

Tomasz Placek

Is the distinction between past, present,  
and future objective?

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Once Einstein said that the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future, but that this important difference does not and cannot occur within physics. That this experience cannot be grasped by science seemed to him a matter of painful but inevitable resignation.

R. Carnap



The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling along the lifeline of my body, does a section of this world come to life as a fleeting image in space which continuously changes in time.

H.Weyl (1949, 116)



Time flows.... temporal things come from somewhere and go elsewhere....



The present is like fire: only things on fire exist, anything that has not caught fire yet is not on fire, and something that was on fire is a mere ash now. (Rilke?).



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Is the special character of “now” derived from consciousness only (Weyl’s vision), or is it more fundamental?

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Opposite experience: a distinction between **here/there** and **now/then**:

I had been there (at the Hradcany Castle), and though I drove far, the castle is still there.

Then our guide had shouted, and although many hours have passed, he is still (? **then** ?) shouting there

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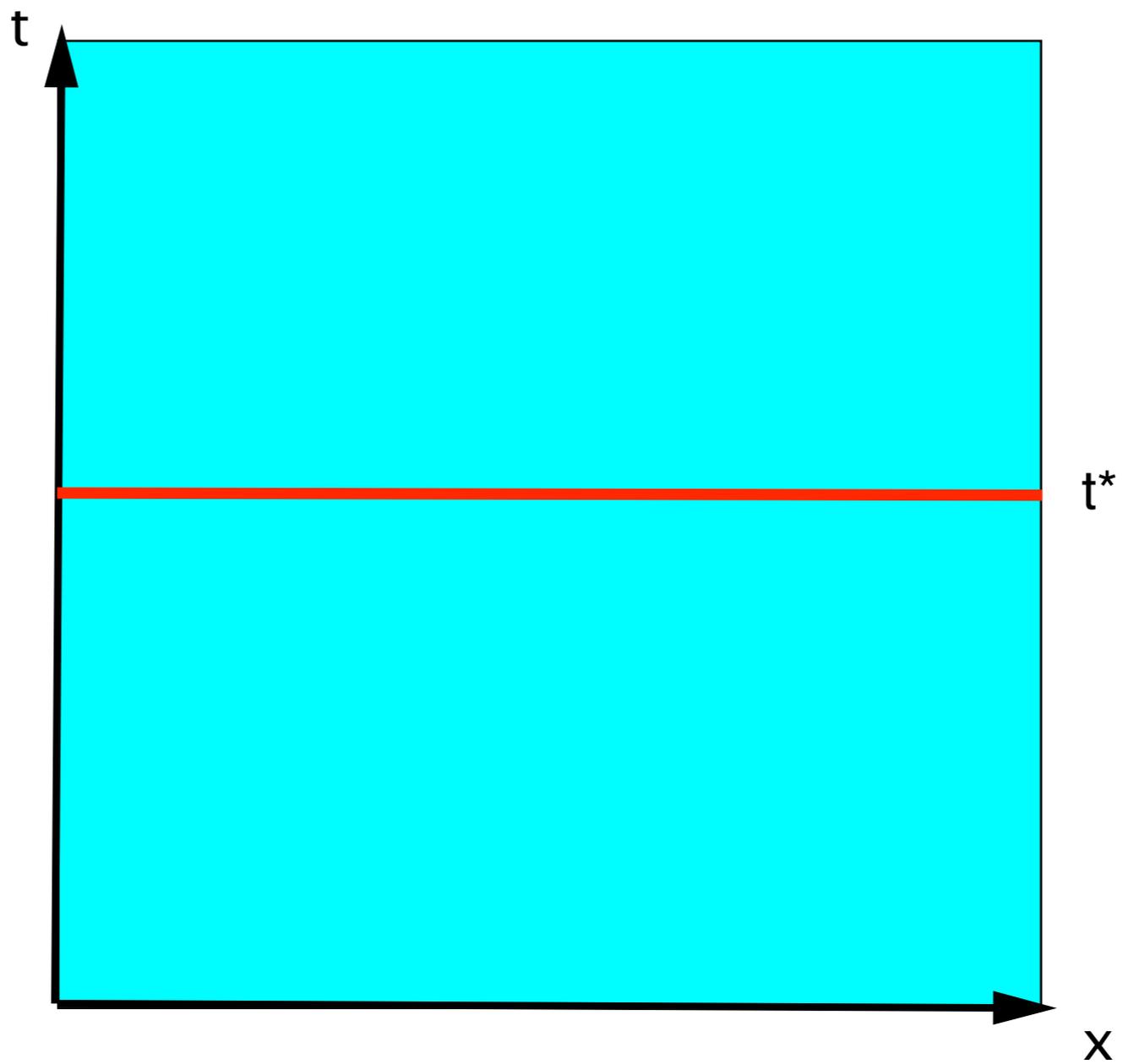
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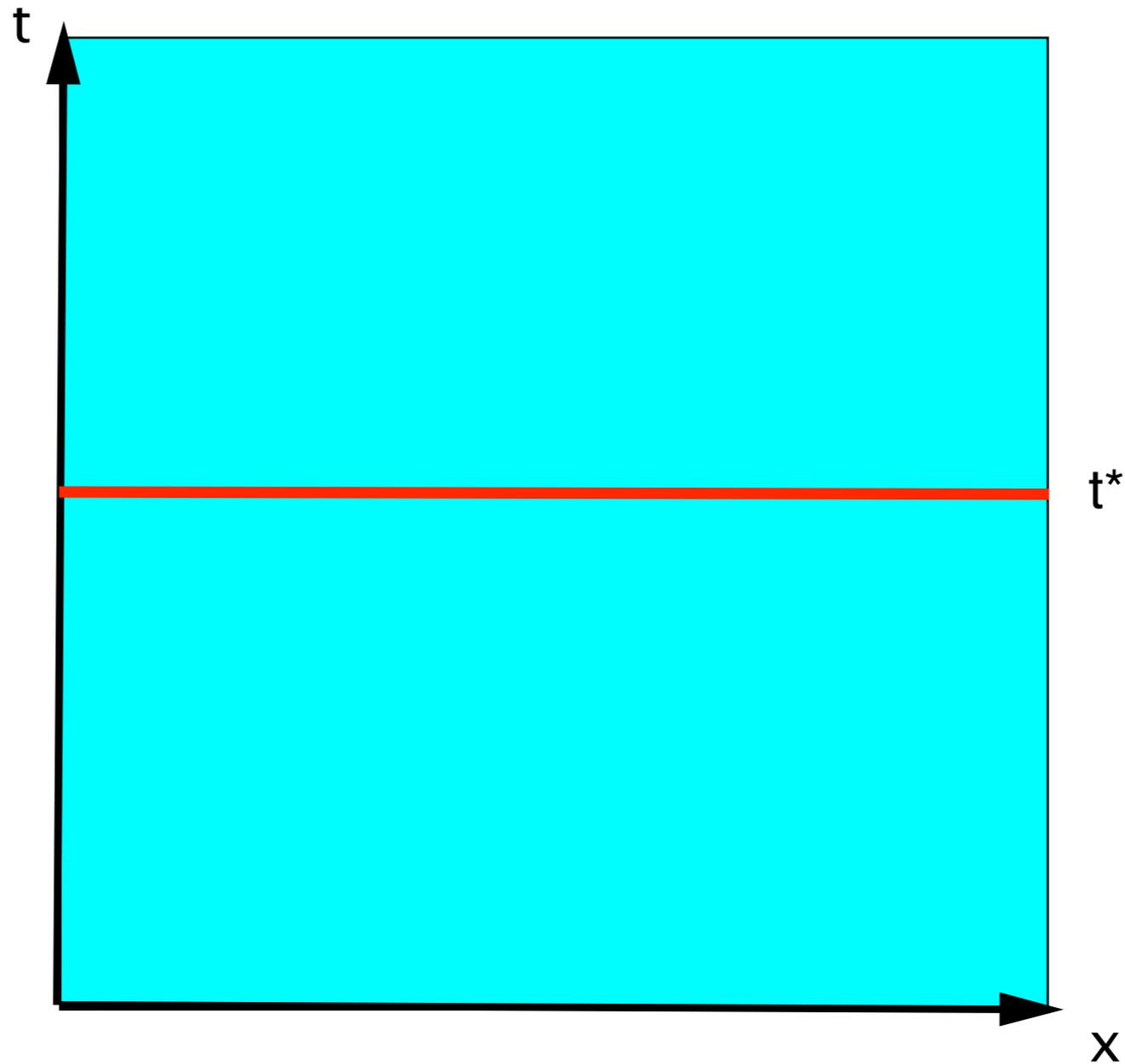
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physical theories of spacetime are inimical to (the introduction) of the present

