2nd: speed of light in vacuum is the same for all possible observers (299.792.458 m/s)
- time dilation as well as space contraction are influenced by the velocity of the dependent inertial reference frame wrt. an inertial reference frame of a different observer (Cf. slide !!!!)
- gravitational fields also may cause time dilation
- world line of an object represents the path it traces in four-dimensional spacetime (Cf. slide !!!!)
- concept of simultaneity is relative as explained

notion of idealistic time

- consequences of relativity theory did not spike an interest by philosophers as expected [IV, pg247,p1; II, pg. 203,p3]
- relativity theory gave astonishing new insights in the nature of time [II, pg202, p1]
- Goedel`s research of relativity theory driven by philosophical ambitions [I, pg199, p1]
- Goedel`s goal was the proof of the views of Parmeneides, Kant as well as modern idealists view on illusion of change [II, pg202, p2]
- "…in some sense even a verification, of Kantian doctrines." [IV, pg247,p1]
- Goedel`s goal was proving the "ideality" or "unreality" of the lapse of time
- "very starting point of special relativity theory consists in the discovery of… the relativity of simultaneity, which… implies that of succession." [II, pg1, p1]

notion of idealistic argument

- “Change becomes possible only through the lapse of time.” [II, pg202, p2]
- A-Series of events: ”nows” appear from the future, come into existence successively and vanish into a fixed past [Cf. VI]
- existence of an objective lapse of time means, that reality consists of an infinity of layers of “now” [II, pg202, p2]
- “if simultaneity is something relative as just explained, reality cannot be split up into such layers in an objective determined way” [II, pg203, p1]
- each observer has his own set of “nows” [II, pg203, p1]
- none of those can claim to exist in an objective lapse of time [II, pg203, p1]

objective lapse of time in Einstein`s solutions

- In Einstein`s and Friedmann`s universes it is possible to determine such time. [V,pg224,p2]
- consider the mean motion of matter over large regions of the universe
- regions need to be large enough, the value of the mean motion does not vary anymore significantly
- “In all cosmological solutions of the gravitational equations (i.e. in all possible universes)… the local times of all these observers fit together into one world time.” [II, pg204, p1]

Goedel`s rotating universes

- Geodel introduced a solution to Einstein`s equations of general relativity which allowed rotating universes [II, pg204, ft10; V, pg224, p1]
- model where the centrifugal force arising from rotation is in balance with the force of gravity pressing celestial bodies towards collapse [V,pg224,p1]
- main difference was the compass of inertia everywhere rotates in the same direction relative to matter (totality of galactic systems) [II, pg204, ft10]
- two variants were proposed:
  - static model: universe rotates at constant angular velocity [V, pg224, p1]
  - dynamic model: allowed expanding universe [V, pg224, p1]
- dynamic model included discoveries by Hubble of “red shift” of distant objects such as nebulas, indicating expanding universe [V,pg224,p1]

absolute time in Goedel`s solutions

- time in R-worlds (except in empty or spatial homogenous ones) lacks the existence of an absolute time [IV, pg251, p1,2]
- distinguishing between various systems of “points in time” is impossible [IV,pg251,p1]
- local times of special observers cannot be fit into one world time [II, pg204, p3]
- no procedure can exist accomplishing this purpose [II, pg204, p3]
- absolute time can not refer to intrinsic properties, but only to individual objects [IV,pg251,p1, II,pg204,p3]

absolute time in R-Worlds and Kant`s philosophy

- Kant as well as Goedel following a idealistic notion of time
- in Kant`s work time is described as a characteristics of objects as we perceive them due to change
- in comparison to Goedel`s solution, time is represented by the world lines of human bodies (or other species)
- in both cases Goedel argues, no absolute time could be given
- Goedel had two objections to Kant overemphasizing the dependence of spatial-temporal structure upon our faculties of representation:
  - temporal properties must be the same for all human beings [I,pg200,p3]
  - Kant failed to see, that geometry is to some extend an empirical science [I,pg200,p3]

time travel in R-worlds

- existence of closed time-like curves in R-worlds is possible [V, pg224, p3]
- moving along a wide geodesic curve towards the future [V, pg224, p3]
- arriving back at the starting point, strictly speaking in the past [V, pg224, p3]
- in principle there exist the possibility for “round trips” on a rocket ship in the present, future or the past and back again [V, pg224, p3]
- same as it is possible in other worlds to travel to distant parts of space [II,pg205,p1]
- practically highly unlikely because of certain practical considerations (more in the FAQ)

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THANK YOU FOR YOUR ATTENTION!

