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**Two-frequency population dynamics in a low-barrier double-well BEC** L.J. LEBLANC, A.B. BARDON, J. MCKEEVER, University of Toronto, F. PIAZZA, A. SMERZI, Universita di Trento, J.H. THYWISSEN, University of Toronto — The dynamics of a a $^{87}$Rb Bose-Einstein condensate (BEC) are studied in a RF-dressed double-well. As we deform the trap from a single to a double well, we bias the system to prepare a population imbalance, $z$, between the wells. After suddenly removing the bias we observe population and phase dynamics. For $\mu \lesssim V_b$, where $\mu$ is the chemical potential and $V_b$ the barrier height, we observe plasma oscillations in $z$ about $z = 0$, as predicted in the two-mode model of the Josephson junction. Additionally, we observe a second, higher frequency component in these oscillations. Through a comparison to three-dimensional GPE calculations, we find that the two-mode frequency dynamics are due to nonlinear mixing of the dipole mode with an octupole mode.

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