# Newton's spacetime is present-friendly



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One can define the relation  $R$  of being co-present:

$e R e$

if  $e R e'$  then  $e' R e$

if  $e R e'$  and  $e' R e''$ , then  $e R e''$

Relations satisfying these three conditions: equivalence relations

Goedel / van Benthem: in Minkowski spacetime there are only trivial equivalence relations

This means:

- (1) either every event is co-present with itself only, or
- (2) every event is co-present with all other events

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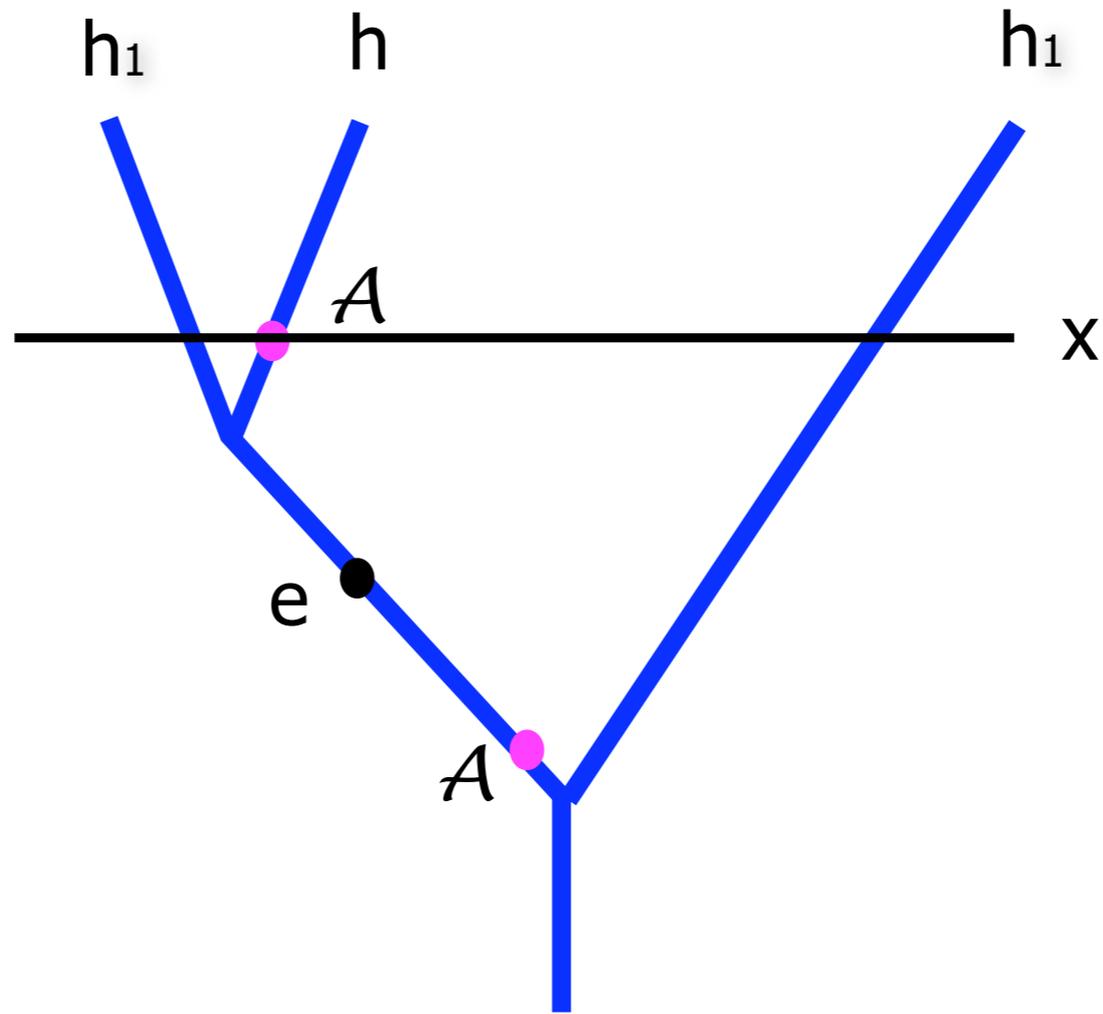
What is in the future of  $e$ ? Something that can occur, but need not to, from  $e$ 's perspective.

What is in the past of  $e$ ? Something from which perspective  $e$  is (was) in the future.

