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Does Hubble expansion cause classical behavior in large quantum objects? CAROLINE HERZENBERG, Argonne National Laboratory (ret.) — Independent studies have proposed that classical behavior can be induced in quantum objects by existing in an expanding universe of finite extent in space-time. For an object at rest in space with a universal Hubble expansion taking place away from it, a Schrodinger type governing equation can be developed that incorporates Hubble expansion speeds. Wave function solutions to this equation are oscillatory, exhibiting pronounced central localization, with a concentration of probability characterized by a radial distance whose square equals the Planck constant divided by the product of the mass and the Hubble constant. Objects with small masses thus tend to behave in a delocalized manner much as quantum objects do in a static space, while objects with large masses become concentrated into small regions. A rough criterion for classicality is introduced by requiring that the region of high probability density for the wave function of an extended object be smaller than the size of the object. This size threshold for classical behavior does not lead to inconsistencies for quantum correlations between distant entangled quantum objects as the constraint applies to the system's center of mass. While local decoherence can extend the range of classical behavior, this cosmologically induced classicality would appear to impose fundamental limitations on quantum behavior in our universe.

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