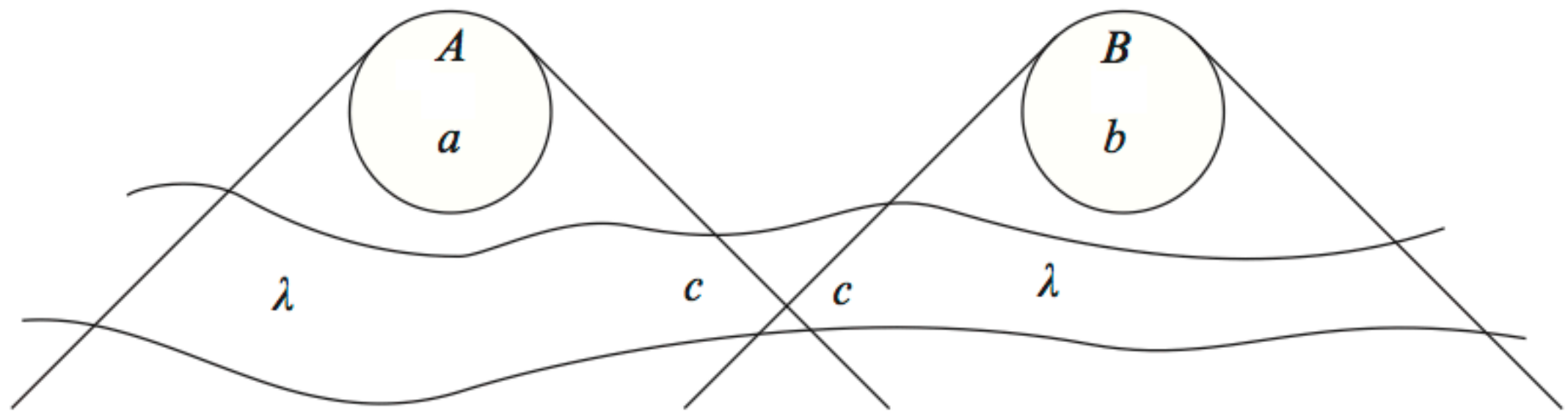


Interventionist causation, Bell's Theorem, and the 'free will' loophole

Huw Price

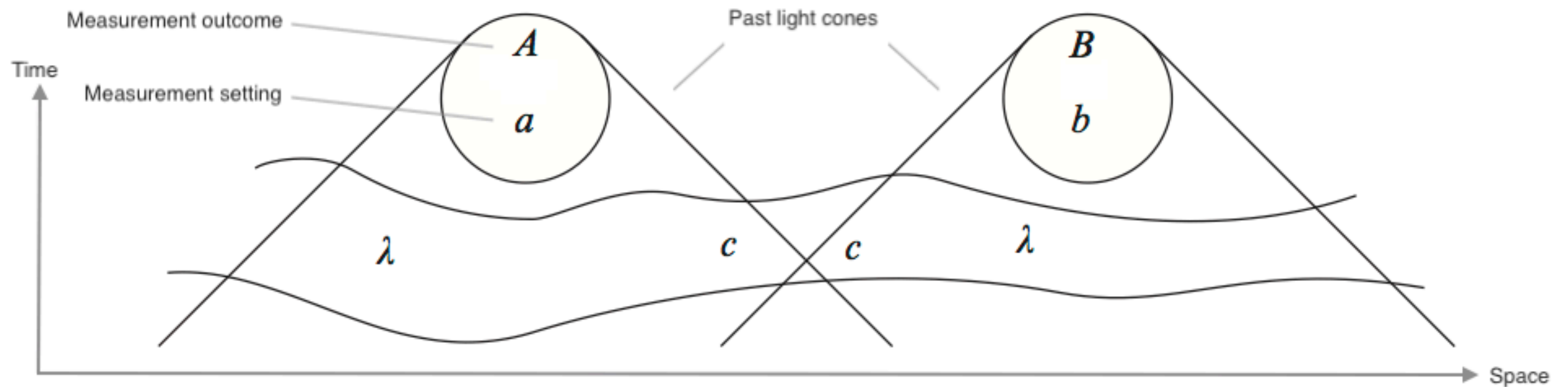
Apology

Bell's Theorem – the set up

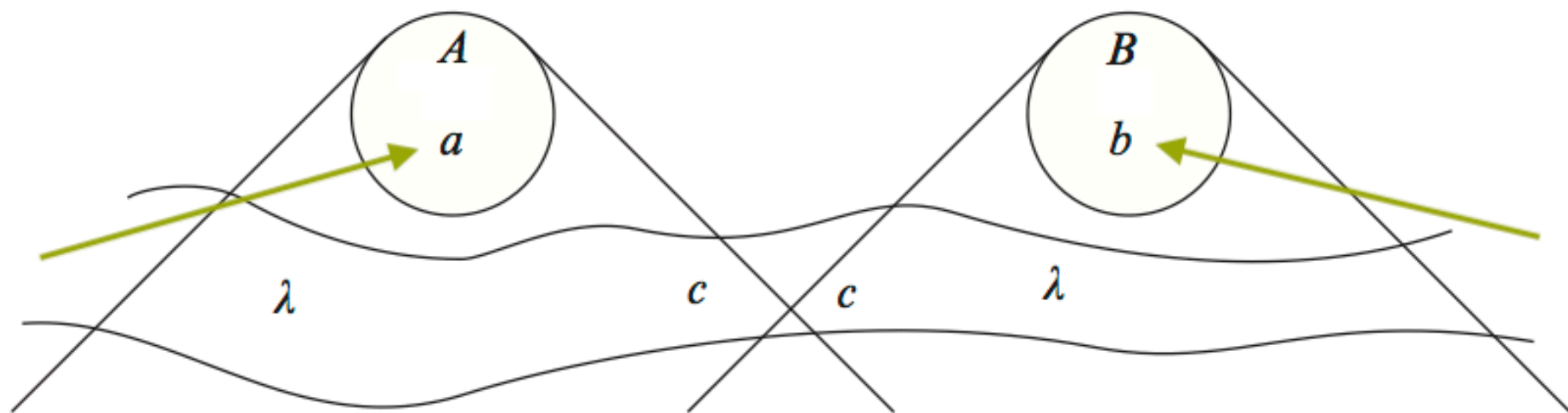


From J. S. Bell, 'La Nouvelle Cuisine'

