Lifetimes of three particles in an isotropic harmonic trap

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We present an analytic calculation of the energy levels and decay rates of particles confined by an isotropic harmonic trap. Using a single adiabatic hyperspherical channel, we derive a transcendental equation whose solutions give the energy levels and decay rates of the trapped states. To gain a more physical interpretation of the results, we examine two regimes: the oscillator length much greater than, and much less than, the two-body *S*-wave scattering length. For the case of a large oscillator length, we find explicit analytic expressions for the decay rate of the trapped states. We find that the decay rate for bosons scales as $|a|^4$ (in agreement with prior work on free-space recombination), with higher-order corrections due to the trap. Moreover, the decay rate shows resonant enhancements due to Efimov physics just as free space rates do. In addition, we show that for a small oscillator length, the decay rate is proportional to the trapping frequency and exhibits log-periodic behavior.

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