# *Superconductivity in quantum-confined Pb*

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Quantum growth of ultrathin Pb films on Ge(111) and Si(111) substrates is studied using Scanning Tunneling Microscopy, total-energy calculations within Density Functional Theory, and phenomenological modeling. Atomically smooth Pb films can be grown over *mesoscopic* length scales, but only above a critical film thickness of five or more monolayers. In the smooth growth regime, there exists an intriguing reentrant bilayer-by-bilayer (RBBB) mode, characterized by strong preference for bilayer growth with periodic interruption of monolayer growth. The salient features of the RBBB mode are attributed to the quantum nature of the film stability, as confirmed *quantitatively* in DFT calculations for Pb/Ge(111). Superconductivity was explored via its ac and dc magnetic response in static fields up to 0.6 T. Even the thinnest films (6 ML) turn out to be amazingly robust type II superconductors with critical temperature slightly below that of bulk Pb (4.9  K versus 7.2 K, respectively) which support *macroscopic* supercurrents of the order of 1 MA/cm2. The robustness of the superconducting state is shown to originate from strong vortex pinning by 2 ML deep voids that are intrinsic to the RBBB growth phenomenon.