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Relativity of the event: examples in JT gravity

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Gravitational gauge constraints imply that local, bulk, measurable operators must be dressed to a fixed reference surface with the worldlines of some observers. Since observers live in their own inertial coordinate systems, they are unable to distinguish between different branches of the wavefunction when the metric is in superposition, and will identify the outcome of their measurement, whatever it is, as a single event occurring at a particular location. In the inertial frame of another set of observers, however, the event of this measurement will be identified as occurring in different locations according to the state of the metric. An event at a definite location for one set of observers will therefore be in a superposition of locations for another set of observers. We quantify an example of this effect in JT gravity, where certain observers see the black hole horizon as "smeared".

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