

BOUT++ Results

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ABSTRACT

This document highlights some results from BOUT++ simulation

metadata

evolved: ['Ni' 'rho' 'jpar']

IC: [1.00000000e-08 0.00000000e+00 0.00000000e+00]

ZMAX: 0.01

TIMESTEP: 100.0

ZMIN: 0.0

ShiftXderivs: false

restart: false

grid: /home/cryosphere/BOUT/tools/cyl_and_helimak_grids/Helimak_1_10_1x32_140_lam_n.nc

MYG: 2.0

dump_format: nc

MXG: 2.0

TwistShift: false

NOUT: 100.0

MZ: 129.0

mxstep: 10000.0

RTOL: 1e-08

type: ccode

ATOL: 1e-12

AA: 2.0

estatic: true

nu_perp: 1e-20

phi_flags: 0.0

ZeroElMass: true

apar_flags: 0.0

ShearFactor: 0.0

ZZ: 1.0

Zeff: 4.0

ys_mode: 1.0

scale: 1e-08

zs_opt: 3.0

xs_opt: 0.0

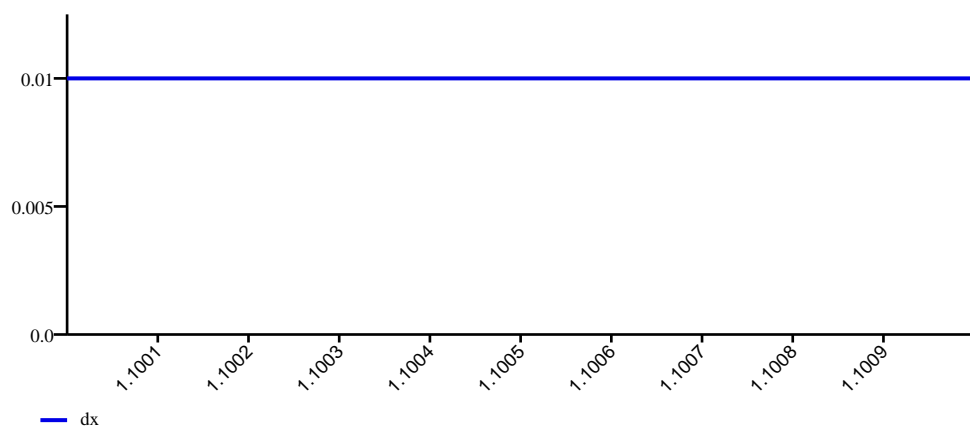
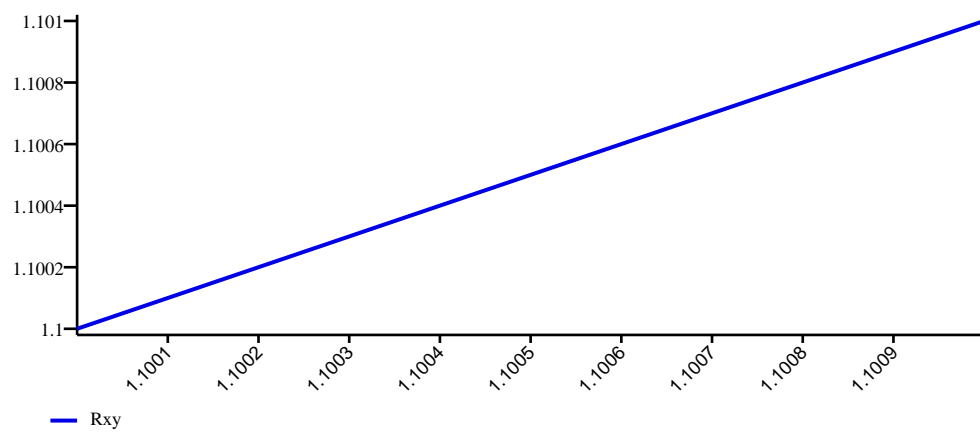
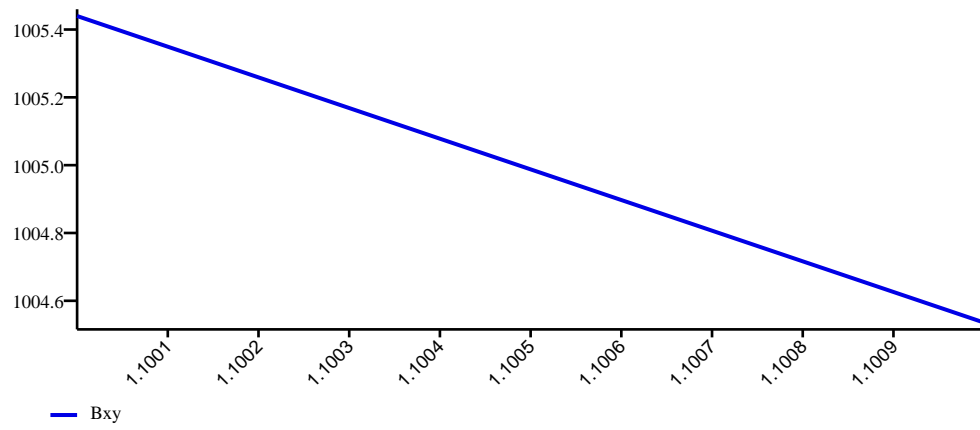
bndry_all: neumann