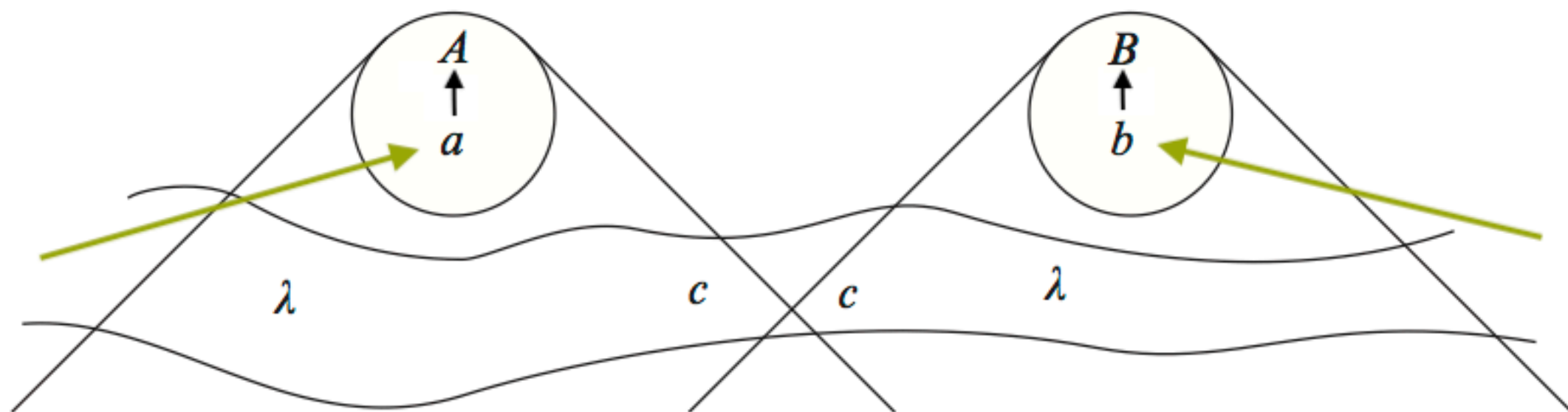
Bell's Theorem – the set up



Identifying the intervention variables



Identifying the intervention variables

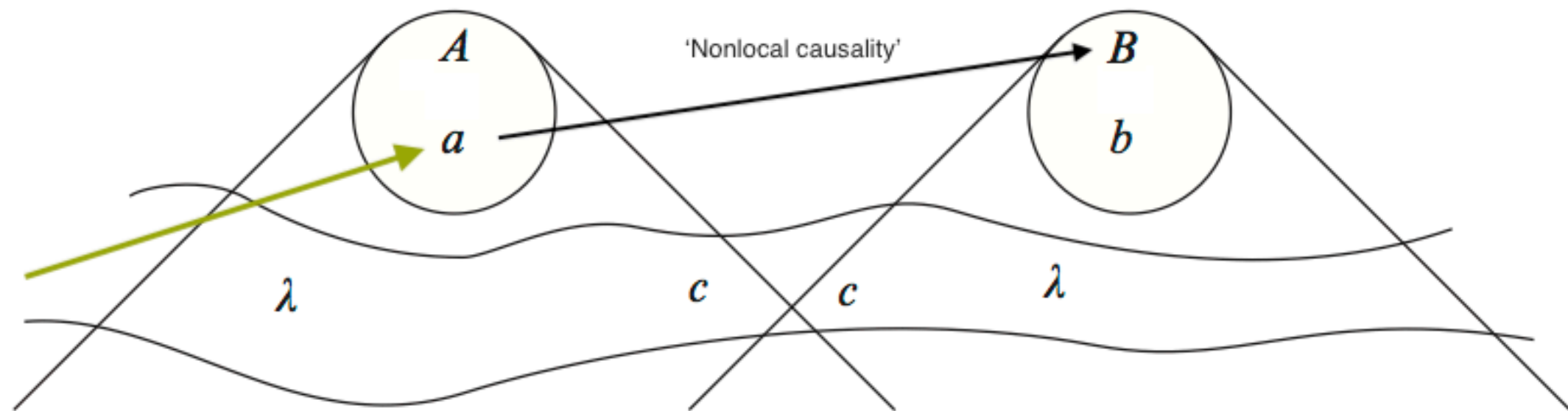


Local causality

Principle of local causality

The direct causes (and effects) of events are near by, and even the indirect causes (and effects) are no further away than permitted by the velocity of light.

