Title: The Relativity Principle in Quantum Mechanics

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Abstract: <p>In order to solve the problem of quantum gravity, we first need to pose the problem. In this talk I will argue that the problem of quantum gravity arises already in the domain of quantum mechanics and the relativity principle. Specifically, the relativity principle implies that the concept of inertial motion should extend also to those systems that are in quantum superpositions of inertial motions. By contrast, relativistic quantum field theory only considers the point of view of classical observers in states of definite relative motion (i.e. the observers of a quantum field do not include inertial observers in quantum superpositions). The problem is that, if we extend the class of inertial observers to include quantum observers, the manifold of local events becomes ill-defined, as `locality' itself becomes an observer-relative property of an event. Thus, the Relativity Principle and the Superposition Principle are jointly opposed to the concept of a space-time manifold of local events, and our understanding of relativistic quantum theory needs to be revised before gravity even enters the picture.</p>

On the relativity principle in quantum mechanics

Jacques Pienaar

Time as sequential breaths, Scott Breton.
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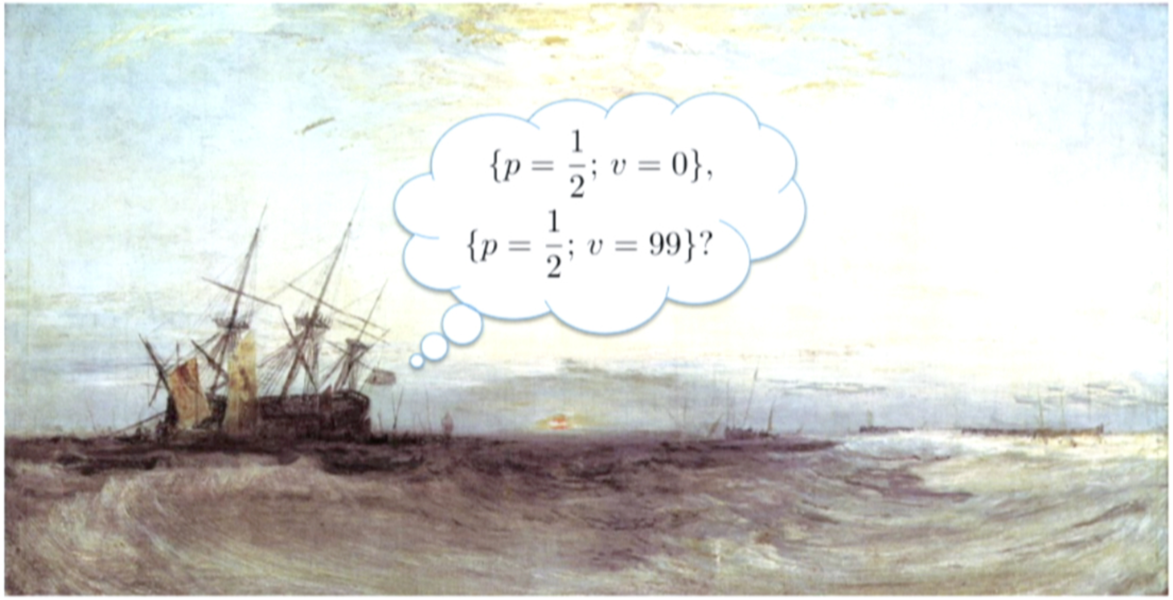
The Relativity Principle

- Applies to **all** reference frames (laboratories) that are *inertial* (no external fields or forces).
- The RP states that certain global properties of the frame may be chosen conventionally, as they have no physical meaning.
- These properties are: the laboratory's location in space and time, its spatial orientation, and its linear velocity.
- This implies that only *relative* properties of inertial systems are measurable.
- For example, two observers in relative motion can each claim to be at rest. Neither claim can be privileged over the other. Choosing one or the other's perspective has no effect on physically measurable quantities.