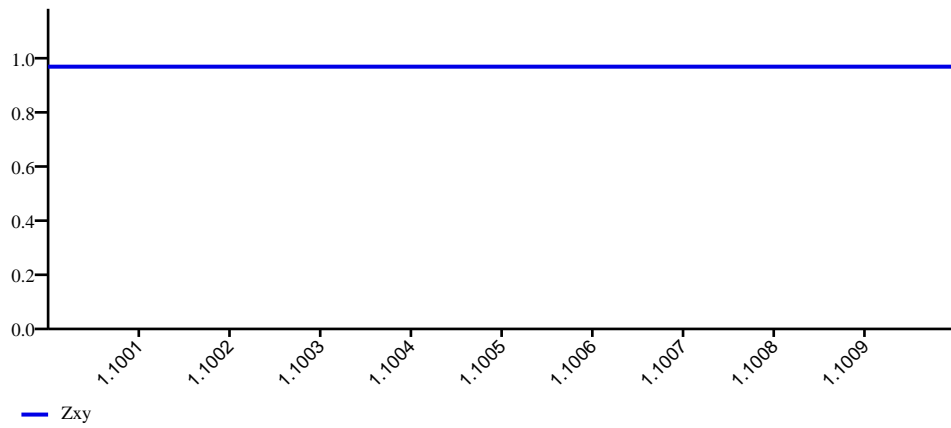
ys_opt: 2.0

zs_mode: 1.0

zs_phase: 0.5

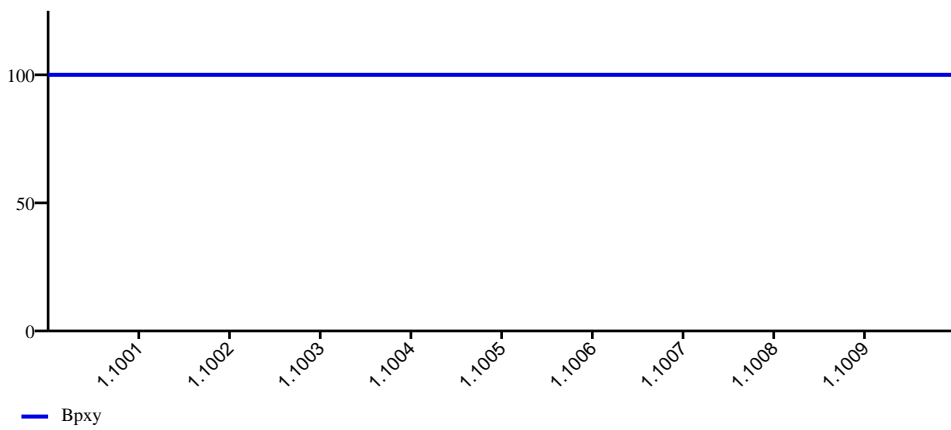
Te_x: [10.] eV



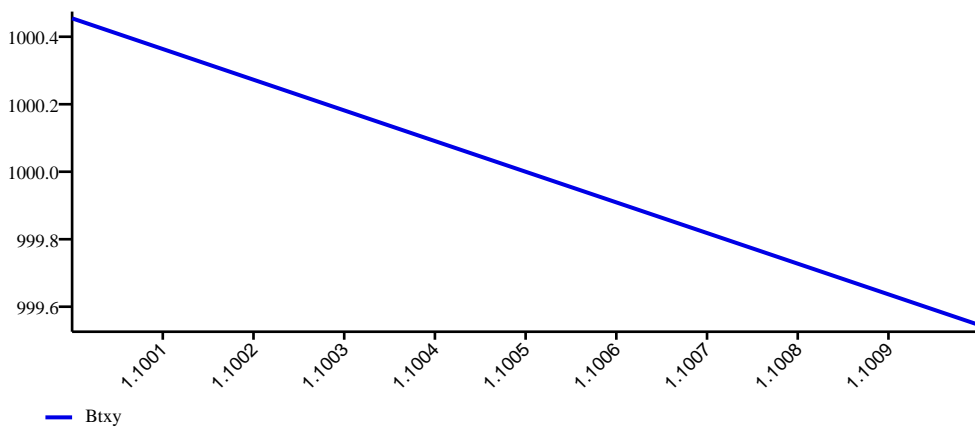


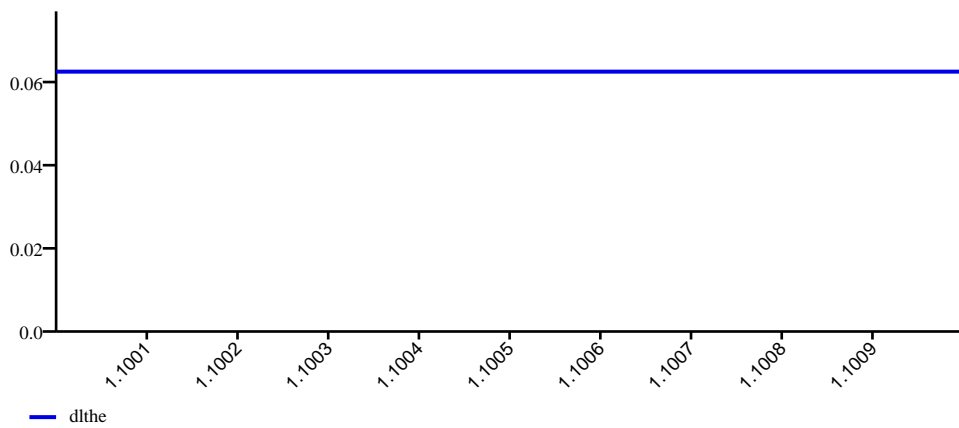
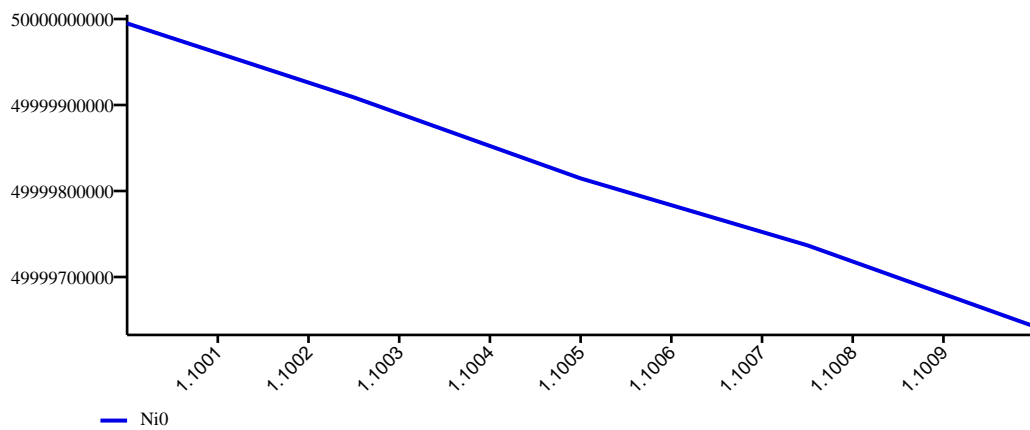
Ti_x: [0.01] eV

bmag: [1005.43981934] gauss



hthe0: [0.31830987] m





Ni_x: [4.99999949e+10] cm⁻³

nx: 5

ny: 32

dt: 100.0

rho_s: [0.45368987] cm

rho_i: [0.01434693] cm

rho_e: [0.0074855] cm

fmei: 0.000272301492212

lambda_ei: [13.98494053]

lambda_ii: [3.4280262]

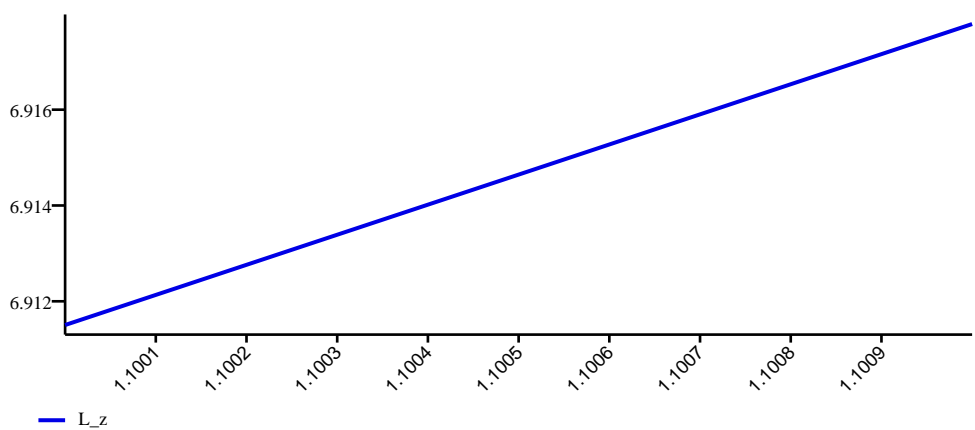
wci: [4816056.5]

wpi: [2.08710320e+08]

