Statistical Mechanics of Nonequilibrium Liquids

by

Denis J Evans and Gary P Morriss

Research School of Chemistry,
Australian National University,
Canberra, ACT
Australia

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List of Symbols

Transport Coefficients

η	shear viscosity
λ	thermal conductivity
η_V	bulk viscosity
ζ	Brownian friction coefficient
D	self diffusion coefficient

Thermodynamic Fluxes

$\mathbf{P}$	the pressure tensor
$\mathbf{J}_Q$	heat flux
$\mathbf{\Pi}$	viscous pressure tensor

Thermodynamic forces

$\nabla\mathbf{u}$	strain rate tensor
γ	shear rate, $=\partial u_x/\partial y$
∇T	temperature gradient
$\nabla.\mathbf{u}$	dilation rate
$\mathbf{u}$	streaming velocity
$\boldsymbol{\varepsilon}$	elastic deformation
$\nabla\boldsymbol{\varepsilon}$	strain tensor
dot($\boldsymbol{\varepsilon}$)	dilation rate, $=1/3(\nabla.\boldsymbol{\varepsilon})$

Thermodynamic State Variables

T	temperature
k_B	Boltzmann's Constant
β	$1/k_BT$
V	volume
p	hydrostatic pressure, $=1/3\ \mathrm{tr}(\mathbf{P})$
N	number of particles
ρ	mass density
n	number density

Thermodynamic Constants

G	shear modulus
C_V	constant volume specific heat
C_p	constant pressure, specific heat
c_V	constant volume, specific heat per unit mass
c_p	constant pressure, specific heat per unit mass
D_T	isochoric thermal diffusivity

Thermodynamic Potentials

E	internal energy
U(**r**,t)	internal energy per unit mass
S	entropy
s(**r**,t)	internal energy per unit volume
σ	entropy source strength = rate of spontaneous entropy production per unit volume
I	enthalpy
Q	heat

Mechanics

L	Lagrangian, seldom used
H	Hamiltonian
H_0	phase variable whose average is the internal energy
I_0	phase variable whose average is the enthalpy
J(**Γ**)	dissipative flux
F_e	external field
α	thermostatting multiplier
iL	p-Liouvillean
i*L*	f-Liouvillean
$A^\dagger$	Hermitian adjoint of A
Λ	phase space compression factor
$\exp_R$	right time-ordered exponential
$\exp_L$	left time-ordered exponential
$U_R(t_1,t_2)$	incremental p-propagator t_1 to t_2
$U_R(t_1,t_2)^{-1}$	inverse of $U_R(t_1,t_2)$., take phase variables from t_2 to t_1
	$U_R(t_2,t_1) = U_L(t_1,t_2)$
$U_R(t_1,t_2)^\dagger$	incremental f-propagator t_1 to t_2
T_R	right time-ordering opertator
T_L	left time-ordering opertator
$C_{AB}(t)$	equilibrium time correlation function, = $< A(t)B^* >$
[A,B]	commutator bracket
{A,B}	Poisson bracket
δ(t)	Dirac delta function (of time)
$\delta(\mathbf{r}-\mathbf{r}_i)$	Kirkwood delta function
	= 0, $\lvert \mathbf{r}-\mathbf{r}_i \rvert >$ an 'infinitesmal' macroscopic distance, l
	= $1/l^3$, $\lvert \mathbf{r}-\mathbf{r}_i \rvert <$ an 'infinitesmal' macroscopic distance, l

$f(\mathbf{k}) = \int d\mathbf{r}\, e^{i\mathbf{k}.\mathbf{r}} f(\mathbf{r})$ spatial Fourier transform

$f(\omega) = {}_0\int^\infty d\mathbf{r}\ e^{-i\omega t} f(t)$	temporal Fourier-Laplace trasform transform
$d\mathbf{S}$	infinitesmal vector area element
$\mathbf{J}^\perp$	transverse momentum current
$\mathbf{\Phi}$	total intermolecular potential energy
ϕ_{ij}	potential energy of particle i,j
K	total kinetic energy
f_c	canonical distribution function
f_T	isokinetic distribution function
m	particle mass
$\mathbf{r}_i$	position of particle i
$\mathbf{r}_{ij}=\mathbf{r}_j - \mathbf{r}_i$	
$\mathbf{v}_i$	velocity of particle i