Stability of negative mass bubbles in de Sitter space-time

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Negative mass makes perfect physical sense as long as the dominant energy condition is satisfied by the corresponding energy-momentum tensor. Until now, only configurations of negative mass had been found. We demonstrate the existence of stable, negative mass bubbles in an asymptotic de Sitter space-time. The bubbles are solutions of the Einstein equations which correspond to an interior region of space-time containing a specific distribution of mass separated by a thin wall from the exact, negative mass Schwarzschild-de Sitter space-time in the exterior. We apply the Israel junction conditions at the wall which impose the conservation of energy and momentum across the wall. The junction conditions give rise to an effective potential for the radius of the wall that depends on the interior mass distribution, or vice versa. We find a potential that gives rise to stable, non-singular, static solutions, which yields an interior mass distribution that everywhere satisfies the dominant energy condition.

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