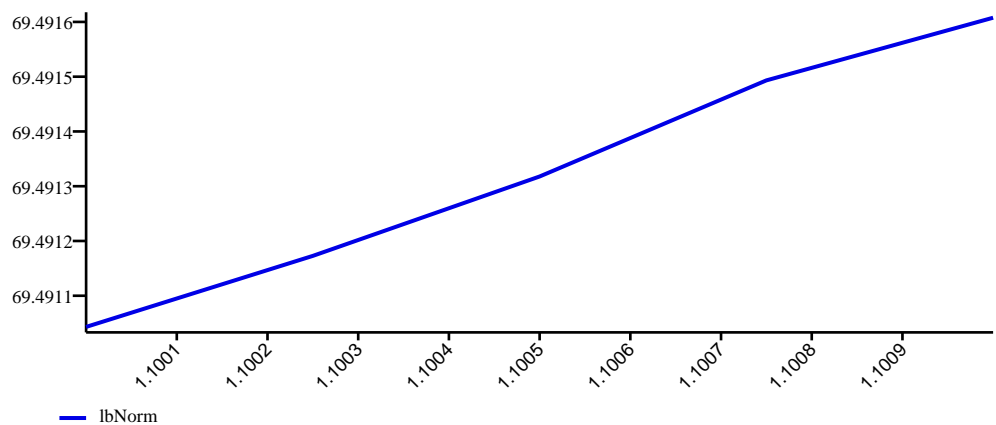
wce: [1.78968289e+10]

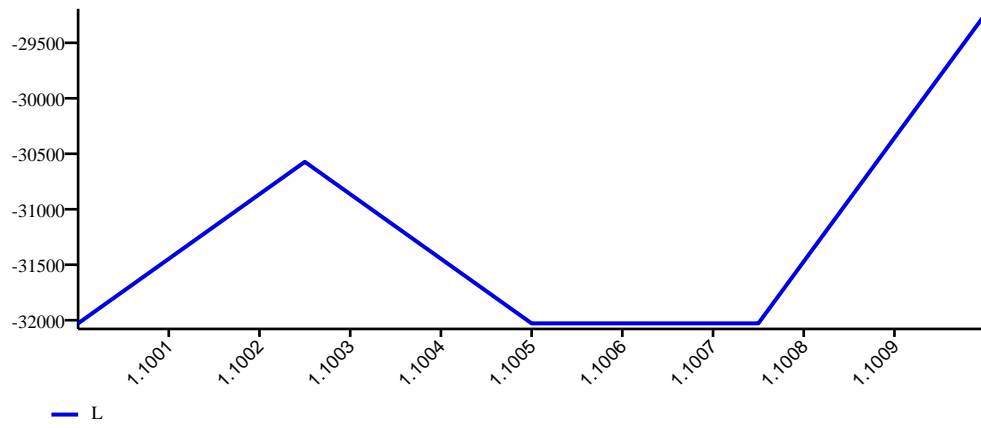
wpe: [1.26114222e+10]

v_the: [1.32499432e+08]
v_thi: [69225.75]
c_s: [2826129.5]
v_A: [689376.5625]
nueix: [64346.30078125]
nuiix: [5793313.]
nu_hat: [0.05344315]
L_d: [0.01050761]
L_i_inrt: [144.19987488]
L_e_inrt: [1.18735200e+11]
Ve_x: [4.19000000e+08]
R0: 1.1004999876

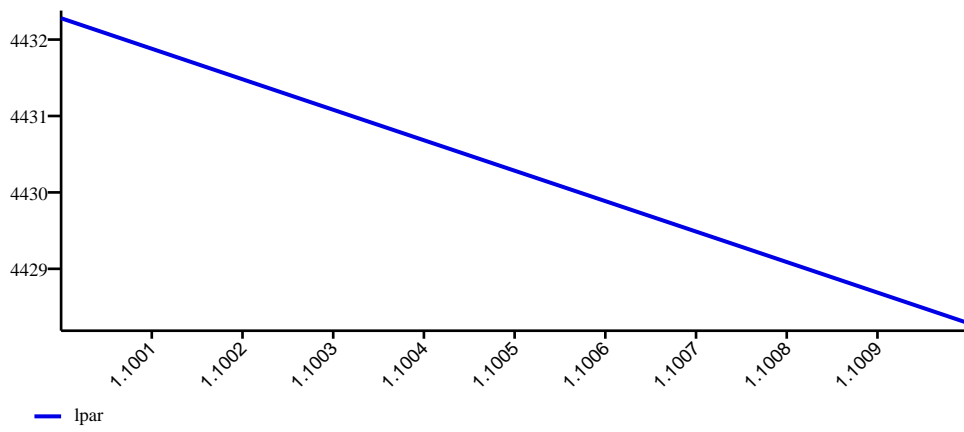


dz: [0.01]





w_Ln: [4.42295823e-05]