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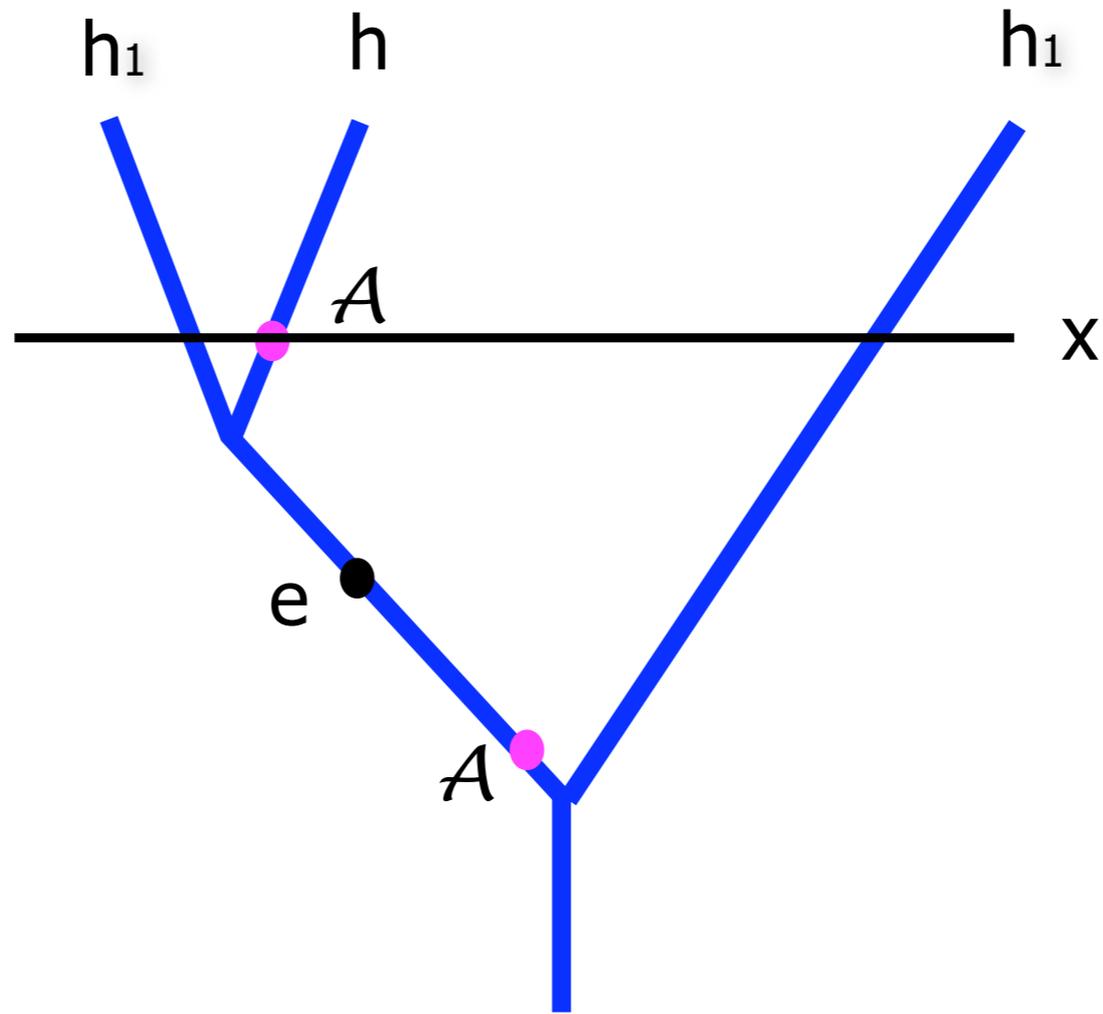
How do we use grammatical tenses? Prior's BT models



$e/h \models A$  iff  $e \in \mathcal{I}(A)$  for  $A$  an atomic formula;

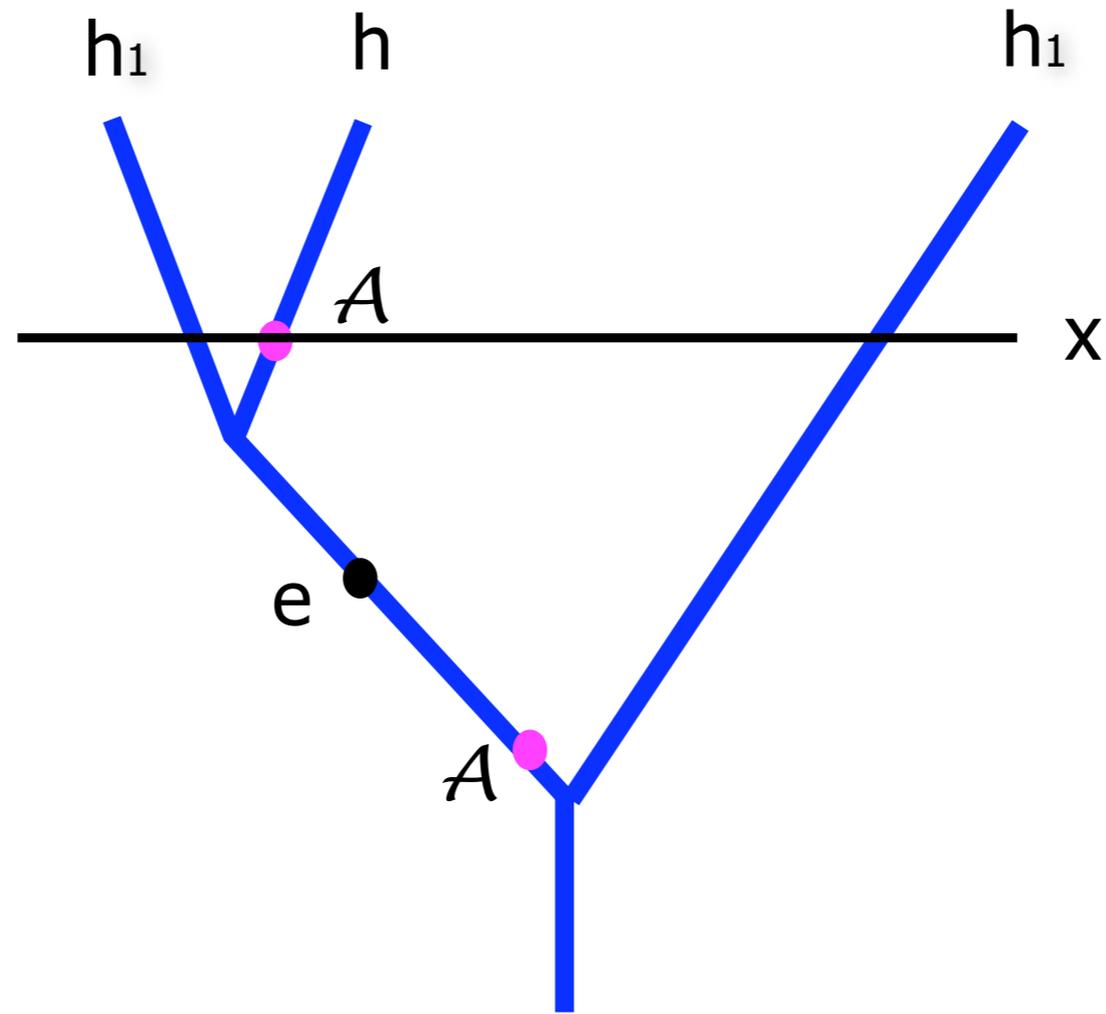
$e/h \models Will: A$  iff  $\exists e' > e: e'/h \models A$ ;