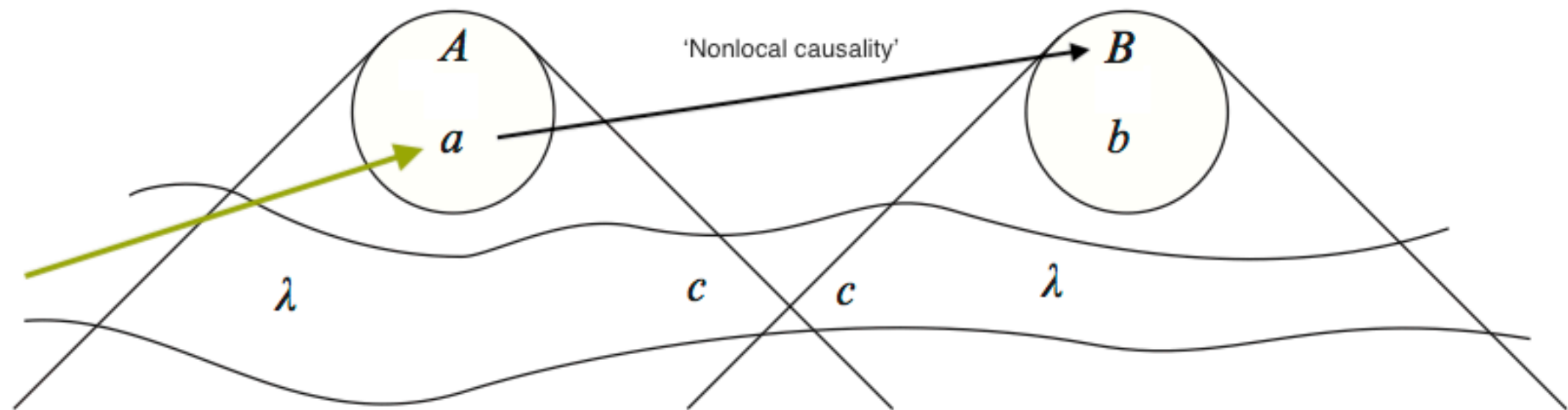
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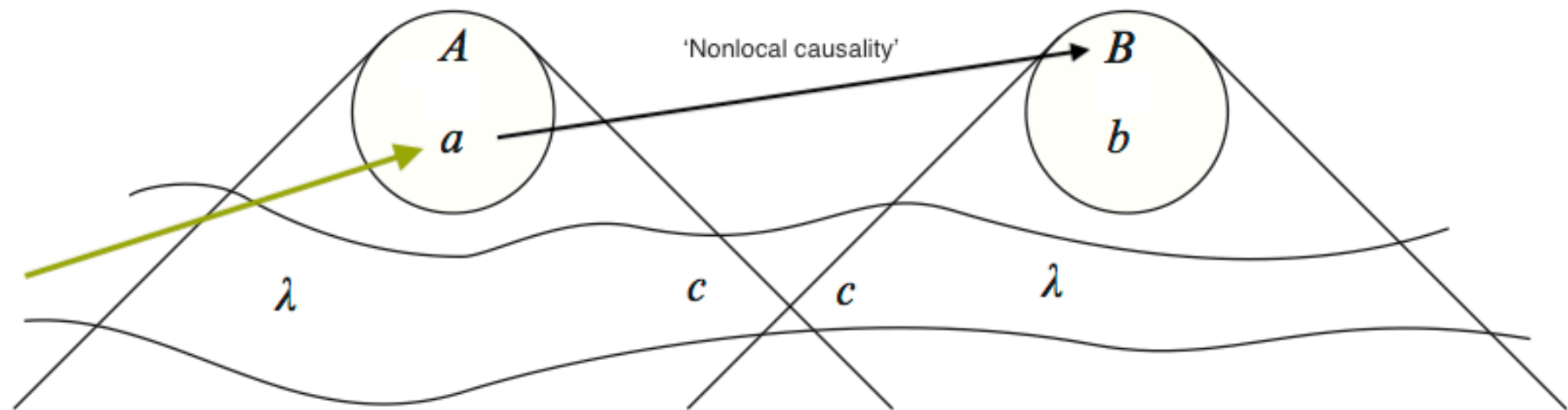
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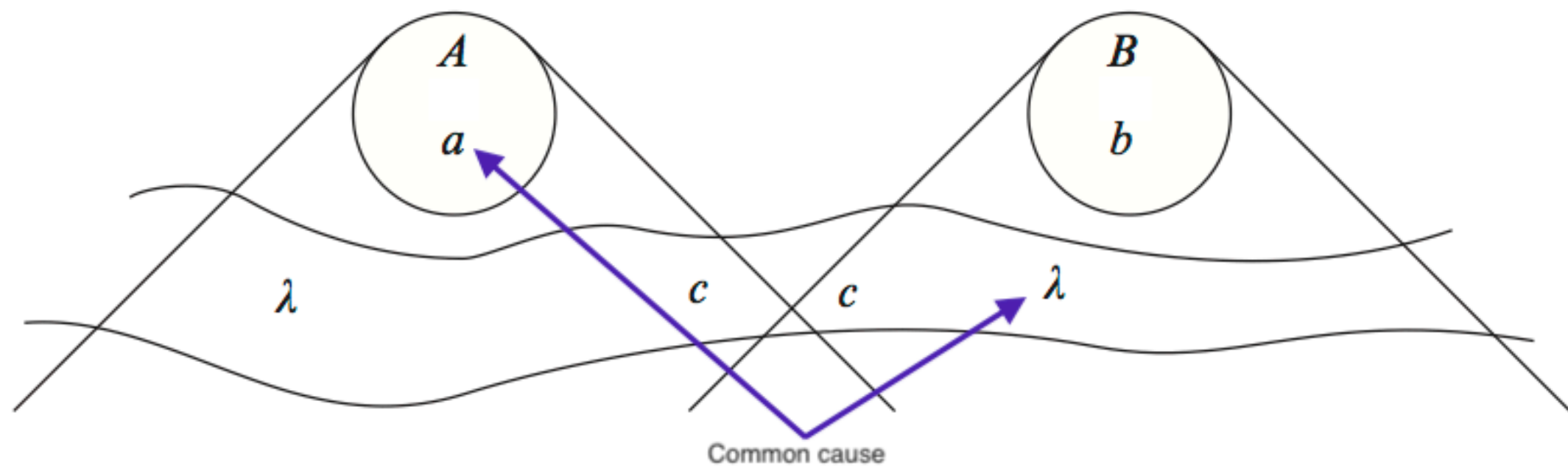
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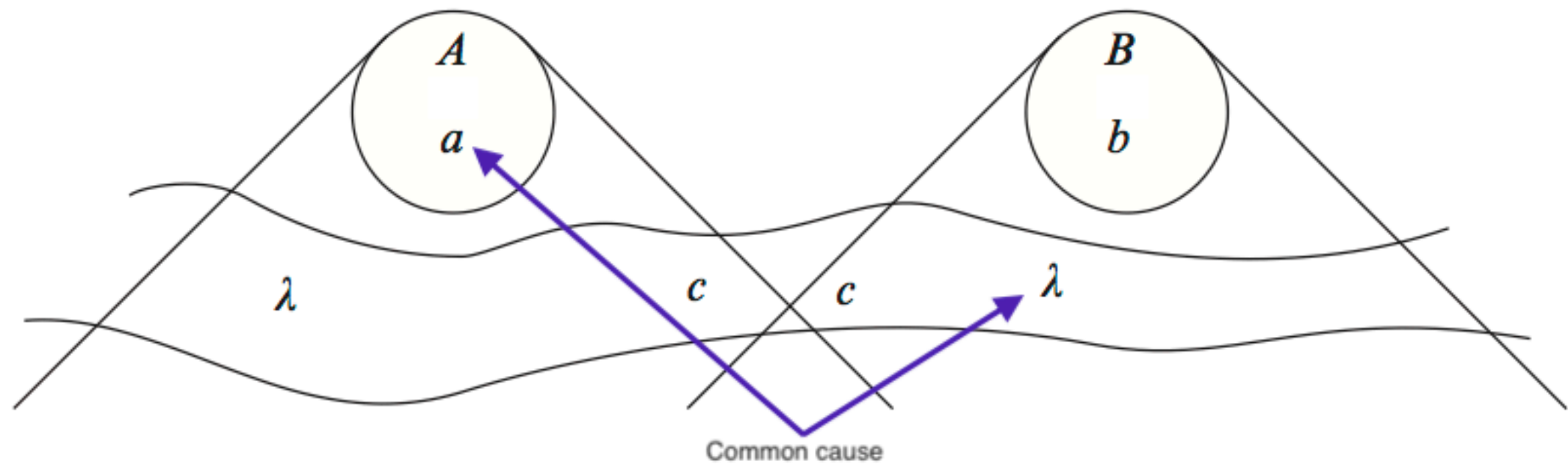
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But there are loopholes ...

