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3D Vortices in Protoplanetary Disks SAMY KAMAL, JOSEPH BARRANCO, San Francisco State University, PHILIP MARCUS, University of California, Berkeley — Like the atmosphere of Jupiter, protoplanetary disks (thin disks of gas & dust in orbit around newly-formed stars) are characterized by rapid rotation and intense shear, inspiring proposals that disks may also be populated with long-lived, robust storms analogous to the Great Red Spot. Such vortices may play key roles in the formation of stars and planets by transporting angular momentum, as well as trapping and concentrating dust grains, seeding the formation of planetesimals, the "building blocks" of planets. In our previous work (Barranco & Marcus 2005), we showed via numerical simulation (with an anelastic spectral code) that vortices near the midplane of the disk suffer an antisymmetric instability and are destroyed. However, internal gravity waves propagate away from the midplane, amplify and break, creating bands of vorticity that roll-up into new long-lived, stable vortices above and below the midplane. We will present new results on 3D vortex dynamics in protoplanetary disks, exploring the role of factors unique to this context: the Coriolis parameter f, the shear rate σ, and the Brunt-Väisälä frequency N are all of the same order of magnitude. In the region around the midplane $N < f$, whereas a few pressure scale heights off the midplane, there is a transition to $N > f$. This leads to strong refraction of internal gravity waves, causing the waves to amplify and break, generating vorticity.

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