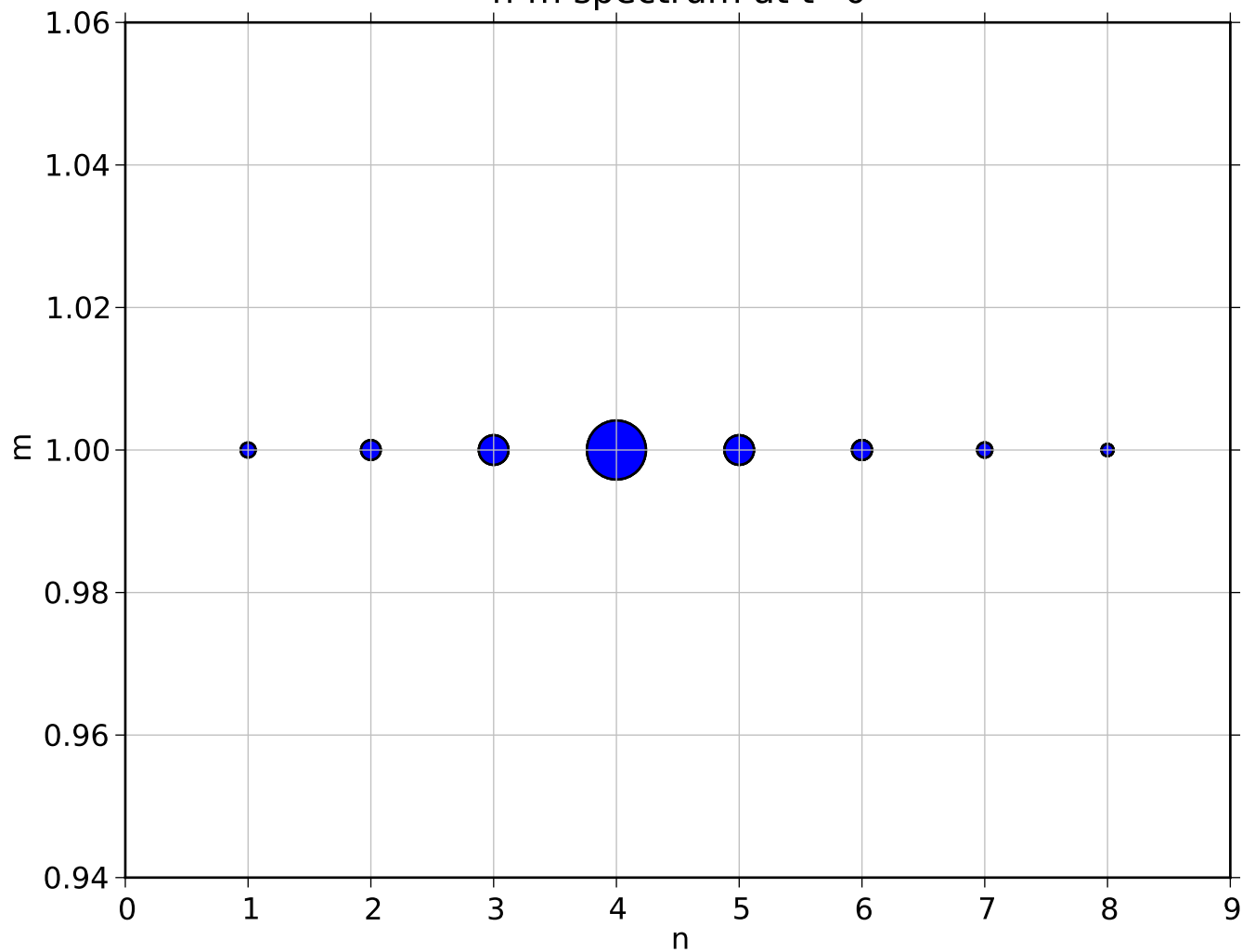
sig_par: [134737.28125]

