Collapse models and QFT

30 y. — new

1] Measurement problem

- no stuff

$\frac{|\uparrow\rangle + |\downarrow\rangle}{\sqrt{2}} \otimes |\text{Big thing}\rangle \in \mathbb{C}^{2^{20^{23}}} \xrightarrow{U_t} \frac{|\uparrow\rangle}{\sqrt{2}} \otimes |\text{Big1}\rangle \otimes |y_1\rangle + \frac{|\downarrow\rangle}{\sqrt{2}} \otimes |\text{Big2}\rangle \otimes |y_2\rangle$ — decoherence

- MW. — no collapse
- Bohm.
- Collapse models.

  break linearity.

  $\partial_t |\psi_t\rangle = -i \hat{H}_0 |\psi_t\rangle + G_\xi(|\psi\rangle)$ — collapse in position; ξ ← random

  - small → atoms are OK
  - big, collapse tables and chairs.

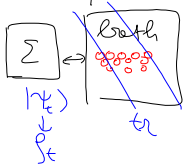
no FTL

$\mathbb{E}\left[|\psi_\xi\rangle\langle\psi_\xi| \right] = \rho_t = \Phi_t \cdot \rho_0 \qquad |\psi(0)\rangle\langle\psi(0)|$

non-linear $\overset{\text{Gisin}}{\Rightarrow}$ FTL. — Φ_t: CPTP map

- Primitive ontology / local beables ≠ observable — be Able ↄ J. S. Bell
  - $|\psi_t(x)|^2 \in \mathbb{R}^{3,x}$
  - ξ itself

Recipe for collapse

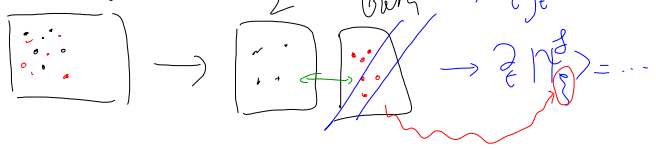


$\partial_t \rho_t = -i[H_0, \rho] - \frac{1}{2}[M,[M,\rho]]$

stochastic unraveling. — white noise

$\frac{\partial}{\partial t}|\psi_t\rangle = \left(-iH_0 + \sqrt{\lambda}(\hat{M} - \langle\hat{M}\rangle)\xi_t - \frac{1}{2}\lambda(\hat{M} - \langle\hat{M}\rangle)^2\right)|\psi_t\rangle$

interacting QFT



All predictions (macroscopic statements) can always be understood in terms of spatial configurations of fermions or of only electrons.

now collapse is an interpretation

$\int \frac{1}{p^2 + m + p^4}$ — regularized QFT ≠ QFT