Kurt Gödel´s notion of idealistic time

Kurt Gödel – Selected Works
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1. Abstract

In the late 1940s Kurt Gödel thought about the impact of the special, as well as the general relativity theory on the notion of time. Gödel published three short texts based upon the extensive discussions with Albert Einstein in Princeton (1990a, 1990b, 1990c).
The topic of these conversations were centered around Gödel's solution of Einstein's field equations of general relativity, as well as the distinguishing factors in regards to the idealistic point of view of Kantian philosophy and Einstein's and Friedmann's models of the universe. The understanding of time in terms of an unrealistic, non-objective concept flourished in the discussion with Einstein.
Einstein's solutions allowed the possibility of a concept of an absolute time by measuring the mean motion of matter over large regions of the universe. Gödel's notion of the rotating universes (R-worlds) strengthened the idealistic notion of time as well as the absence of the concept of an absolute lapse of time. In this talk I will follow Gödel's argumentation towards a concept of the unreality of time in contrast to a possible existence of an absolute lapse of time.
Due to several unique properties of Gödel's (static) universe, the possibility of some closed time curves arise. At the end the possibility of moving in time along a geodesic curve, enabling an object traveling in time, shall be sketched. The problems and consequences will be pointed out briefly.

2. Introduction

In the late 1940´s several aspects of relativity theory fueled Kurt Gödel´s interest and the implications on the nature of time. The very starting point of special relativity theory is centered around the concept of simultaneity due to the the notion of time dialation. While two different observers in two different inertial reference frames with different velocities will experience two events successively, while two observers in the same inertial reference frame are going to observe the same events simultaneously. The described notion relativity of simultaneity and to a large extend that of succession carried intriguing implications for the philosophical minded [2, pg202, p1]. Gödel discussed in three texts the result of his thoughts about the meaning of the objectivity of simultaneity as well as the existence of an objective lapse of time. He discussed these implications with Albert Einsteins who he accompanied during his famous walks on the campus of Princeton University.
Gödel himself had much deeper interest in these matters then just the notion of time resulting from the relativity theory from the point of view of a physicist. The philosophical understanding of time and the formal proof of the idealistic notion of time were the goals he persued. Idealistic philosophers like Parmenides, Berkley, especialy Kant and the modern idealists, who deny the objectivity of change while considering change as a form of illusion, more precisely a result of our special mode of perception [2, pg202, p2]. In the third part Gödel´s argument of the idealistic notion of

time will be discussed. The concept of the lapse of time is the topic of the fourth chapter followed by the sketch of the intriuging, resulting concepts of time travel and its problems in Gödel´s universes.

3. Idealistic Time

From the philosophical point of view of idealists as mentioned, change becomes possible only through the lapse of time. Kant centered his ideas around the concept of perception. Events coming into existence in the phenomena due to the sensibility of an observer. A different observer experiences the same even in a different fashion according to its own sensibility. The consequence of relativity theory is the absense of an objective lapse of time according to its inertial reference frame. While the concept of perception is constituting the premises for an idealistic philosopher, Gödel substituted the world lines of observers resulting in the same notion of time.
McTaggert describes in [8] two models for events in time: A-series and B-series. The A-series describes, that realitiy consists of an infinity of layers of "now". Points of a possible future come into existence successively and vanish into a fixed past. The B-series describes the relativity of two events in time. The concepts of simultaneity, event A after (or before) event B are the focus of this idea modeling time.
The concept of simultaneity described as an aspect of relativity theory is something relative, as described. Each observer has his own set of "nows", hence his own model of A-series of events. This inference is the idealistic notion of time. None of the possible observers is able to claim, that its lapse of time is the objective one. Hence time is something relative and time cannot be split up into such layers of "nows" as described [2, pg03, p1] in an objective determined way.
Runing the argument from Kants point of view, the premise that each observer has its own perception of change, hence of the lapse of time according to its situation as well as sensibility capibilities, the resulting notion of time is the same while none of those observers could claim an objective way according to the perception of the world as well as its own model of "phenomena".