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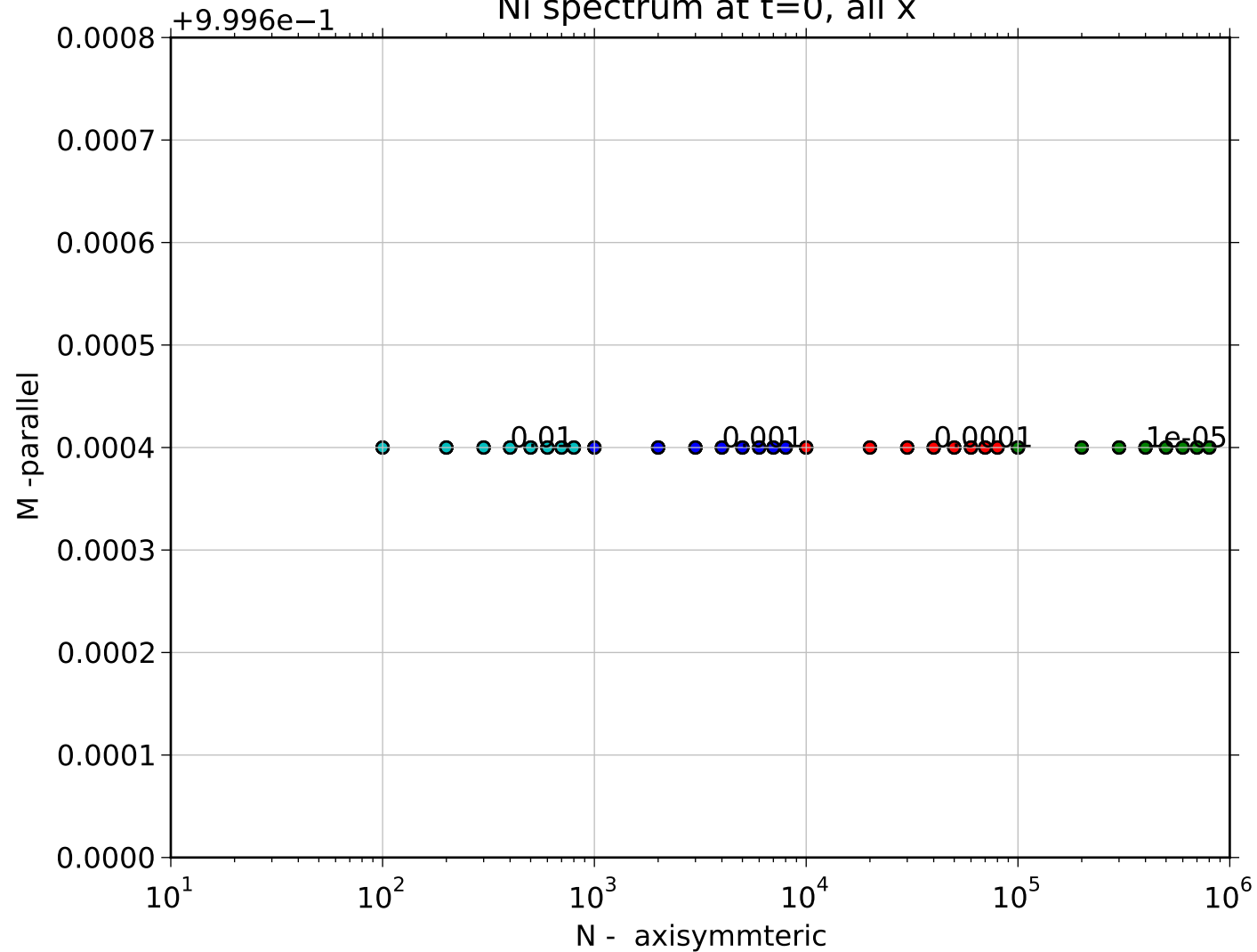
int physics_run(BoutReal t) { solve_phi_tridag(rho, phi, phi_flags); if(estatic || ZeroElMass) { Apar = 0.0;
} else { solve_apar_tridag(Ajpar, Apar, apar_flags); } mesh->communicate(comms); Nit = Ni0; Tit = Ti0; Tet
= Te0; Vit = Vi0; nu = nu_hat * Nit / (Tet^1.5); mu_i = mui_hat * Nit / (Tit^0.5); kapa_Te =
3.2*(1./fmei)*(wci/nueix)*(Tet^2.5); kapa_Ti = 3.9*(wci/nuiix)*(Tit^2.5); pei = (Te0+Ti0)*Ni + (Te +
Ti)*Ni0; pe = Te0*Ni + Te*Ni0; if(ZeroElMass) { jpar = ((Te0*Grad_par_LtoC(Ni)) -
(Ni0*Grad_par_LtoC(phi)))/(fmei*0.51*nu); jpar = lowPass(jpar,8); /* for(int jx=MXG;jxngx-MXG;jx++) {
for(int jy=MYG;jyngy-MYG;jy++) { for(int jz=0;jzngz;jz++) { jpar[jx][jy][jz] = ( (Te0[jx][jy] *
(Ni[jx][jy+1][jz] - Ni[jx][jy][jz])) - (Ni0[jx][jy] * (phi[jx][jy+1][jz] - phi[jx][jy][jz])) ) / (fmei * 0.51 *
nu[jx][jy][jz] * dy[jx][jy] * sqrt(mesh->g_22[jx][jy])); } } } */ jpar.applyBoundary();
mesh->communicate(jpar); Ve = Vi - jpar/Ni0; Ajpar = Ve; } else { Ve = Ajpar + Apar; jpar = Ni0*(Vi - Ve);
} ddt(Ni) = 0.0; if(evolve_ni) { ddt(Ni) -= vE_Grad(Ni0, phi); /* ddt(Ni) -= Vpar_Grad_par(Vi, Ni0) +
Vpar_Grad_par(Vi0, Ni) + Vpar_Grad_par(Vi, Ni); ddt(Ni) -= Ni0*Div_par(Vi) + Ni*Div_par(Vi0) +
Ni*Div_par(Vi); ddt(Ni) += Div_par(jpar); ddt(Ni) += 2.0*V_dot_Grad(b0xcv, pe); ddt(Ni) -=
2.0*(Ni0*V_dot_Grad(b0xcv, phi) + Ni*V_dot_Grad(b0xcv, phi0) + Ni*V_dot_Grad(b0xcv, phi)); */
ddt(Ni) = lowPass(ddt(Ni),8); } ddt(Vi) = 0.0; if(evolve_vi) { ddt(Vi) -= vE_Grad(Vi0, phi) + vE_Grad(Vi,
phi0) + vE_Grad(Vi, phi); ddt(Vi) -= Vpar_Grad_par(Vi0, Vi) + Vpar_Grad_par(Vi, Vi0) +
Vpar_Grad_par(Vi, Vi); ddt(Vi) -= Grad_par(pei)/Ni0; } ddt(Te) = 0.0; if(evolve_te) { ddt(Te) -=
vE_Grad(Te0, phi) + vE_Grad(Te, phi0) + vE_Grad(Te, phi); ddt(Te) -= Vpar_Grad_par(Ve, Te0) +
Vpar_Grad_par(Ve0, Te) + Vpar_Grad_par(Ve, Te); ddt(Te) += 1.333*Te0*( V_dot_Grad(b0xcv, pe)/Ni0 -
V_dot_Grad(b0xcv, phi) ); ddt(Te) += 3.333*Te0*V_dot_Grad(b0xcv, Te); ddt(Te) +=
(0.6666667/Ni0)*Div_par_K_Grad_par(kapa_Te, Te); } ddt(Ti) = 0.0; if(evolve_ti) { ddt(Ti) -=
vE_Grad(Ti0, phi) + vE_Grad(Ti, phi0) + vE_Grad(Ti, phi); ddt(Ti) -= Vpar_Grad_par(Vi, Ti0) +
Vpar_Grad_par(Vi0, Ti) + Vpar_Grad_par(Vi, Ti); ddt(Ti) += 1.333*( Ti0*V_dot_Grad(b0xcv, pe)/Ni0 -
Ti*V_dot_Grad(b0xcv, phi) ); ddt(Ti) -= 3.333*Ti0*V_dot_Grad(b0xcv, Ti); ddt(Ti) +=
(0.6666667/Ni0)*Div_par_K_Grad_par(kapa_Ti, Ti); } ddt(rho) = 0.0; if(evolve_rho) { /* ddt(rho) -=
vE_Grad(rho0, phi) + vE_Grad(rho, phi0) + vE_Grad(rho, phi); ddt(rho) -= Vpar_Grad_par(Vi, rho0) +
Vpar_Grad_par(Vi0, rho) + Vpar_Grad_par(Vi, rho); */ ddt(rho) +=
mesh->Bxy*mesh->Bxy*Div_par_CtoL(jpar); /* for(int jx=MXG;jxngx-MXG;jx++) { for(int
jy=MYG;jyngy-MYG;jy++) { for(int jz=0;jzngz;jz++) { ddt(rho)[jx][jy][jz] = Bxy[jx][jy]*Bxy[jx][jy] *
(jpar[jx][jy+1][jz] - jpar[jx][jy][jz]) / (dy[jx][jy] * sqrt(mesh->g_22[jx][jy])); } } } */ ddt(Ajpar) = 0.0;
if(evolve_ajpar) { /* for(int jx=MXG;jxngx-MXG;jx++) { for(int jy=MYG;jyngy-MYG;jy++) { for(int
jz=0;jzngz;jz++) { ddt(Ajpar)[jx][jy][jz] += (1./fmei) * (phi[jx][jy][jz] - phi[jx][jy-1][jz]) / (dy[jx][jy] *
sqrt(mesh->g_22[jx][jy])); ddt(Ajpar)[jx][jy][jz] -= (1./fmei)*(Te0[jx][jy]/Ni0[jx][jy])*(Ni[jx][jy][jz] -
Ni[jx][jy-1][jz]) / (dy[jx][jy] * sqrt(mesh->g_22[jx][jy])); } } } */ ddt(Ajpar) += (1./fmei)*Grad_par(phi,
CELL_YLOW); ddt(Ajpar) -= (1./fmei)*(Te0/Ni0)*Grad_par(Ni, CELL_YLOW); ddt(Ajpar) +=
0.51*interp_to(nu, CELL_YLOW)*jpar/Ni0; }