The 'free will' loophole

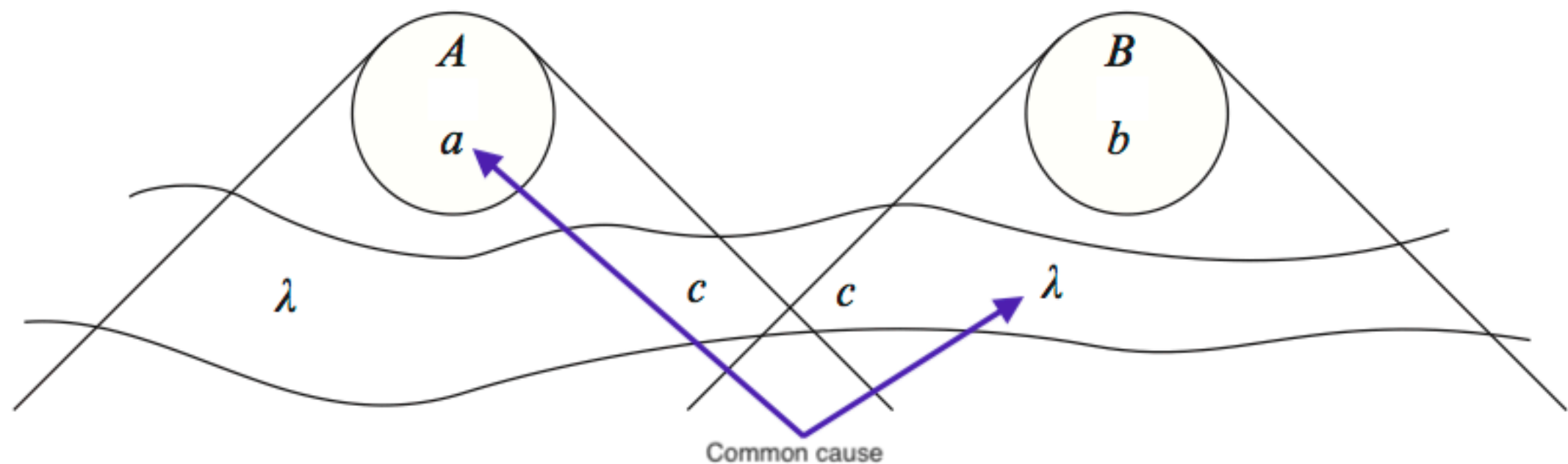


The 'free will' loophole



Bell's argument assumes that the settings a and b are statistically independent of λ .

