

Abstract Submitted  
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**Macroscopic superposition states of cold bosons in an asymmetric double well with Orbital Degrees of freedom**<sup>1</sup> MIGUEL-ANGEL GARCIA-MARCH, LINCOLN D. CARR, Colorado School of Mines — We study the dynamics of ultracold bosons in three-dimensional double wells when they are allowed either to condense in single-particle ground states or to occupy excited states. On the one hand, the introduction of second level single-particle states opens a range of new dynamical regimes. On the other, since the second level eigenstates can carry angular momentum, NOON-like macroscopic superposition (MS) states of atoms with non-zero angular momentum can be obtained. This leads to the study of the dynamics of atoms carrying vorticity while tunneling between wells. We obtain new tunneling processes, like vortex hopping and vortex-antivortex pair superposition along with the sloshing of atoms between both wells. The resulting vortex MS states are much more robust against decoherence than the usual NOON states, as all atoms in the vortex core region must be resolved, not just a single atom.

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