Gravity induced collapse of the wave-function

Tejinder P. Singh
Tata Institute of Fundamental Research, Mumbai

The works of Karolyhazy and collaborators [K-model], Diosi, and Penrose, independently suggest that the quantum collapse of the wave-function is a consequence of the self-gravity of the quantum object. In particular, the physics of the K-model can be expressed in the following manner: if the mass of the object under consideration is much smaller than Planck mass, its Schwarzschild radius is much smaller than its Compton wavelength, and quantum behaviour dominates. On the other hand, if its mass is much larger than Planck mass, the Schwarzschild radius far exceeds Compton wavelength, and classical, macroscopic behaviour emerges. The important question then is: how to describe the physics when the mass is comparable to Planck mass? We argue that in this case both the Dirac field (described by the Dirac equation) and the gravitational field (described by Einstein equations), of the object must be considered simultaneously, with the mass of the object being a common source for both fields. This suggests the consideration of a new non-linear Schrodinger equation which involves both the Planck constant and Newton's gravitational constant, and which might be of use for understanding the quantum measurement problem.