$e/h \models Was: A$  iff  $\exists e' < e: e'/h \models A$ ;



$e/h \models_{Poss} A$  iff  $\exists h' : e \in h' \wedge e/h' \models A$ ;

$e/h \models_{Sett} A$  iff  $\forall h' : e \in h' \rightarrow e/h' \models A$ ;



$e/h \models At_x : A$  iff  $\exists e' : e' \in h \cap x \wedge e'/h \models A$ ,

where  $x \in Instants$ .

*Instants*: partition of  $W$  that respects the ordering  $\leq$

# Branching space-times - Belnap 1992

possible histories have spatial and  
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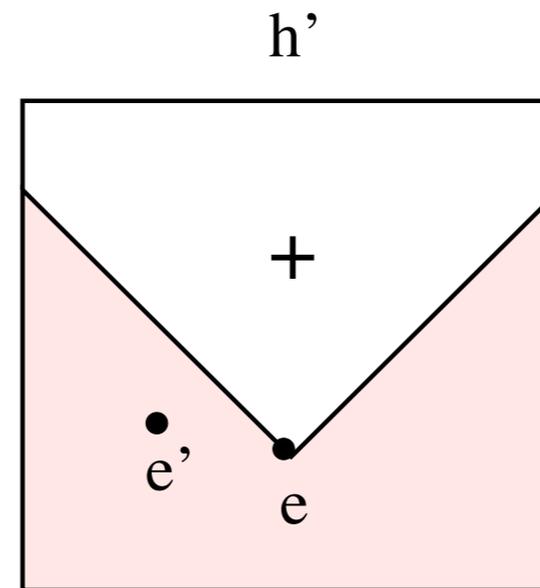
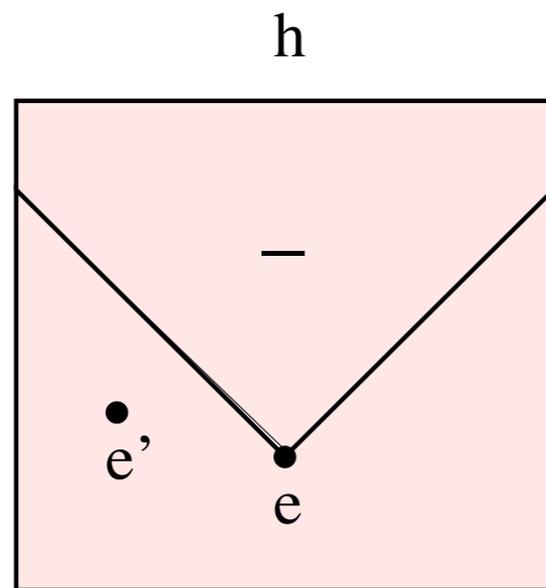
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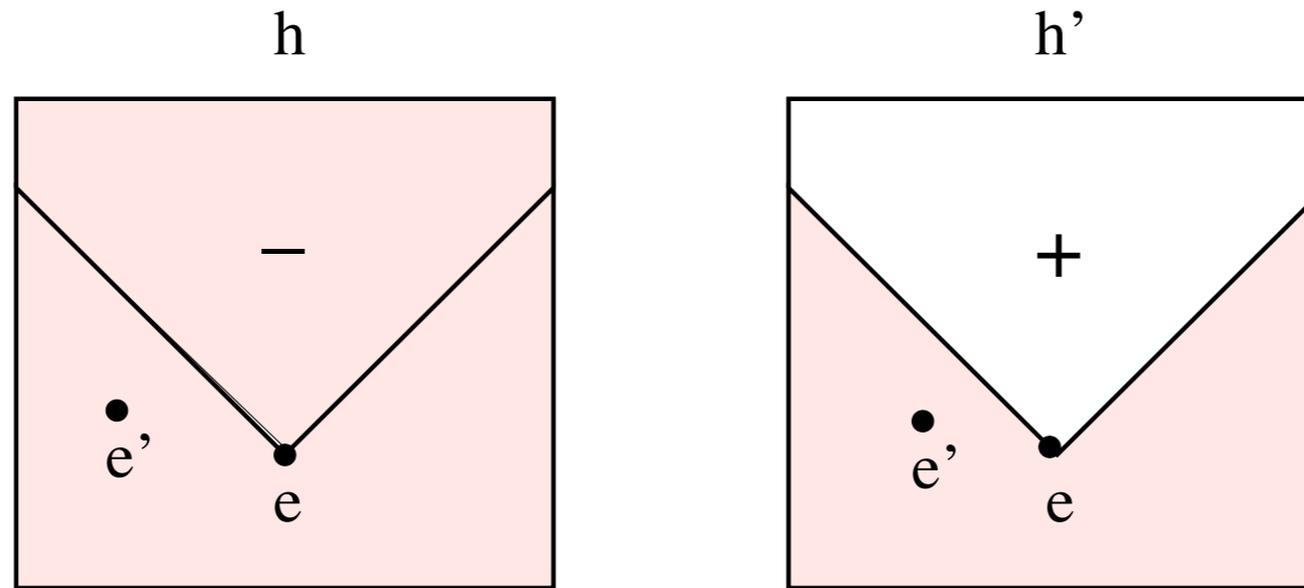
Minkowskian branching structures: Müller 2002 and Wroński/  
Placek 2006

