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Quantum Criticality in Ferroelectrics STEPHEN ROWLEY, GILBERT LONZARICH, JAMES SCOTT, SIDDHARTH SAXENA, University of Cambridge — Materials tuned to the neighbourhood of a zero temperature phase transition often show the emergence of novel quantum phenomena. Ferroelectric crystals provide a type of quantum criticality that arises purely from the crystalline lattice. In many cases the ferroelectric phase can be tuned to absolute zero using hydrostatic pressure or chemical or isotopic substitution. Close to such a zero temperature phase transition, the dielectric constant and other quantities change into radically unconventional forms due to the quantum fluctuations of the electrical polarization. We present low temperature high precision data demonstrating these effects in pure single crystals of SrTiO3 and KTaO3. We outline a self-consistent field theory enabling quantitative predictions to be made without any free adjustable parameters and compare this to experiment. Near to the quantum critical point we observe the emergence of a peak in the dielectric constant at approximately 2 K in SrTiO3 and 3 K in KTaO3. The results are compared to quantum criticality in ferromagnetic d-metals and we indicate how the effective interactions between critical fluctuation modes often appear to become attractive as the ordering temperatures tend to absolute zero in both cases.

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