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Thermal production of early dark matter from van der Waals fluid

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We present a new paradigm for scalar dark matter (DM) particles production in the early Universe. We show the appearance of a new quadratic potential after inflation. This result is due to the stabilization of scalar fields particles. In this case, the mass of this field increases and becomes a candidate for dark matter. We show the van der Waals equation of state for DM, which leads to the Boltzmann equation and the DM number density. We establish the correspondence between the thermodynamic variables needed to describe simple systems by the van der Waals gas. Particularly, we obtain the relationship between the DM cross-section and the redshifts. Finally, we discuss the local stability of dark matter by the heat capacity.

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