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Stable negative mass solutions in de Sitter spacetime

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We demonstrate the existence of stable, non-singular, negative mass solutions in de Sitter spacetime. The solutions correspond to the exact negative mass Schwarzschild-de Sitter spacetime on the outside of a thin, spherical wall and a smooth mass distribution on the inside, that is non-singular at the origin. The solution satisfies the Israel junction conditions at the location of the wall. The mass distribution satisfies the dominant energy condition everywhere, hence can represent physical matter. The central point of our analysis is that our construction of the effective potential for the location of the wall admits a stable minimum for the position of the location of the wall. Such negative mass bubbles could be important in understanding the formation and existence of voids in the universe.

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