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EXAMPLARY TOPICS:

- idealism
- Kant`s idealistic notion of time
- time travel in Goedel`s universes
- time travel paradoxes and solutions

Idealism

- group of metaphysical theories
- asserting that the world as we know it is fundamentally mental or otherwise immaterial
- opposite site of the theories of materialism
- consciousness creates and determines the material world
- some philosophers: Plato, Parmeneides, George Berkley
- many influences in chinese, indian philosophy as well as religion
- german idealistic philosophers of dominating 19th century
- beginning with Kant, Hegel, Fichte, Schelling and Schopenhauer
- Goedel focused particularly on Kant`s work and views

Kant`s idealistic notion of time

- time is neither “something existing in itself” nor “a characteristic or ordering inherent in the objects” [Cf. VII §11]
- time is “a characteristics not inherent in the things themselves, but in relation to our sensibility [Cf. VII §11]
- time is part of the phenomena, perceived by conscience due to change
- Kant did not mean that temporal properties could be different for different observers
- Kant refers to beings of an entire different nature
- Kant`s relativistic view is based on the difference of perception
- only contradiction between Kant and relativity theory according to Goedel:
  - “in Kant`s opinion, natural science… must necessarily retain the forms of our sense perception and can do nothing else but set up relations between appearances within this frame.” [IV,pg257,p3]

practical concerns of time travel in R-worlds

- basing calculations on mean density of matter in our world [II,pg205,ft11]
- assuming the ability of transformation of matter completely into energy [II,pg205,ft11]
- weight of fuel of the rocket ship to complete voyage in t years would be of the magnitude of $10^{22}/ t^{2}$ times the weight of the ship [II,pg205,ft11]
- velocity of the ship must be at least $1/\sqrt{2}$ of the velocity of light [II,pg205,ft11]
- velocity needed, making those journeys possible in a reasonable length of time are beyond what might be considered possible [II,pg205,p2]

time travel paradox

- in all possible universes applicable
- traveling back in time offers the possibility to meet ones younger self
- one could do something to the younger instance, that one does not recall happened to oneself
- one could murder the younger instance
- sending telegraphs into the past
- those impossibilities had been used to raise objections towards the possibility that our world might be a R-world as well as the possibility of time travel