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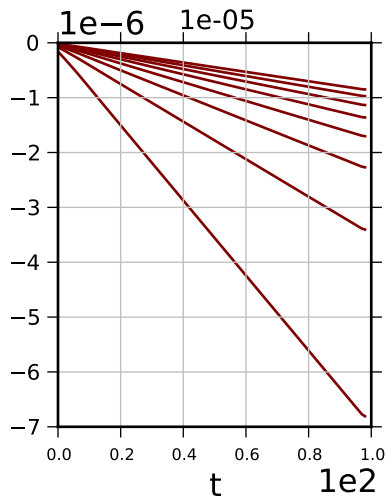
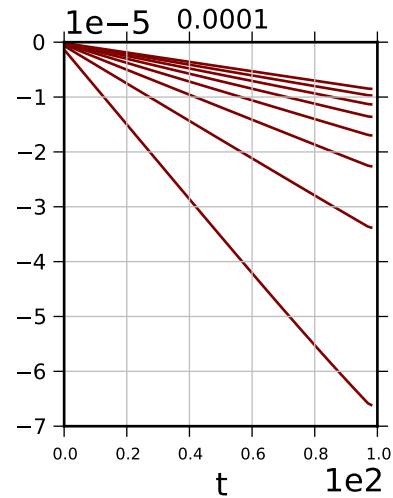
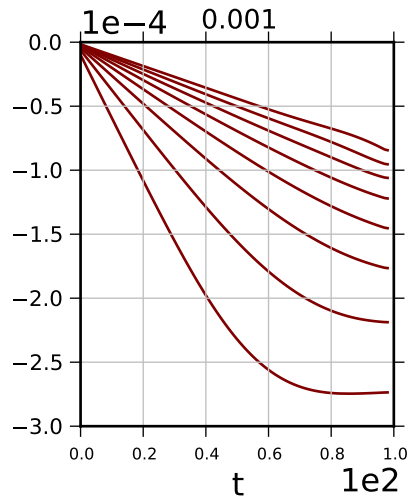
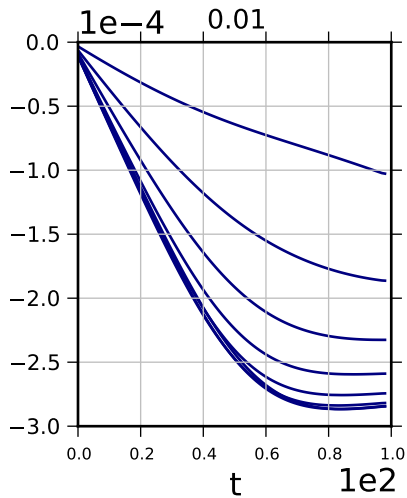

n-m spectrum at t=0



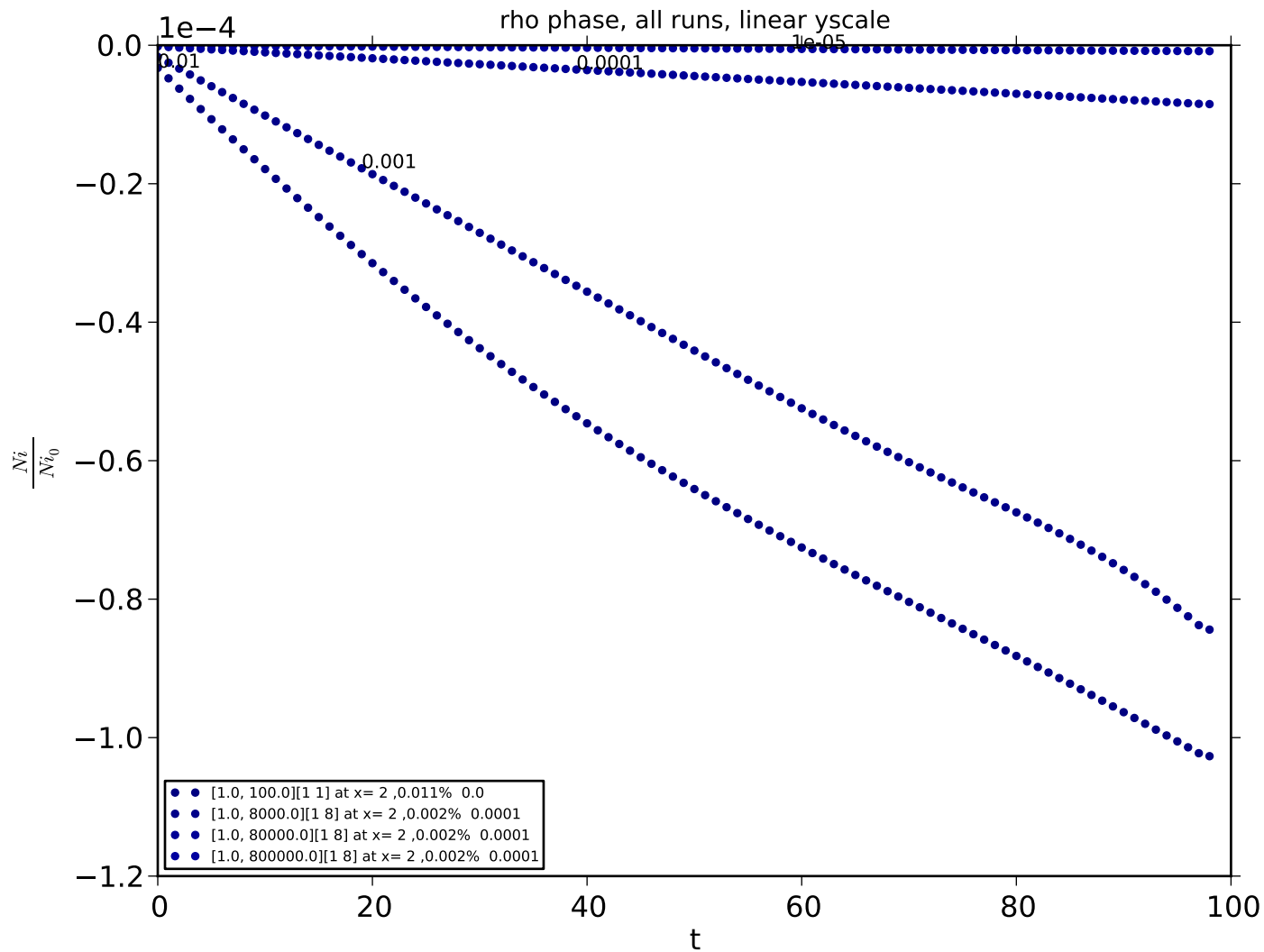
Ni spectrum at t=0, all x



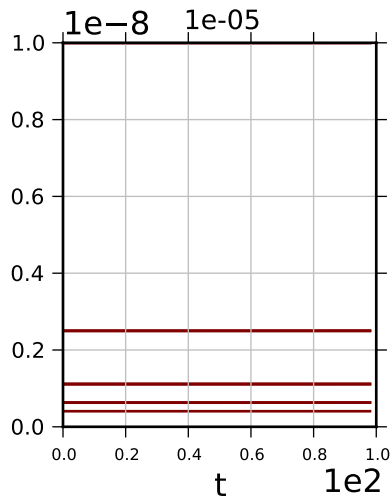
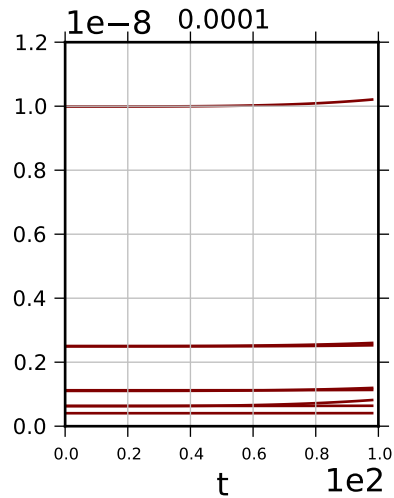
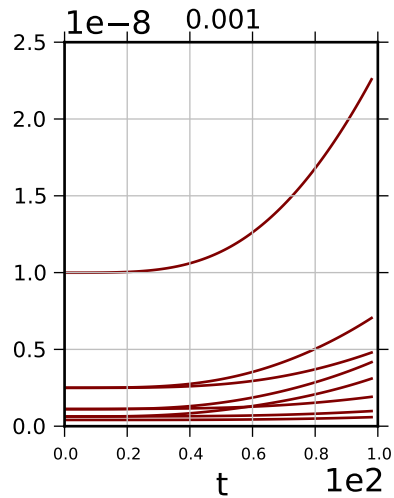
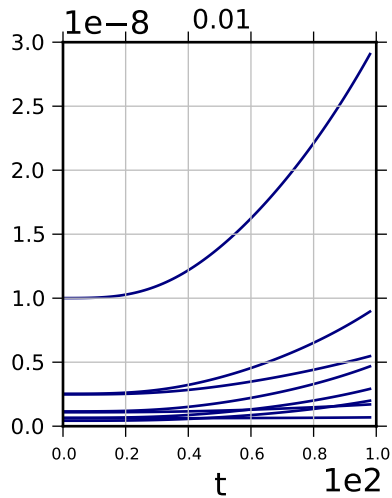
Dominant mode phase for ρ