possible histories are isomorphic to the Minkowski spacetime

# One splitting point, two histories

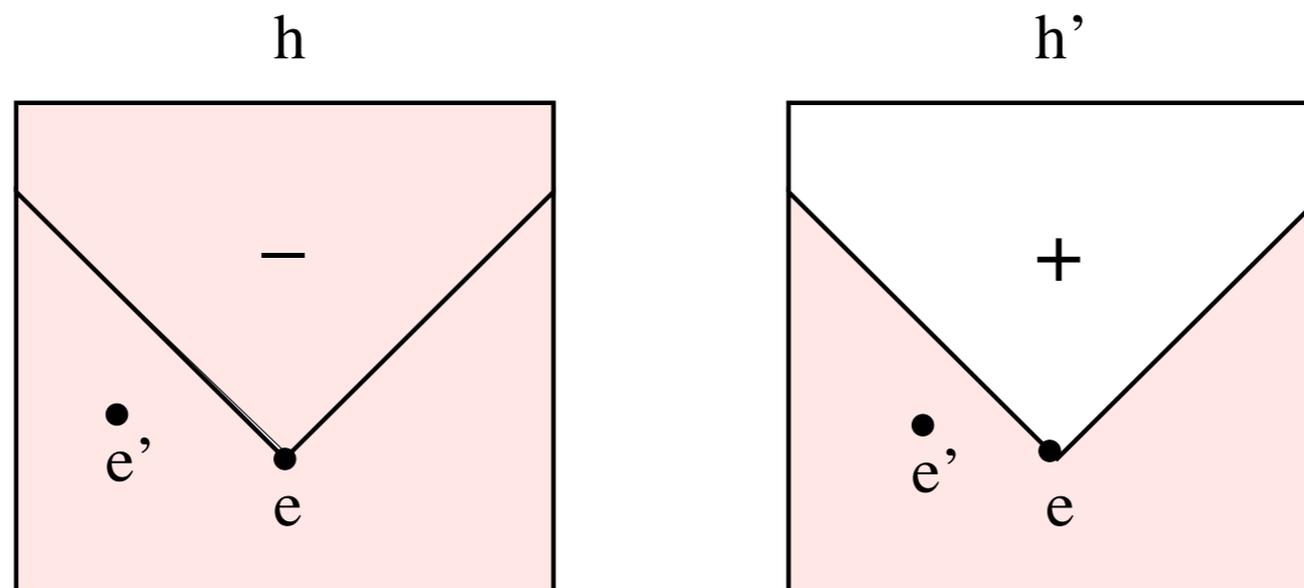


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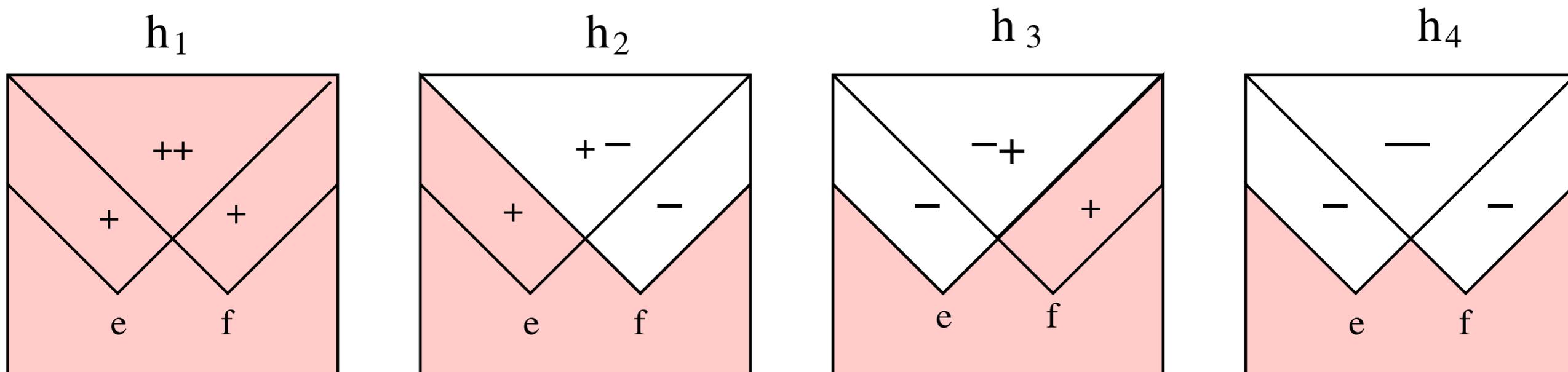


Two splitting points, four histories

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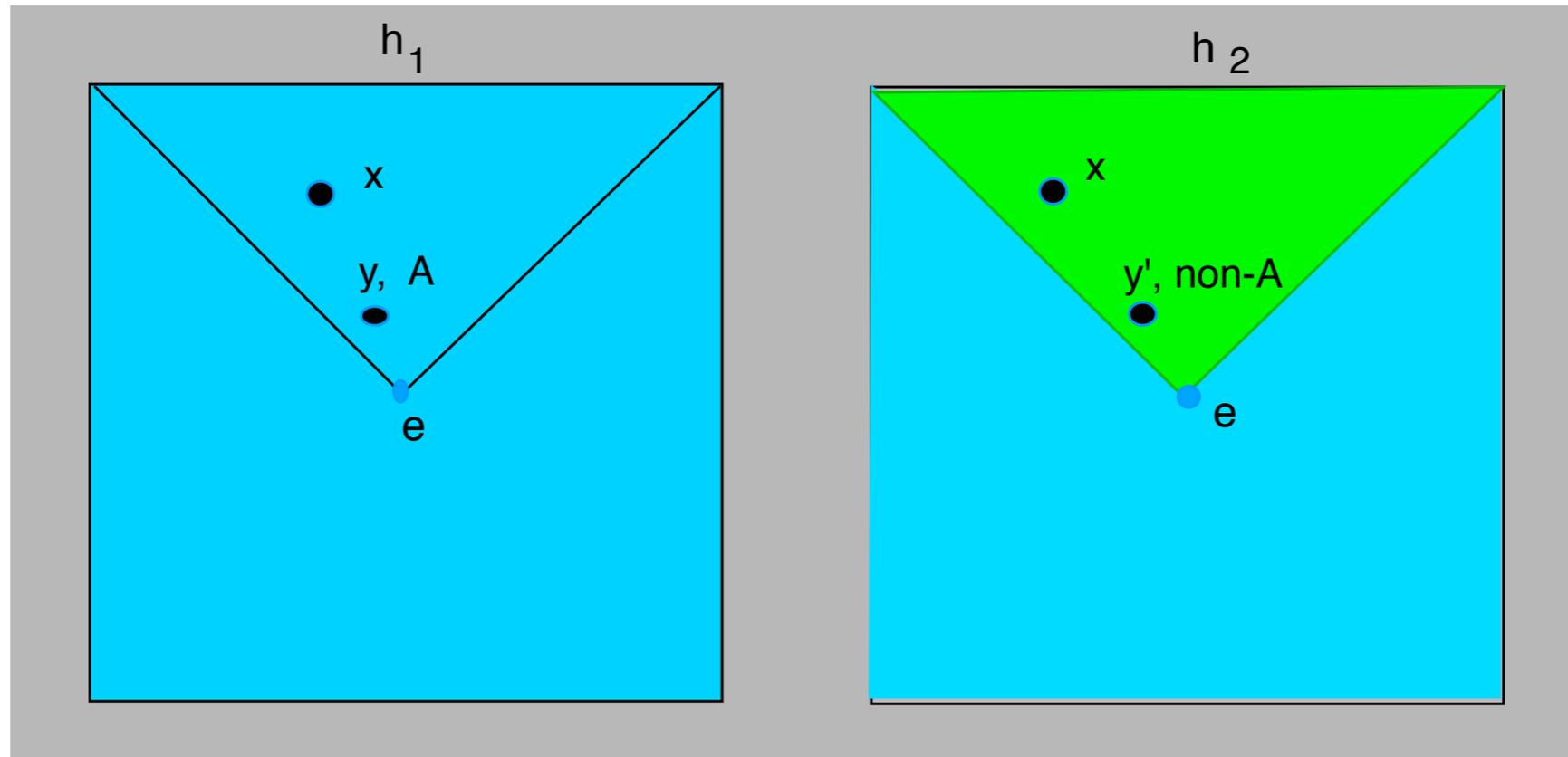