time dilation, space contraction

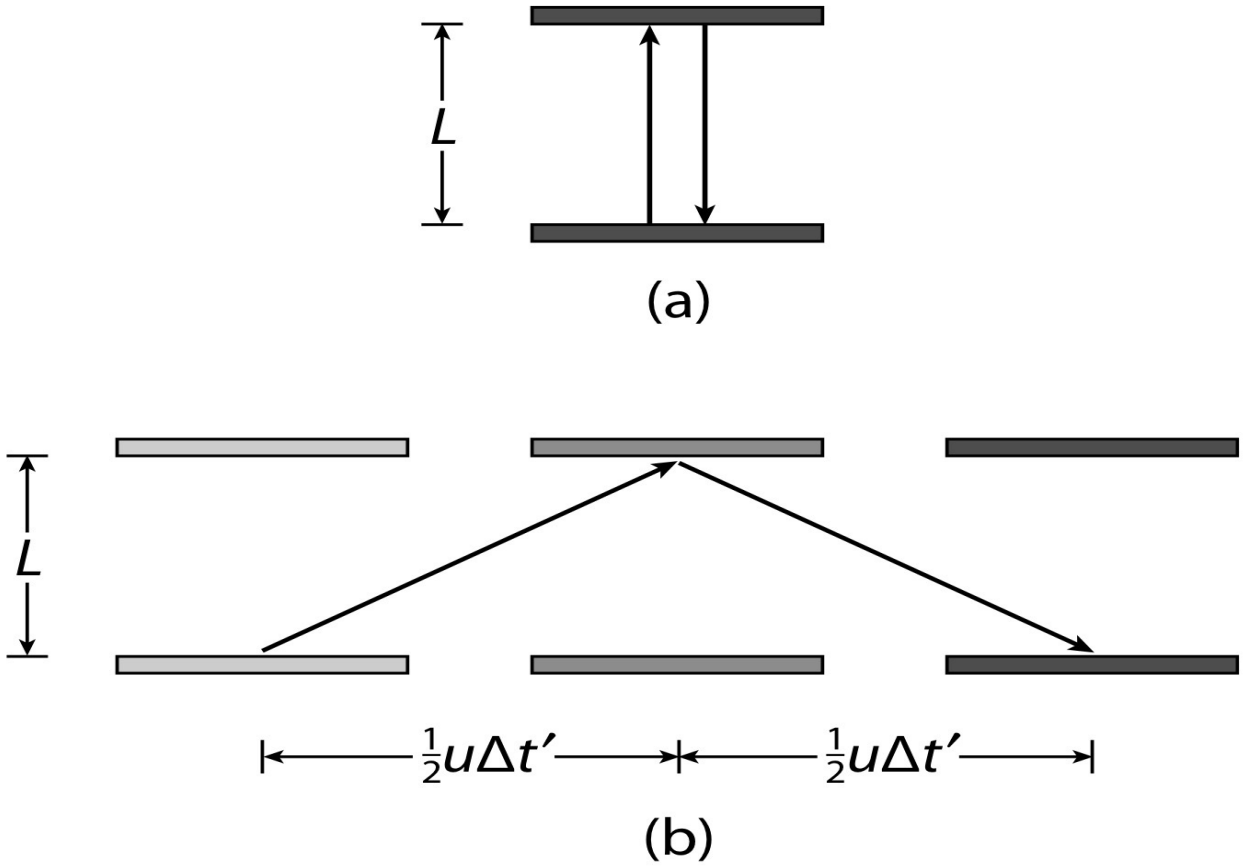
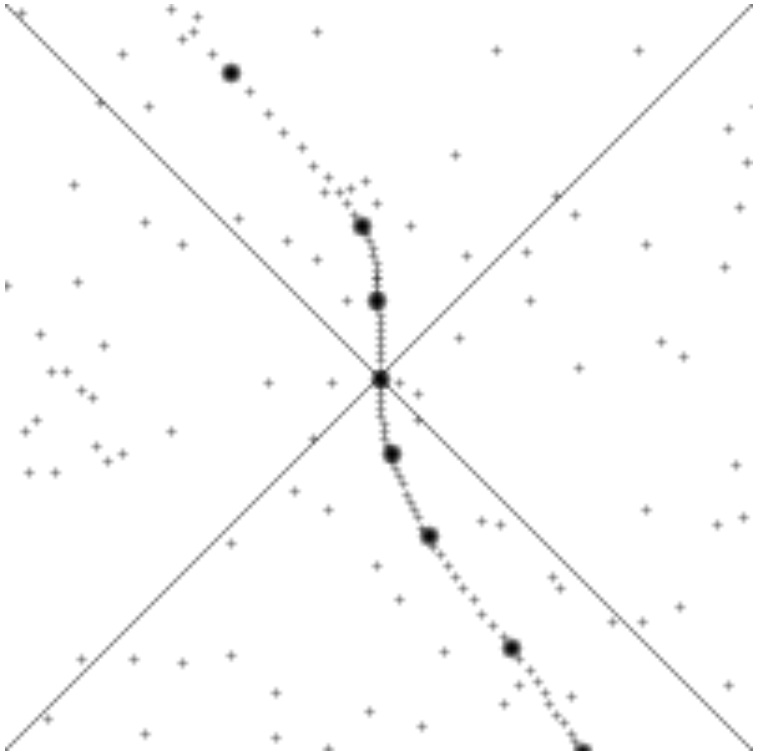


Figure 1 Einstein's clock in its rest frame (a) and in a moving frame (b).

world lines



- vertical direction indicates time
- horizontal direction indicates distance
- center represents an accelerating observer
- dashed line is the spacetime of the observer
- dots mark specific events in spacetime
- NOTE: changes in of co-moving inertial frames when the observer does accelerate