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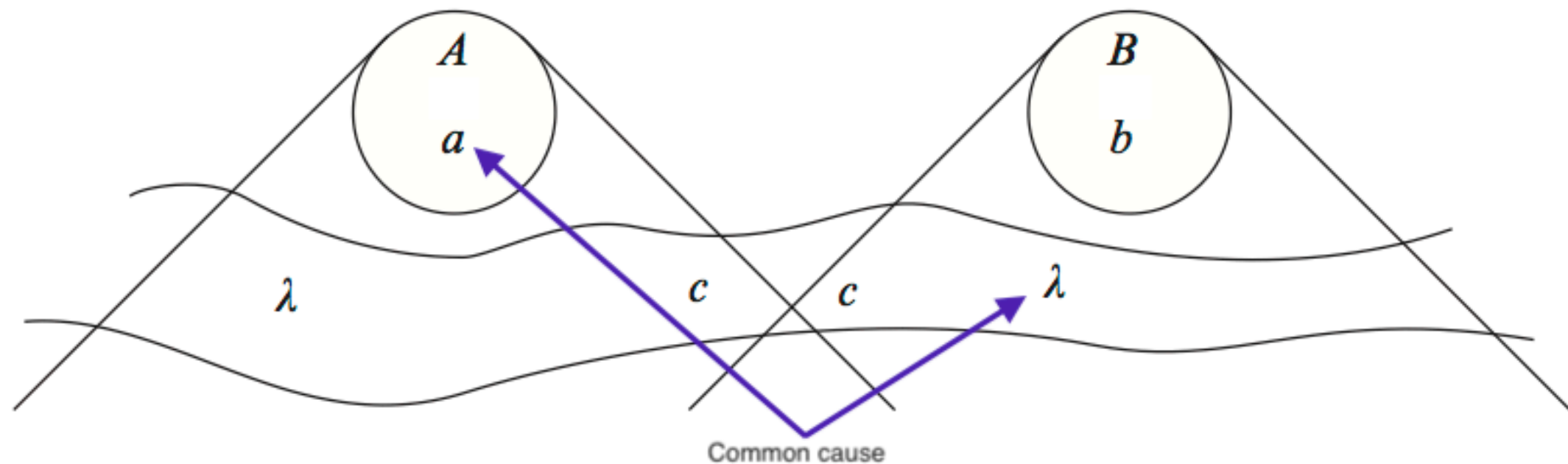


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As Bell noted, this could fail if both a and λ are controlled by a common cause – **'superdeterminism'**.

The ‘free will’ loophole

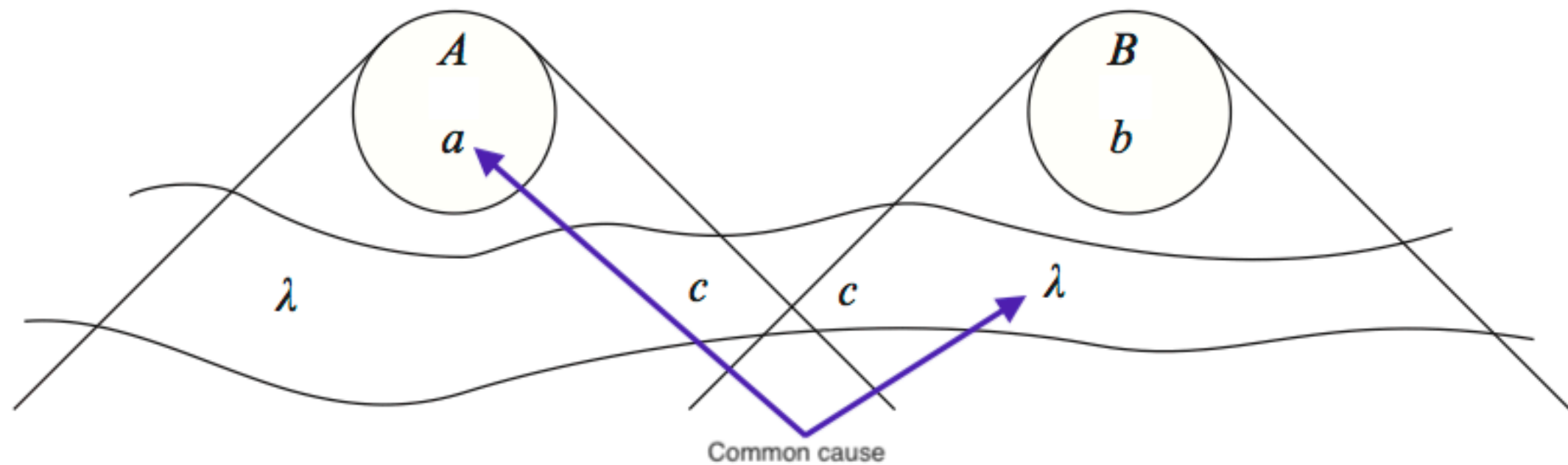
An essential element in the reasoning here is that a and b are free variables. One can envisage then theories in which there just *are* no free variables for the polarizer angles to be coupled to. In such ‘superdeterministic’ theories the apparent free will of experimenters, and any other apparent randomness, would be illusory.