# Two splitting points, four histories



## Extra postulate:

Splitting is always for a reason, and that reason is arbitrarily close to the splitting point



If  $h_1 \perp_e h_2$  and  $x \in h_1$  i  $e < x$ , then

$$\exists y \in W \exists A \in Atoms (e < y < x \wedge y/h_1 \models A \wedge y'/h_2 \not\models A),$$

where  $y' = s(y) \cap h_2$  (i.e.,  $y$  and  $y'$  occur in the same location).

Recall the central idea: smth is in the future of  $e =$  with respect to  $e$ ,  
smth can happen but need not to. Hence this schema:

$$e \models \textit{Poss} : A_x \text{ but } e \not\models \textit{Sett} : A_x$$

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Yet, at least for some  $A$ , this option is excluded by our extra postulate.

A spatiotemporal location  $x$  is in the future of event  $e$  iff

1.  $\exists y : y \in Loc \wedge y \leq x$ ;
2.  $e \models Poss : At_y : A$ ;
3.  $e \models Poss : At_y : \neg A$ .

for some atomic formula  $A$  (note that the ordering refers to locations, not events).

A spatiotemporal location  $z$  is in the past of  $e$  iff

$\forall e' \exists h \in Hist: (e' \in z \wedge e, e' \in h \rightarrow Loc(e) \text{ is in the future of } e')$ .

Something is co-present with  $e$  iff it neither is in the past of  $e$   
nor in the future of  $e$ .

