Quantum measurement and quantum gravity

Many-Worlds or Collapse of the Wave-Function?

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I. Many worlds or collapse?

- Two ways of explaining quantum measurement : 'many worlds + decoherence' or 'collapse of the wave function'.
- A thoeretical argument that favours the collapse of the wave-function :
- Classical time is external to quantum mechanics.
- In the absence of classical matter fields there would be no classical time [consequence of Einstein hole argument].
- Ought to formulate quantum mechanics without external time.

II. Quantum mechanics without classical time

- Imagine a system of quantum particles with total energy much less than Planck energy. The 'spacetime' is a quantum Minkowski spacetime, and the 'equation of motion' is the analogue of the Klein-Gordon equation.
- If the total energy is increased, the background spacetime has a weak, linear 'quantum gravitational field' and the equation of motion is the analogue of the Klein-Gordon equation on a curved background.
- If the total energy becomes comparable to Planck mass, we have a nonlinear quantum gravitational field. The equation of motion is nonlinear, because the motion of particles is affected by their own fields.
- In particular, if there were only one particle, of mass comparable to Planck mass, its equation of motion would be nonlinear, because of its self-gravity. Seen from an external spacetime, this would be a nonlinear Schrodinger equation, which could induce collapse.