Improved empirical potential for the ground state of Be_2

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We have performed new direct-potential-fit (DPF) analyses of the rotationally resolved $A^1\Pi_u$ ($v' = 2$, 3; $J' = 1, 2$) $\rightarrow$ $X^1\Sigma^+_g$ ($v'' \in [0, 10]$; $J'' \in [0, 3]$) stimulated emission pumping spectra of Be_2 [1] using two quite different analytical potential energy functions which incorporate the correct theoretically-known long-range behavior in different ways. These functions are: the damped Morse/long-range (MLR) potential [2] and the Chebyshev polynomial expansion (CPE) potential [3]. In contrast with the potential energy function determined in the original DPF analysis of Merritt et al., both of our functions unambiguously support the existence of the $v = 11$ last vibrational level which is bound by only 0.50(5) cm^{-1}. These empirical potentials predict the equilibrium distance r_e = 2.444(1) and the dissociation energy D_e = 934.8(0.3) cm^{-1}, values which are both remarkably close (within the uncertainties) with the best ab initio estimates.

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