A Novel Quantum Well of Embedded SrTiO$_3$ in LaAlO$_3$

HANGHUI CHEN, ALEXIE KOLPAK, SOHRAB ISMAIL-BEIGI, Department of Physics, Yale University — Inspired by the novel behavior of LaAlO$_3$/SrTiO$_3$(001) heterointerfaces, we propose new sets of interfaces in which one TiO$_2$ or SrO layer is embedded in LaAlO$_3$. These interfaces can form quantum wells which trap electrons or holes in a single atomic layer of TiO$_2$ or SrO, respectively, when the “polar catastrophe” occurs. This narrow confinement, in contrast to the situation at the LaAlO$_3$/SrTiO$_3$(001) interfaces, sheds light on the still uncertain origin of the charge carriers and provides ideas for engineering their properties. In addition, we study the field effect on these systems to predict the critical external electric field required to induce an insulating-to-metallic transition.