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Polar and non-polar oxide interfaces: charge and spin behaving badly[1]

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Interfaces between two dissimilar materials are well known to lead to new behavior and often useful properties. Whereas covalent semiconductors have been studied and used for decades, and the interfaces of magnetic metals also have assumed great importance, the use of oxides in such juxtaposed systems is much more recent. Oxides add the huge impact of ionicity, and the correlated electron behavior that occurs if open shells are present. Even without correlation effects, finite overlayers (slabs) involving a polar discontinuity can sustain a surprisingly large separation of charge, as will be illustrated with calculational results on $LaAlO_3$ slabs on $SrTiO_3$ substrates: a strong *polar distortion*, uniform over several unit cells, creates the necessary screening. The most recent results on the mechanism and character of the insulator-to-metal transition with thickness will be discussed. Polar discontinuities are not necessary to create exotic behavior, as we illustrate with rutile-structure VO_2/TiO_2 multilayers, where a topologically protected zero-gap two-dimensional half-metal arises in a thickness regime between thin insulating and thick conducting VO_2 slabs. Work done in collaboration with R. Pentcheva, V. Pardo, and K. Otte.

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