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Dynamic Transitions of Vortices into Phase Slips in Josephson Junctions Under DC and AC Currents[1] AHMAD SHEIKHZADA, ALEX GUREVICH, Department of Physics and Center for Accelerator Science, Old Dominion University — We present extensive numerical simulations of nonlinear dynamics of vortices driven by strong dc and ac currents in thin film Josephson junctions of finite length. We solved a nonlinear integro-differential equation which takes into account the nonlocal electrodynamics of films, vortex Cherenkov radiation and the essential effects of interaction of vortices with the edges of the junction. Our simulations have shown that in overdamped junctions vortices expand as they move faster and turn into phase slips as current increases. In underdamped junctions vortices entering from the edges become unstable due to Cherenkov radiation and produce a cascade of expanding vortex-antivortex pairs, which ultimately drives the whole junction into resistive phase slip state. Vortices driven by ac currents can exhibit a variety of complicated dynamic states which manifest themselves in jumps and regions with negative differential resistance on current-voltage characteristics.

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