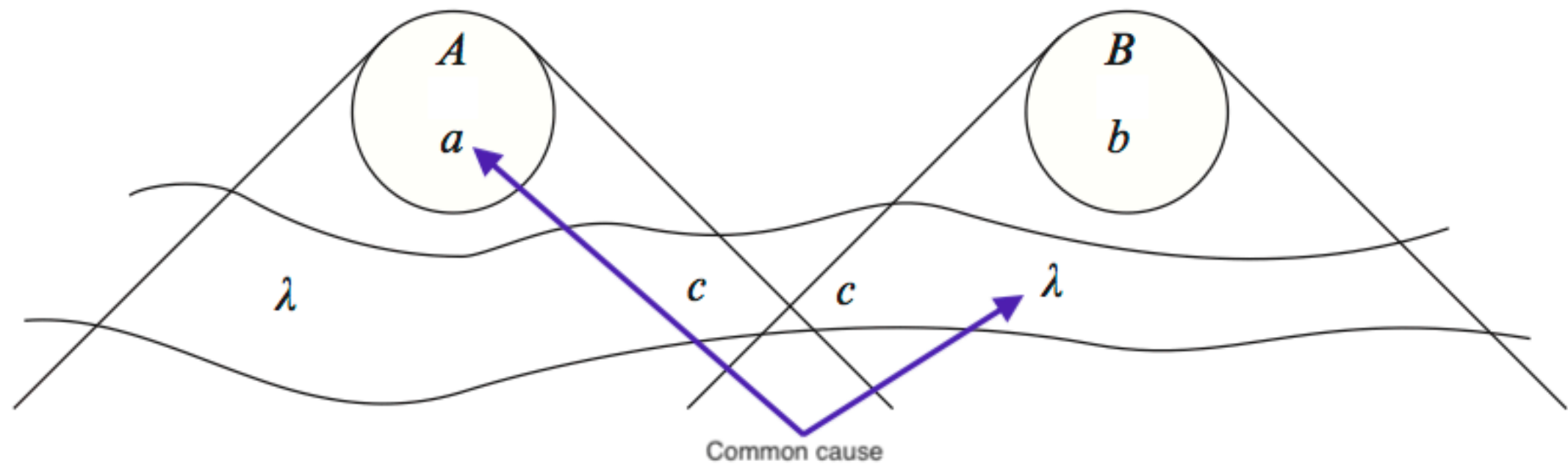
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Objections to superdeterminism

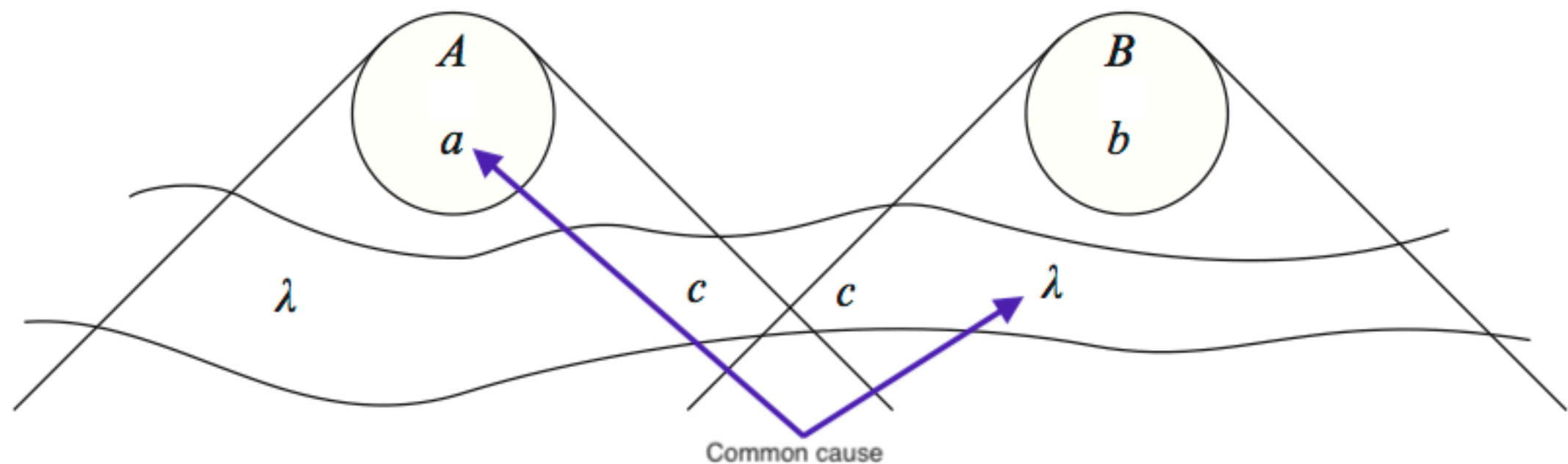


Objections to superdeterminism



‘Undercuts the core assumptions necessary to undertake scientific experiments’ – Wiseman (2006)

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Quasars (2018).

An interventionist's view of scientific method

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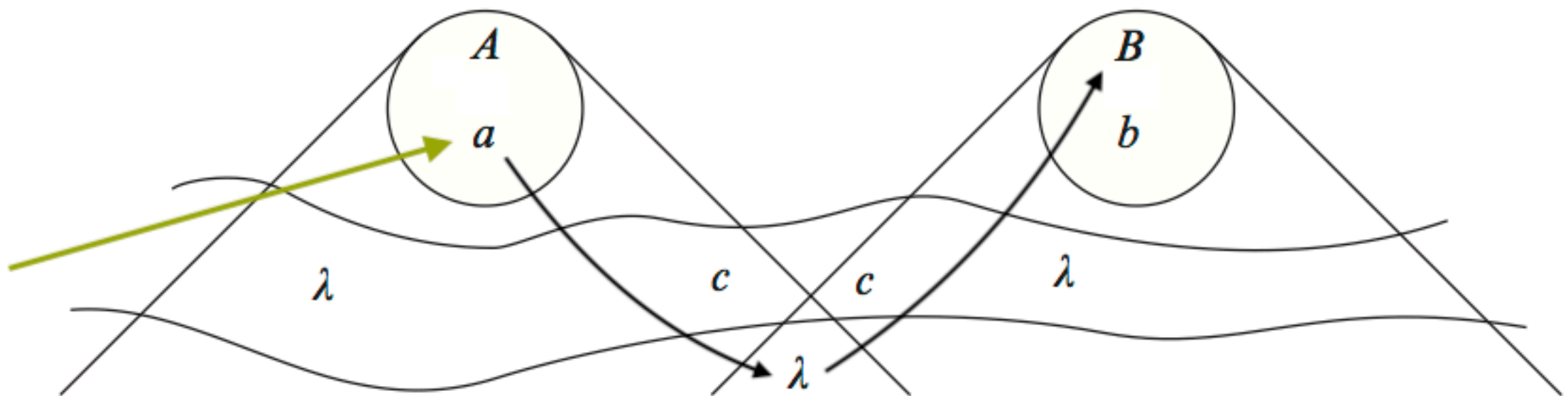
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But this doesn't close the ‘independence loophole’.