Dominant mode behavior for rho

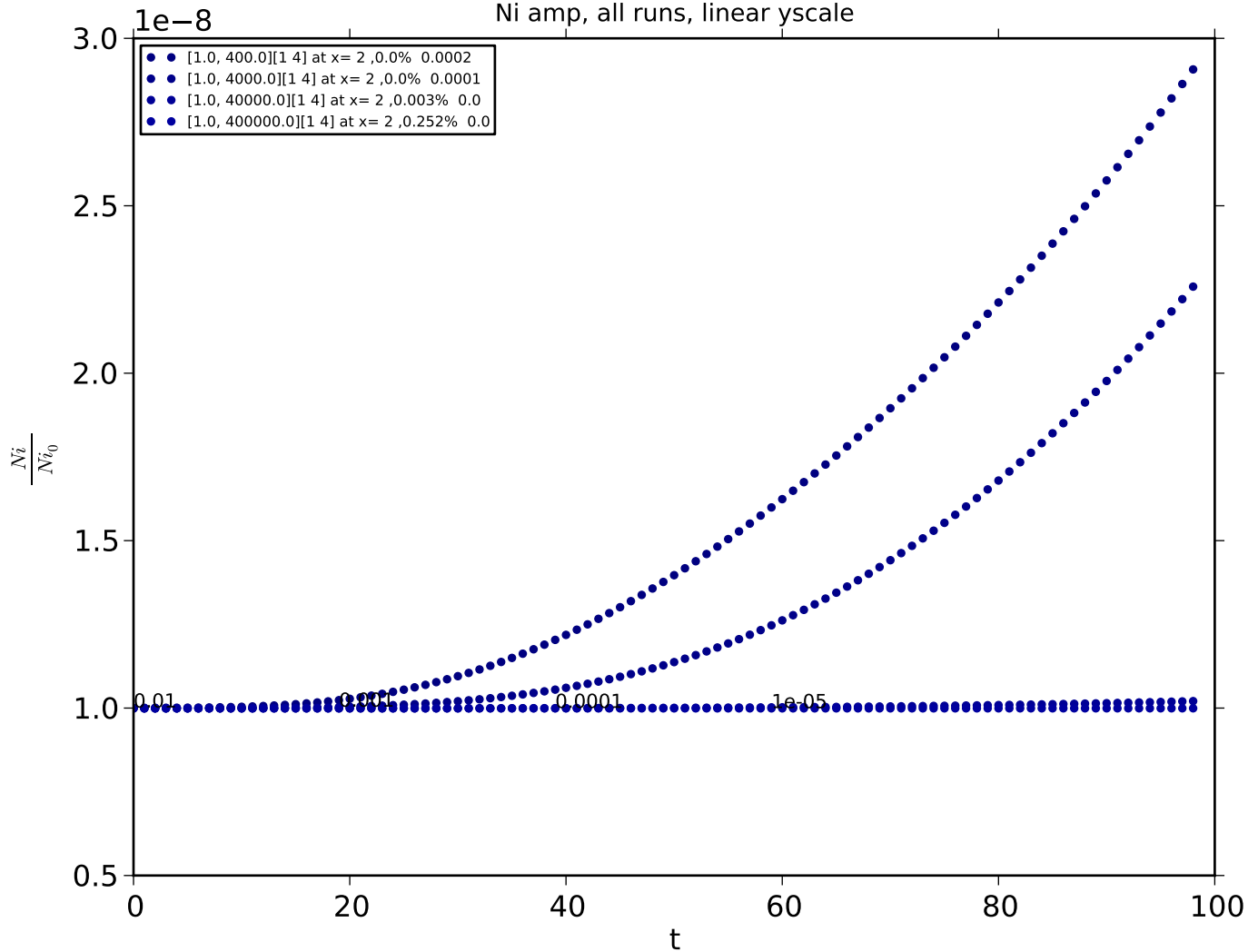


Dominant mode amp for Ni

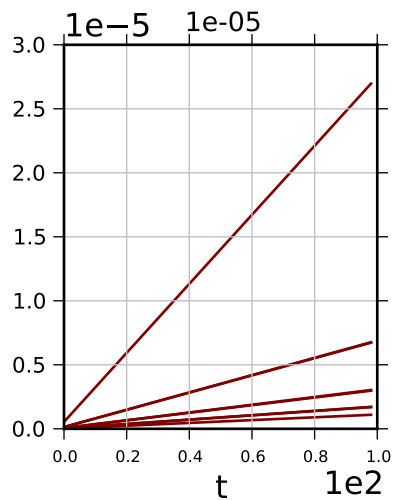
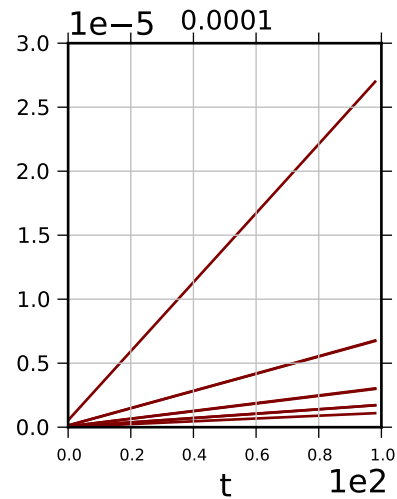
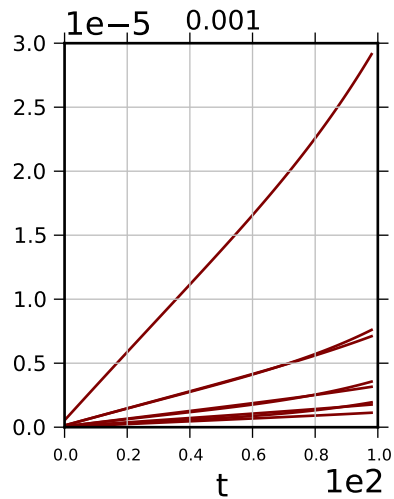
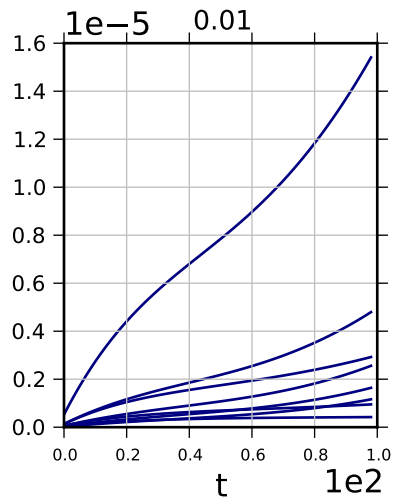