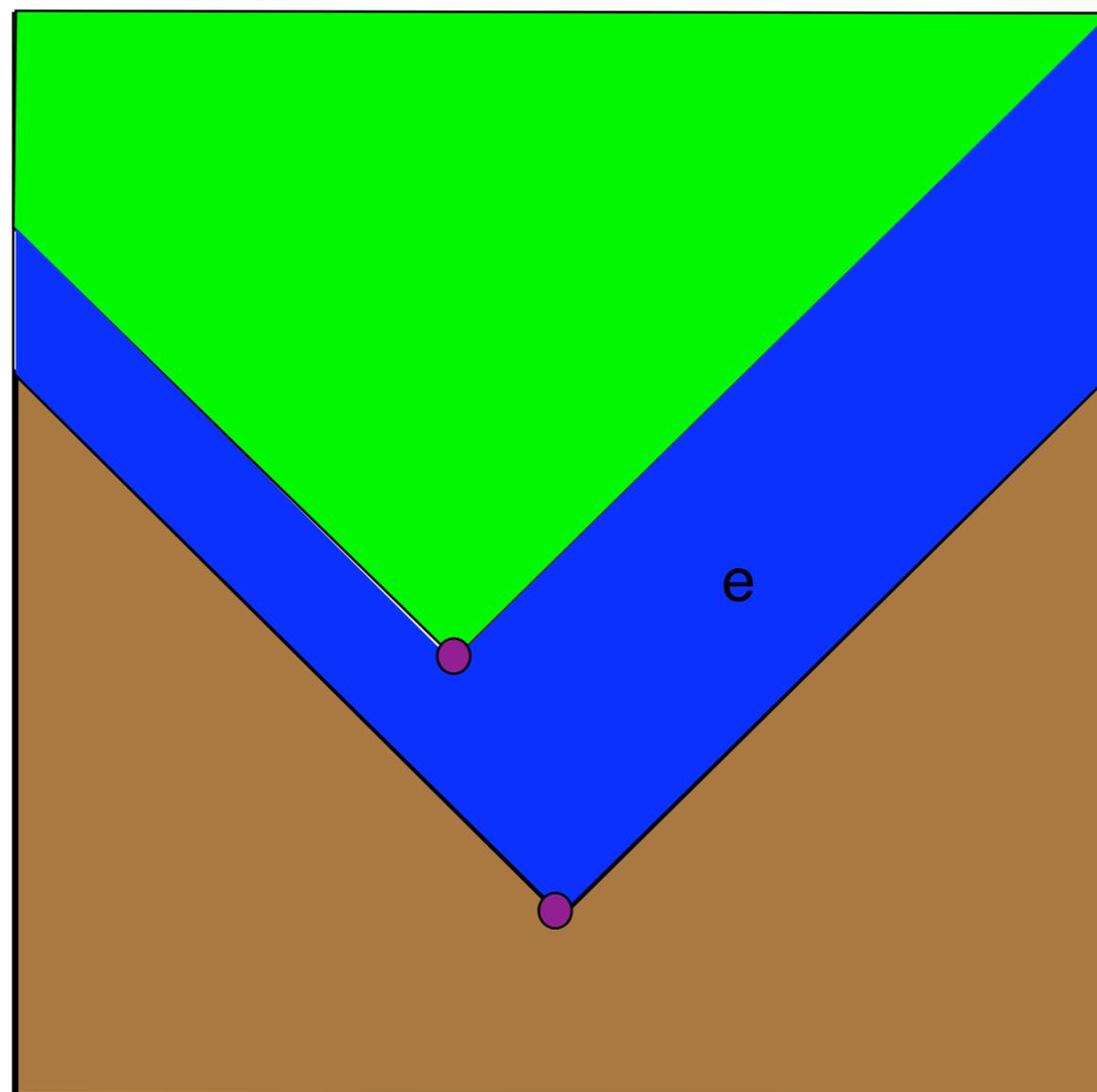
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Something is in the past of  $e$  iff  $e$  was in future with respect to  
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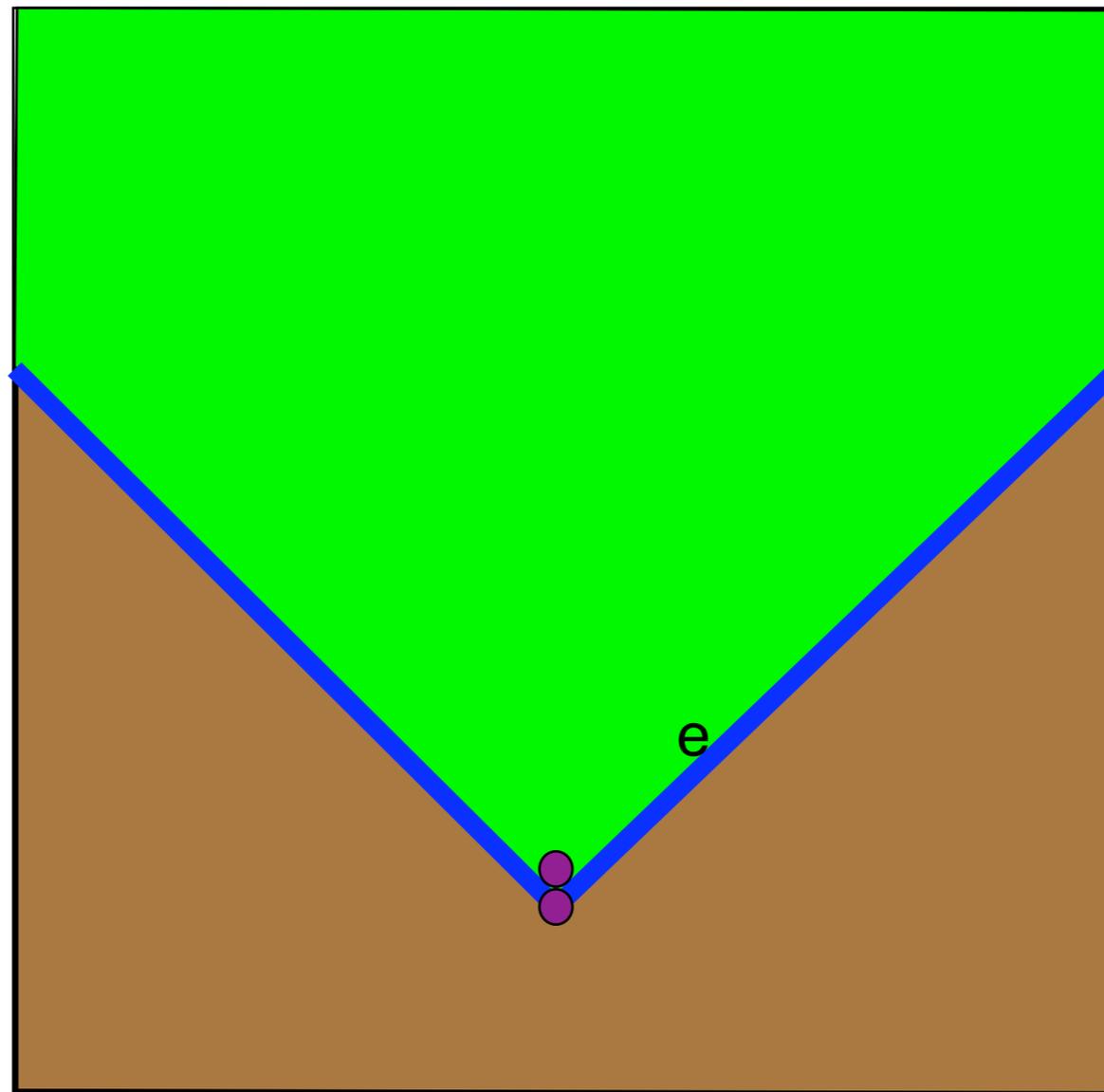
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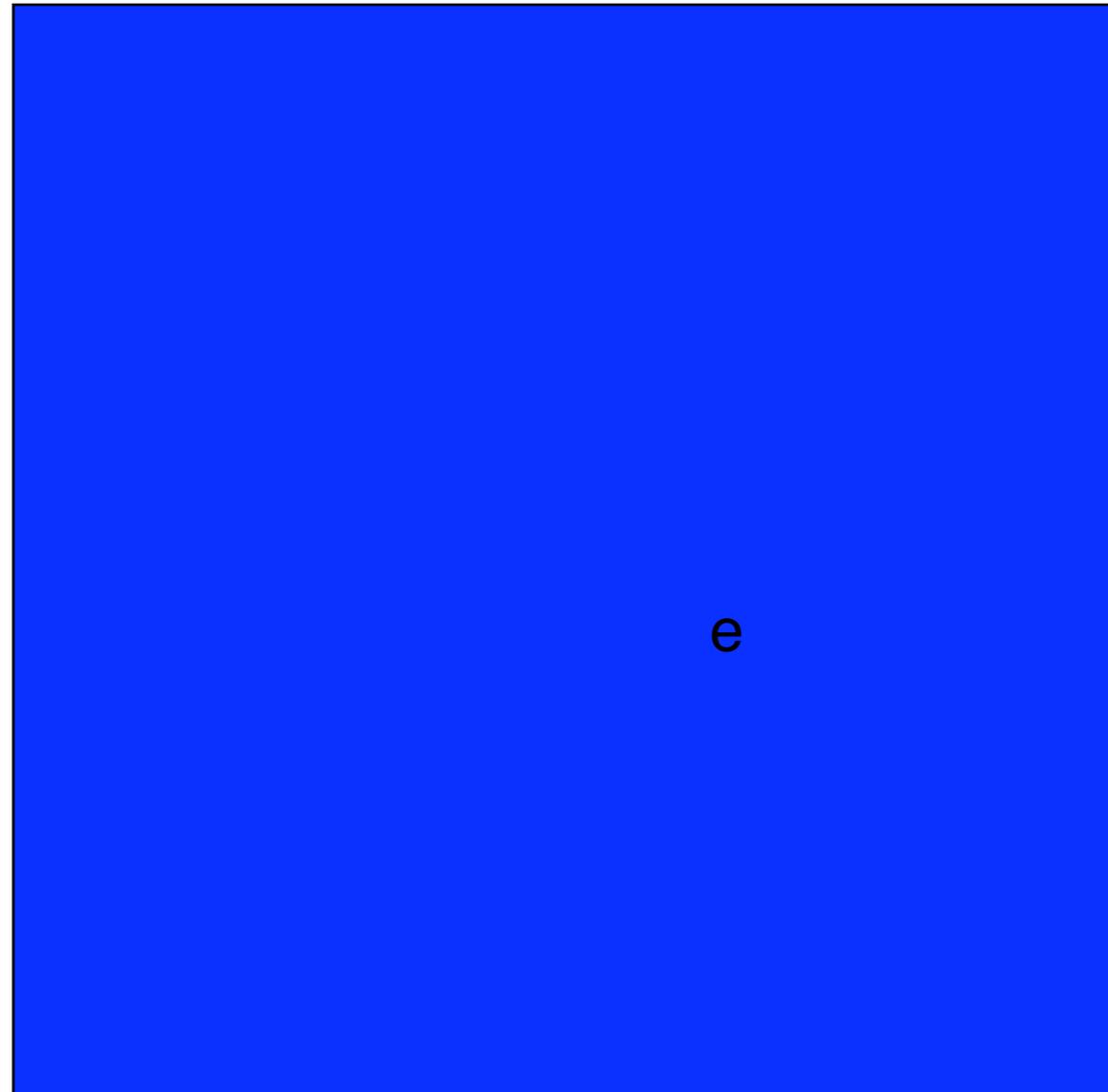


