Response to "How Quantum Theory Tried to Get Rid of Time and General Relativity Started Looking for it" by Alex Blum

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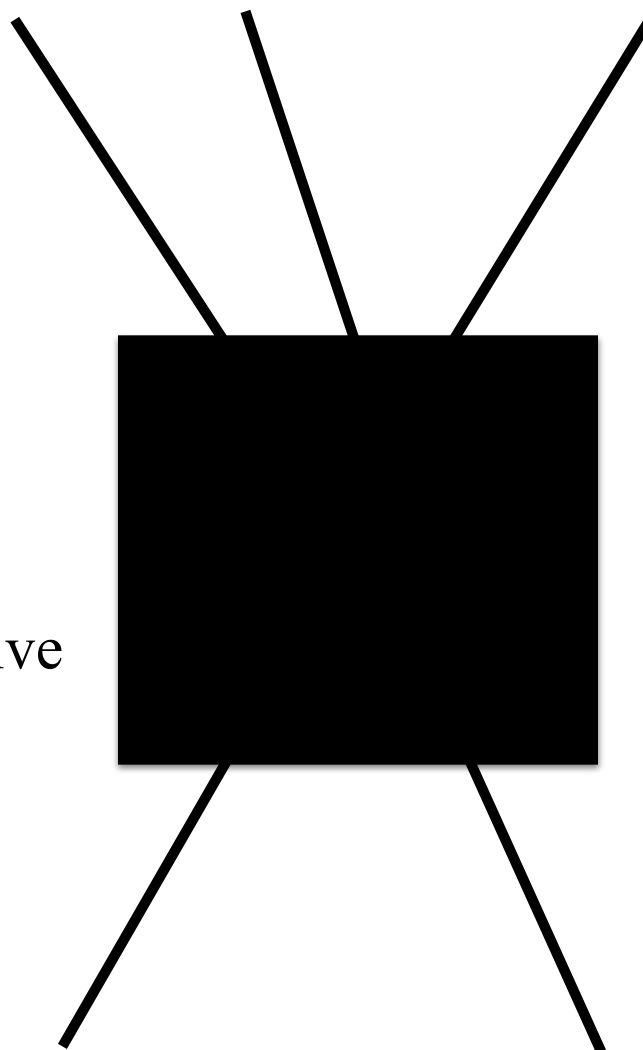Ludwig-Maximilians-Universität München
The Problem of Time In Perspective
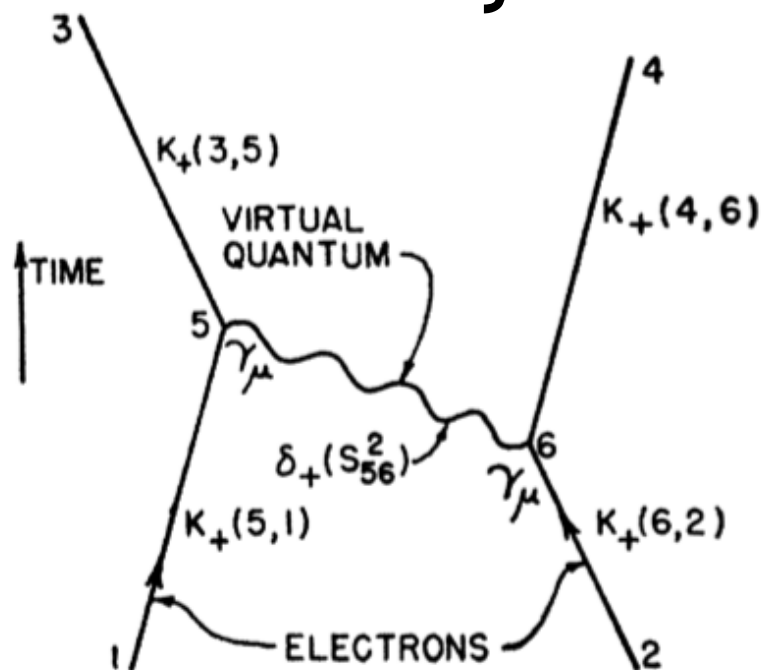03.07.2015

Interaction Picture?

Heisenberg

$|\psi\rangle$ Constant, global

Observables $A(t)$ evolve

Schrödinger

$|\psi\rangle$ Evolves in time

Observables A constant

Feynman's Theory

FIG. 1. The fundamental interaction Eq. (4). Exchange of one quantum between two electrons.

$$Amp = \int \mathcal{D}[\gamma] e^{iS[\gamma]}$$

- Free propagation and interaction separated
- Black Box realized, Lorentz invariance
- Creation and annihilation of paths
- Measurement issues same as QM
- As invariant as possible

Path Integral for Klein-Gordon Propagator And the Direction of Time

$$2i I_+^0(x_f, x_i) = \int_0^\infty du \int \mathcal{D}[\gamma]\, e^{-i \int_0^u du'\, \frac{1}{2}\left((d\gamma^\mu/du')^2 + m^2\right)}$$

$$I_+^0(y, x) = \int \frac{d^4 l}{(2\pi)^4} \frac{e^{-il(y-x)}}{l^2 - m^2 + i\epsilon}$$

Derived +iε prescription
encodes causal structure