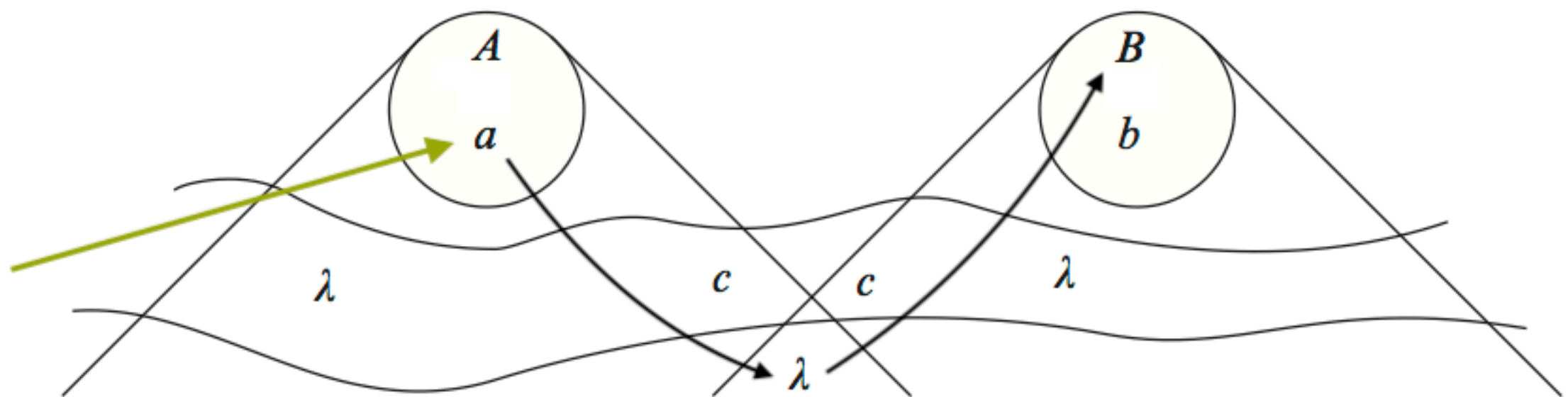
Retrocausality



Since Bell himself, some people have noted that there's another way a can fail to be independent of λ – if a is a **cause** of λ .

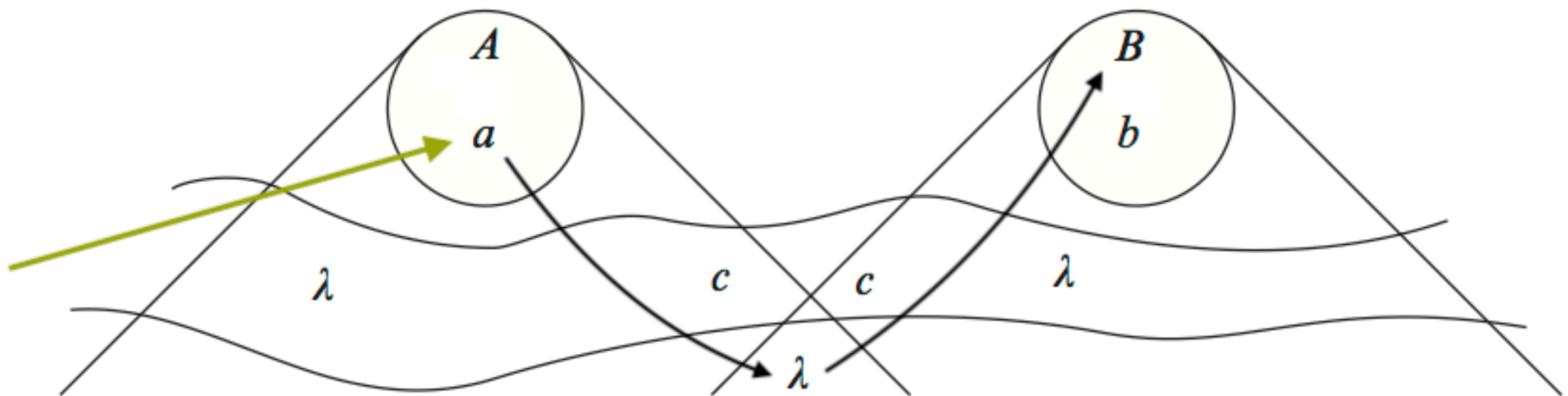
Many people confuse this for superdeterminism, but it is very different – because it is entirely compatible with free intervention on a .

