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Testing Dark Matter and Unification of Forces with Gravitational Waves

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I will show that a new gravitational wave signature is expected in extensions of the Standard Model with extra gauge symmetries broken at vastly different energy scales. The spectrum contains a characteristic double-peak structure consisting of a sharp peak from domain walls and a smooth bump from a first order phase transition in the early Universe. I will provide an example of such a model, with baryon number and color unified into an $SU(4)$ gauge group and lepton number promoted to an $SU(2)$ gauge symmetry. The model contains two types of dark matter particles, accommodates leptogenesis, and provides nonzero neutrino masses. I will discuss how future gravitational wave experiments, such as LISA, Big Bang Observer, DECIGO, Einstein Telescope, and Cosmic Explorer, can be used to look for this novel signature.

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