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Pseudo-Nambu-Goldstone dark matter, first-order phase transitions, and gravitational waves

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We investigate the potential stochastic gravitational waves from first-order electroweak phase transitions in a model with pseudo-Nambu-Goldstone dark matter and two Higgs doublets. The dark matter candidate can naturally evade direct detection bounds, and can achieve the observed relic abundance via the thermal mechanism. Three scalar fields in the model obtain vacuum expectation values, related to phase transitions at the early Universe. We search for the parameter points that can cause first-order phase transitions, taking into account the existed experimental constraints. The resulting gravitational wave spectra are further evaluated. Some parameter points are found to induce strong gravitational wave signals, which have the opportunity to be detected in future space-based interferometer experiments LISA, Taiji, and TianQin.

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