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Specific Heat of $Na_{0.35}CoO_2 \cdot 1.3H_2O$: Effects of Sample Age; Two Energy Gaps; Non-Magnetic Pair Breaking N.E. PHILLIPS, R.A. FISHER, N. OESCHLER, LBNL and University of California, Berkeley, R.J. CAVA, M.-L. FOO, Princeton University, J.E. GORDON, Amherst College — Specific-heat measurements on three samples of $Na_{0.35}CoO_2 \cdot 1.3H_2O$ show an evolution of the superconductivity and its eventual disappearance with increasing sample age. The results, in combination with other recent work [1], provide a basis for understanding the extreme "sample dependence" of the properties of this material. Samples of different age are in effect samples of slightly different materials: A non-magnetic pair-breaking action produces a residual density of electron states that increases with sample age. It occurs preferentially in the electron band (one of two with different energy gaps) with the smaller gap, producing a change in the nature of the superconducting condensation. It also weakens the overall electron pairing of the superconducting state until it gives way to a competing ordering, possibly a CDW. The same combinations of features in the specific heat have been seen in measurements on other individual samples, showing that they are "intrinsic". The changes in the specific heat are evidently related to structural and electronic changes that occur on a similar time scale [1], and include an increasing concentration of O vacancies, which could be the pair-breaking scattering centers.
[1] P. W. Barnes et al., Phys. Rev. B **72**, 134515 (2005).

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