January 2019

The van der Waals Fluid’s liquid vapor coexistence locus, using Maxima/Gnuplot

Carl W. David
University of Connecticut, Carl.David@uconn.edu

Follow this and additional works at: https://opencommons.uconn.edu/chem_educ

Part of the Physical Chemistry Commons

Recommended Citation
https://opencommons.uconn.edu/chem_educ/104
The van der Waals Fluid’s liquid vapor coexistence locus, using Maxima/Gnuplot

January 21, 2019

Carl W. David
Department of Chemistry
University of Connecticut
Storrs, Connecticut -6269-3060

1 Abstract

The Maxima/Gnuplot code for plotting the van der Waals locus of liquid and vapor molar volumes as a function of pressure and temperature (all reduced) is presented. 

2 Introduction

The Sage equations from reference 2 which are used to plot the coexistence curve of liquid and vapor pressures and temperatures are re-interpreted here using Maxima (and Gnuplot).

Using Maxima, one can essentially employ Gnuplot to plot the same function as the original Sage material presented in papers 96 & 97 but employing more sophisticated annotations (among other things). The code (we actually use wxMaxima, not Maxima itself) is:

\[
\begin{align*}
\text{reset;} \\
\text{vg}(x) & := -1/6*(4*x*\exp(2*x) - \exp(4*x) + 1)*\exp(x)/(x*\exp(3*x) + x*\exp(x) - \exp(3*x) + \exp(x)) + 1/3 \\

\text{vl}(x) & := -1/6*(4*x*\exp(2*x) - \exp(4*x) + 1)*\exp(-x)/(x*\exp(3*x) + x*\exp(x) - \exp(3*x) + \exp(x)) + 1/3 \\

\text{T}(d) & :=
\end{align*}
\]

\(^{(1)}\) (Emeritus) Carl.David@uconn.edu

The results are shown in Figure 1 (below). Note that the default view was used.
Figure 1: The full “3D” plot done using Maxima. The code shown does not work on a Windows 10 machine, only an Ubuntu equipped device. The non-closure of the two loci at (1,1,1) remains a mystery. (We remind the reader that these are reduced variables notwithstanding the labels show.) When running this code as actually shown, the plot shows up in a separate window, which allows the user to re-orient the plot using the mouse. The drawing shown here was generated by the last line of code.