Application of a $\phi^4$ Model to the Liquid-Gas Critical
Point of $^3$He

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A $\phi^4$ model has been applied to the liquid-gas critical
point with the universal ratios of leading critical and correction
amplitudes built in. We have used this model to analyze recently obtained
heat capacity at constant volume, $C_V$ and isothermal susceptibility, $\chi_T$
data near the critical point of the pure $^3$He. The $C_V$, and $\chi_T$ measurements
were performed in the same sample cell along the critical isochore
over the reduced temperature range of $10^{-4} < |T/T_c - 1| < 10^{-1}$. This
RG-based crossover $\phi^4$ model with a minimal set of three adjustable para-
parameters provides an excellent fit to the $C_V$ and $\chi_T$ data both above and
below the critical point. The correlation length, $\xi$, calculated from the
$\phi^4$ model with the three pre-determined parameters, agrees with previous experimental measurements over the entire crossover range. The
good agreement between the $\phi^4$ model calculation and the experiment-
tal measurements extends beyond the theoretically predicted crossover
range.

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