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The Two-Mode Approximation in a Realistic Bose-Josephson Junction in a ^{85}Rb/^{87}Rb BEC Mixture JEFFREY HEWARD, MARK EDWARDS, Georgia Southern University, CHARLES CLARK, NIST — We have studied the behavior of an experimentally realistic Bose-Einstein condensate (BEC) mixture subjected to a double-well potential. The mixture studied consists of ^{87}Rb and ^{85}Rb held in an optical trap with an external magnetic field that enables tuning of the ^{85}Rb–^{85}Rb scattering length. This system, without the external double–well potential, has been implemented at JILA [S.B. Papp, et al, Phys.Rev.Lett. **101**, 040402 (2008)]. A double–well potential can be added to this system by applying another pair of lasers as was done in a previous experiment for single condensates [M. Albiez, et al, Phys. Rev. Lett. **95**, 010402 (2005)]. We have used the Variable Tunneling Model (VTM) within the two–mode approximation to search for novel condensate mixture behavior in this experimentally accessible system. Possible behaviors include Bose–Josephson oscillations with both swapping and non–swapping modes and macroscopic quantum self–trapping with zero and pi modes as described in a recent paper [I. Satija, et al, arXiv:0811.1921v1 [quant-ph]]. We compare the behavior as predicted by the two–mode VTM with the solution obtained by integrating the coupled Gross–Pitaevskii equations. We propose some new experiments designed to observe these novel phenomena.

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