The present can be thick; but it can be infinitely thin...

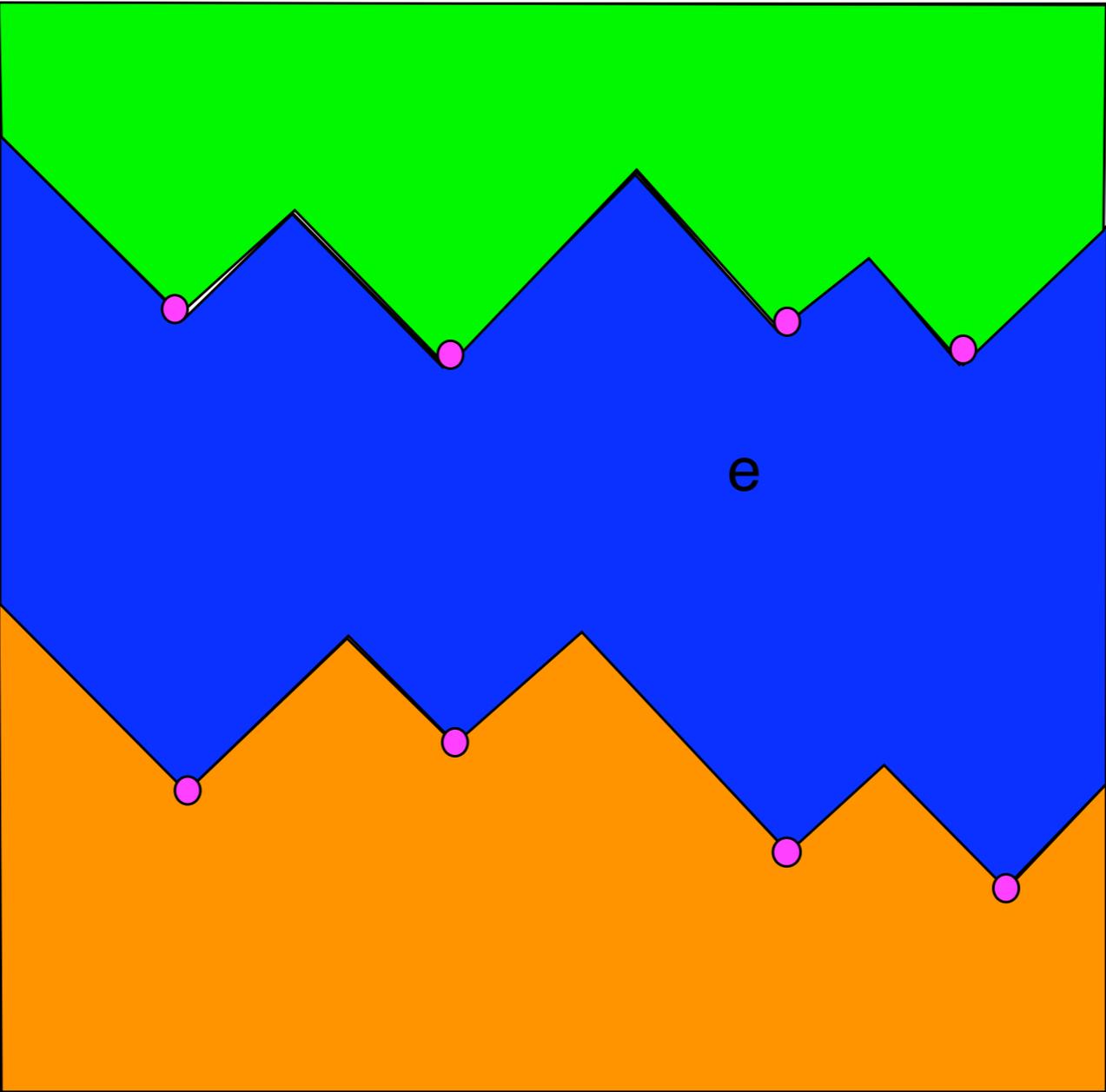
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It can also be as thick as the entire universe. This means that there is no past and no future.



Generally: the shape of the present is like a thick generalized letter **W**:



## To sum up:

1. the notion of present is indexical; for that reason there cannot be a theory explaining / stating that a given event is now, like there cannot be a theory that Tomasz Placek is me.
2. relativity can be made present-friendly by defining an (invariant) concept of “the region of spacetime co-present with a given event  $e$ ”.
3. the shape of that region depends on the localization of chancy events.
4. The present is history dependent: even if  $e$  and  $e'$  belong to the same location, the present of  $e$  and the present of  $e'$  can be different.

END

Pictures come from:

<http://wso.williams.edu/~dmarshal/carnap.html>

<http://th.physik.uni-frankfurt.de/~jr/physpiceinstein.html>

[http://www-groups.dcs.st-and.ac.uk/~history/  
Mathematicians/Weyl.html](http://www-groups.dcs.st-and.ac.uk/~history/Mathematicians/Weyl.html)

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