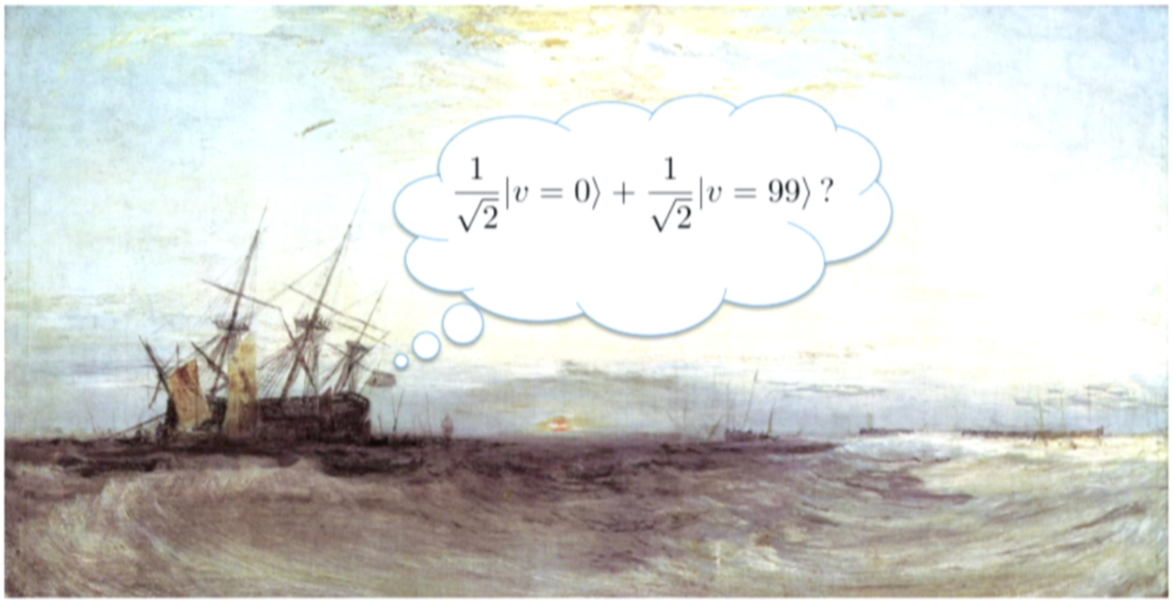
The Relativity Principle 2

The Relativity Principle

The Relativity Principle



The Relativity Principle

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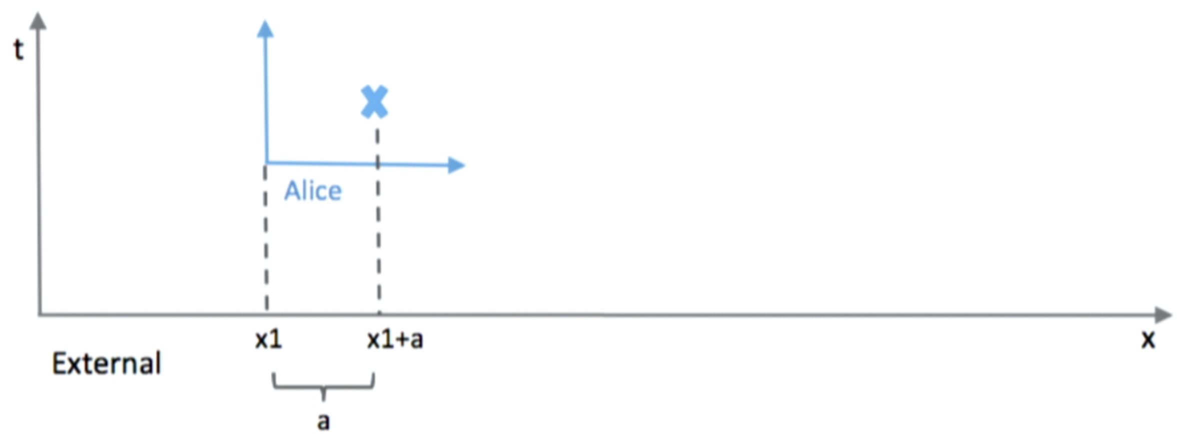
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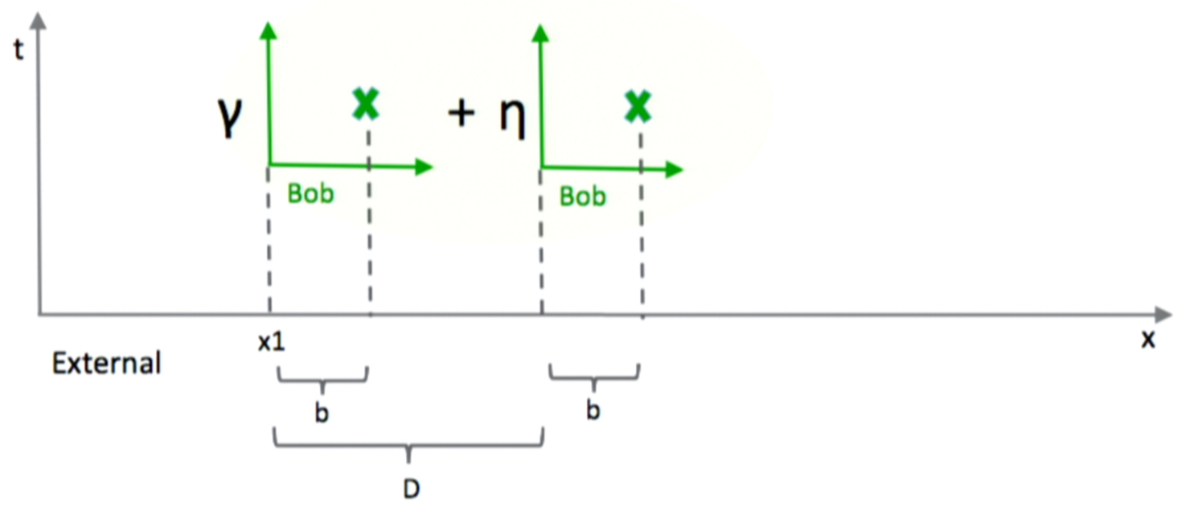
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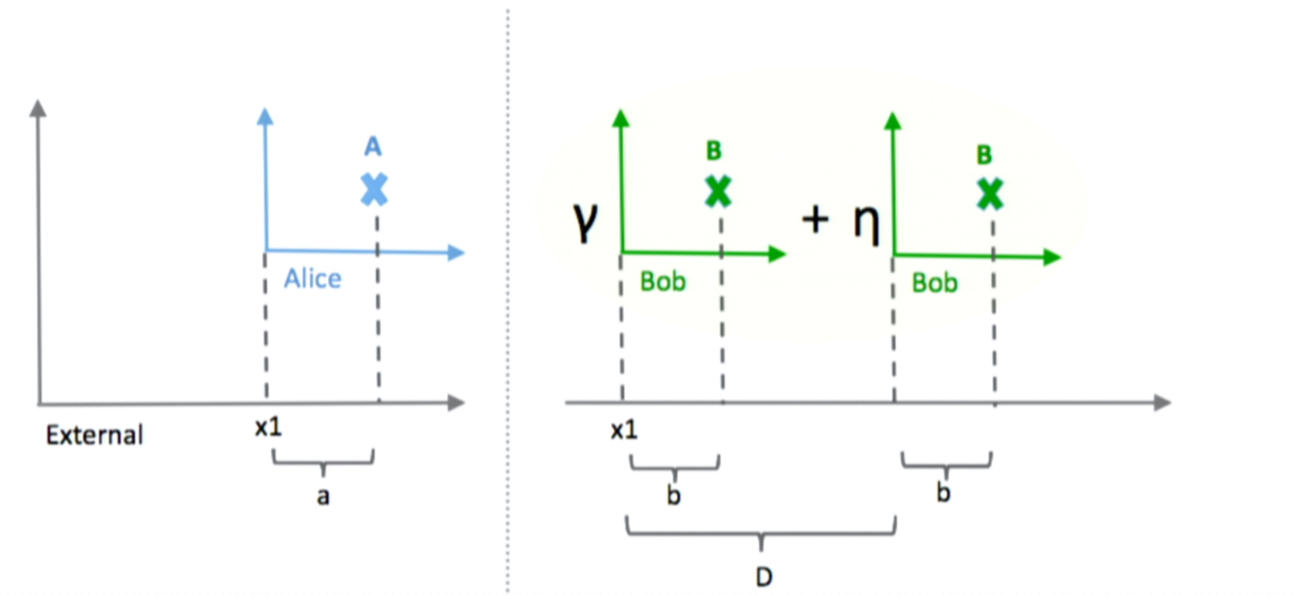

	Alice's co-ordinates:	Bob's co-ordinates:
Marker A:	$\|a\rangle\langle a\|$	$\|\gamma\|^2 \|a\rangle\langle a\| + \|\eta\|^2 \|a-D\rangle\langle a-D\|$
Marker B:	$\|\gamma\|^2 \|b\rangle\langle b\| + \|\eta\|^2 \|b+D\rangle\langle b+D\|$	$\|b\rangle\langle b\|$

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The End

Human mechanics, Moholy Nagy