Retrocausality



There are various ‘metaphysical’ objections to retrocausality, but interventionists should dismiss them. *Interventionism says nothing about temporal order.*

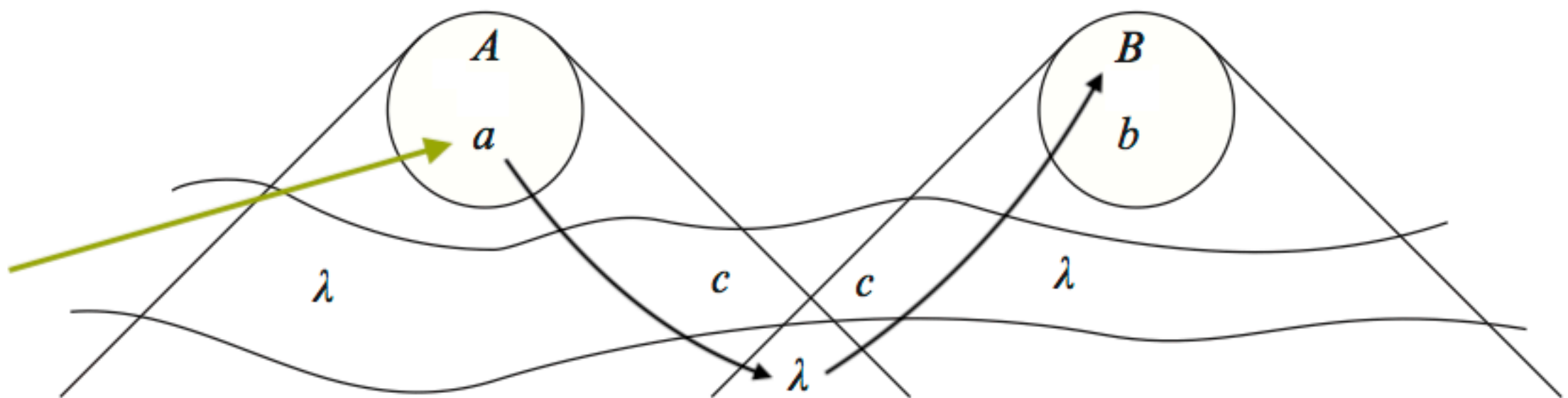
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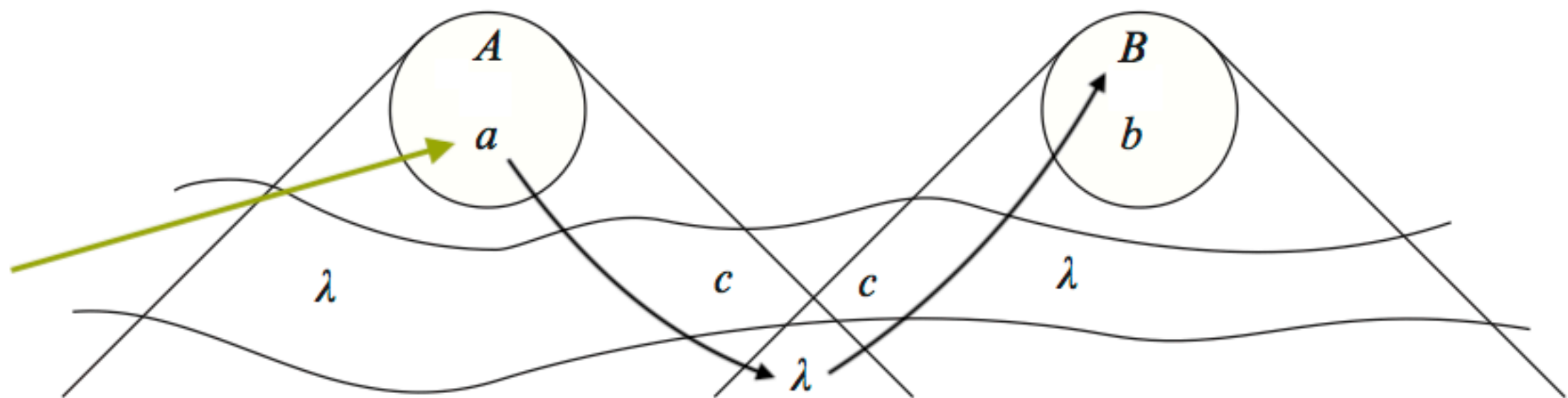
By interventionist lights, Bell’s Theorem is a very strong argument **for** retrocausality – it shows that *unless* wiggling a wiggles λ , we are stuck with nonlocal causality (*contra* SR).

Retrocausality



Objection: We can't observe λ , to see if it wiggles.

Retrocausality



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Reply: That's true, but causal inference is often indirect.

Radio days



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Bell quotes Einstein (1907) on retrocausality

...in my opinion, regarded as pure logic...it contains no contradictions; however it absolutely clashes with the character of our total experience, and in this way is proved the impossibility of the hypothesis...

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...in my opinion, regarded as pure logic...it contains no contradictions; however it absolutely clashes with the character of our total experience, and in this way is proved the impossibility of the hypothesis...

Response: Einstein didn't know about the peculiar aspect of our total experience revealed by Bell's work – but the quote suggests he would favour experience over 'pure logic' or *a priori* metaphysics.

Bell himself on retrocausality

CERN

1988 June 8

Dear Professor Price, thanks for your letter and papers. I enjoyed the nontechnical paper but am not strong enough for the other. I have not myself been able to make any sense of the notion of backward causation. When I try to think of it I lapse quickly into fatalism. What little I can say on that has been said in a discussion with Shimony, Clauser, and Horne: *Dialectica* 39 (1985) N°2 pp86-110.

with best wishes

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*This paper discusses only superdeterminism – so it is not clear that Bell properly distinguished the two views.

The End