4. Lapse of Time

As described the idealistic notion of time is based on the absense of an objective lapse of time. Gödel and Einstein differed in that point of view, Einsteins considered Gödels notion meaningful and insightful though. In Einstein´s and Friedman´s solutions of the field equations (i.e. possible universes) the determantion of an objective lapse of time would be possible. Einstein considered the mean motion of matter in huge area of the universe, e.g. multiple galaxies. If the regions are large enough, the value of the mean motion of matter does not vary anymore siginificantly. Due to this measured value an objective lapse of time could be determined. "In all cosmological solutions of the

gravitational field equations (i.e. all possible universes) ... the local times of all theses observers fit together into one world time." [2, pg204, p1]
However, Gödel introduced solutions of Einstein´s gravitational field equations of general relativity which allowed rotating universes, called R-worlds [2, pg204, ft10; 5, pg224, p1]. In this model the centrifugal force arising from the rotation is in balance with the force of gravity pressing celestial bodies towards the collapse [5, pg224, p1]. The arising feature from these solutions is the compass of intertia rotates everywhere in the same direction relative to matter, by means of the totality of galactic systems [2, pg204, ft10]. Gödel proposed two variations of that model. In one hand, there is a static version in which the universe is rotating at constant angular velocity. This soultion has some strange properties and can hardly be considered our universe. On the other hand, Gödel introduced a dynamic model. This solution could be considered a more realistic version while supporting the astronomical data, especialy the "red shift" of distant objects such as nebulas. Researchers agree, that this is a strong indicator for an expanding universe. Gödel´s dynamic version of the universe supports expanding univereses as well and has some more realistic properties [5, pg224, p1].
Furthermore, Gödel showed that time in R-worlds lacks the existence of an absolute time, except in empty or some spatial homogenous versions [4, pg251, p1,2]. It is impossible to distinguish in between various systems of "points in time". The local times of special observers cannot be fit into one world time [2, pg204, p3]. There exists no procedure to accomplish this purpose. The aforementioned procedure formulated by Einstein is not applicable in those cosmological soultions as well. Gödel showed, that the worlds possess properties of symmetry that for ech possible concept of simultaneity and succession there exist other which cannot be distinguished from it by intrinsic properties. It only can be accomplished by referencing to specific individual objects, e.g. galactic systems [2, pg204, p3; 4,pg251, p3].

5. Time Travel

Gödel indicated the possibility of closed time curves in the static versions of the aforementioned R-worlds [5, pg224, p3]. In case one progresses in time (forward, backward) along a geodesic curve, one would arrive at the starting point. More precise, since the journey would take time one would arrive in the past compared to the starting point in time. This assertion underlines at least in theoretical principle the possiblity of round trips on a rocket ship into the present, future or past and back again same as to travel towards distant points in space.
Gödel indicated some problems as well as the usual paradoxies within that notion. One example is the possibility to travel back in time and do something to ones younger self in an earlier period of his life which one is not able to recall or had have happened. Furthermore Gödel mentioned some technical difficulties. The main issues described are the traveling velocity near the speed of light, a very high acceleration and the enormous amount of fuel needed to accomplish such a journey. Basing on calculation on mean density of matter in our world and assuming the ability of transformation of matter completly into energy, the weight of the fuel in order to complete the journey in

a rocket ship within t years would be of the magnitude of $10^{22} / t^2$ times the weight of the rocket ship itself [2, pg205, ft11]. The velocity of the ship must be at least $1/\sqrt{2}$ of the velocity of light. The velocitiy needed making those journeys possible in a reasonable length of time is beyond what might be considered possible [2, pg205, p2].
Since at least the theoretical possibility of time travel in Gödels static universes exists, Gödel had been able to counter an objection towards the existence of an objective lapse of time. Gödel knew about the possibility of the agument, that his notion is only considering the A-series of events while the B-series is still intact. By showing the possibility of time travel the B-series also lost an objective meaning, strictly speaking the concepts of before, after and simultaneity lost an their objective meaning.

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