Singular Perturbations in Longitudinal Phase Space*, <u>C. LIMBORG</u>, J. SEBEK, SSRL, SLAC -

We present observations, measurements, and analysis of longitudinal oscillations that exhibit singular perturbations. While the standard perturbation technique adequately describes instability thresholds, it fails to describe the behavior of the electron beam beyond threshold. Above threshold, we can observe a bifurcation phenomenon in which the beam orbit can be described as a stable limit cycle. In the presence of narrow band impedance, we can repeatedly generate an instability in which the amplitude of the synchrotron sidebands undergoes a sawtooth oscillation. Since we are able to accurately control our impedance and since we can change both our beam current and energy, we can modify the damping time, the growth time of the instability, and the amplitude and phase of the non-linear driving term.