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Primordial black holes from a cosmic phase transition: The collapse of Fermi-balls

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We propose a novel primordial black hole (PBH) formation mechanism based on a first-order phase transition (FOPT). If a fermion species gains a huge mass in the true vacuum, the corresponding particles get trapped in the false vacuum as they do not have sufficient energy to penetrate the bubble wall. After the FOPT, the fermions are compressed into the false vacuum remnants to form non-topological solitons called Fermi-balls, and then collapse to PBHs due to the Yukawa attractive force. We derive the PBH mass and abundance, showing that for a $\mathcal{O}(\mathrm{GeV})$ FOPT the PBHs could be $\sim 10^{17}$ g and explain all of dark matter. If the FOPT happens at higher scale, PBHs are typically overproduced and extra dilution mechanism is necessary to satisfy current constraints.

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