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## Zero-Range Effective Field Theory for Resonant Wino Dark Matter

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The most dramatic “Sommerfeld enhancements” of neutral-wino-pair annihilation occur when the wino mass is tuned to near critical values where there is a zero-energy  $S$ -wave resonance at the neutral-wino-pair threshold. If the wino mass is larger than the critical value, the resonance is a wino-pair bound state. If the wino mass is near a critical value, low-energy winos can be described by a zero-range effective field theory in which the winos interact nonperturbatively through a contact interaction. The effective field theory is controlled by a renormalization group fixed point at which the neutral and charged winos are degenerate in mass and their scattering length is infinite. The parameters of the zero-range effective field theory can be determined by matching wino scattering amplitudes calculated by solving the Schrödinger equation for winos interacting through a potential due to the exchange of weak gauge bosons. The power of the zero-range effective field theory is illustrated by calculating the rate for formation of the bound state in the collision of two neutral winos through the emission of two soft photons.

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