Dominant mode behavior for Ni

Ni amp, all runs, linear yscale

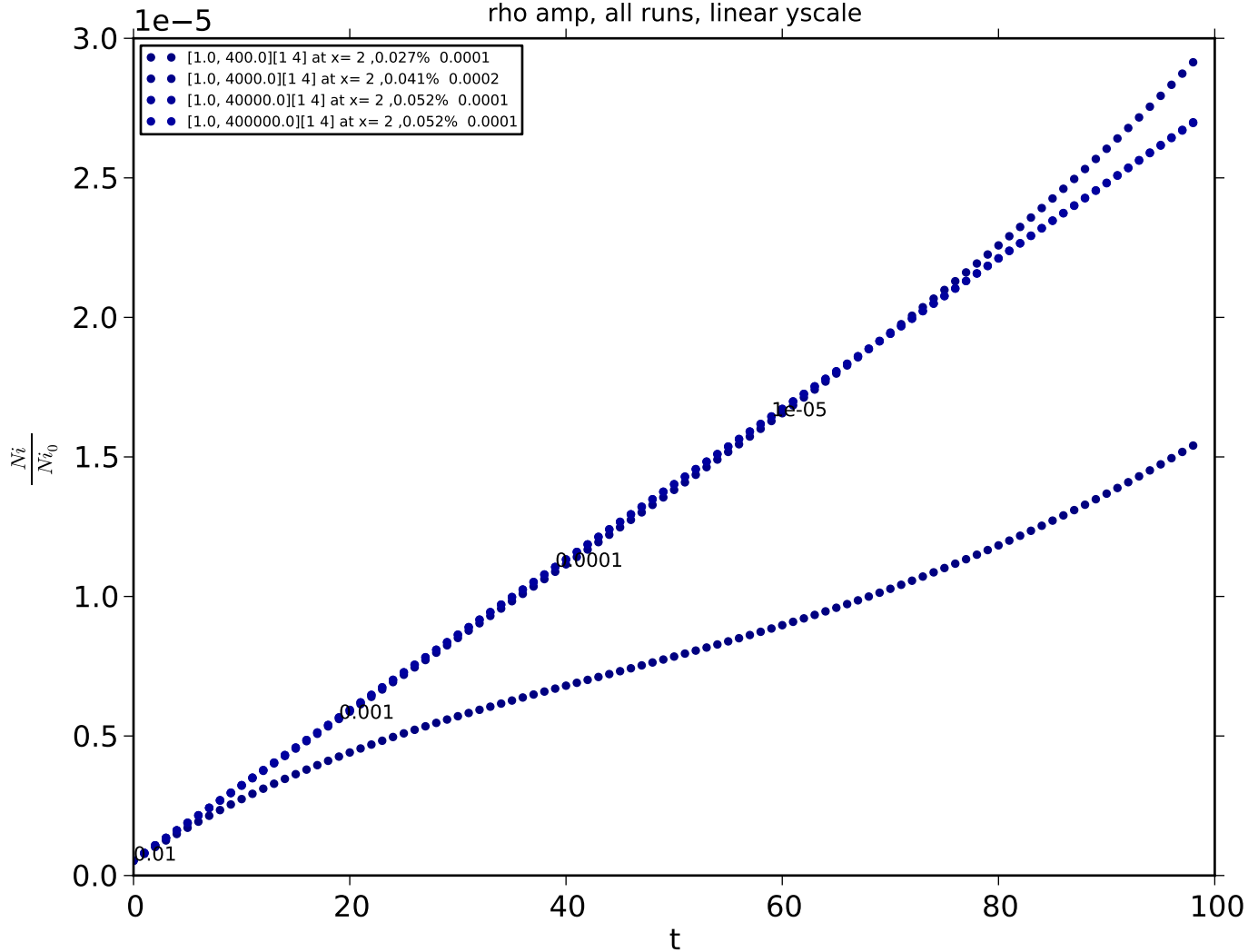


Dominant mode amp for ρ

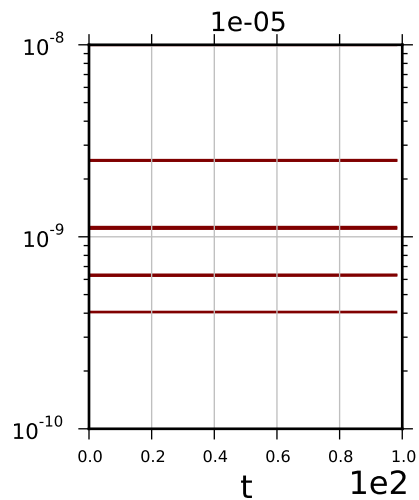
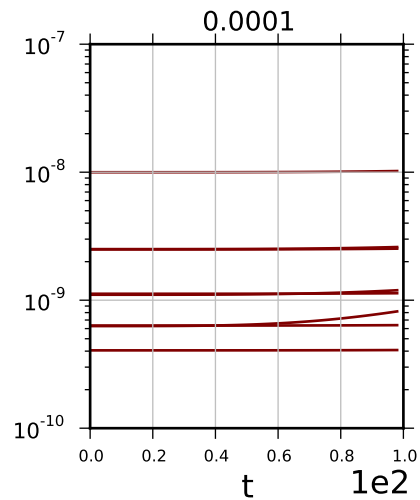
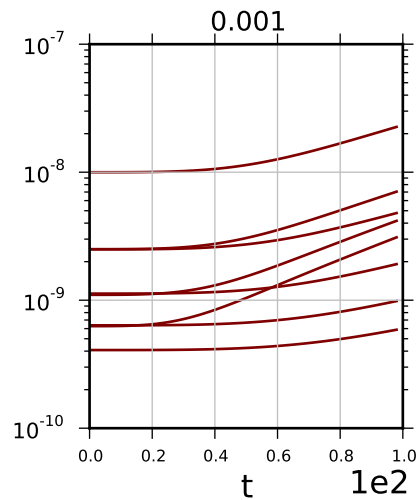
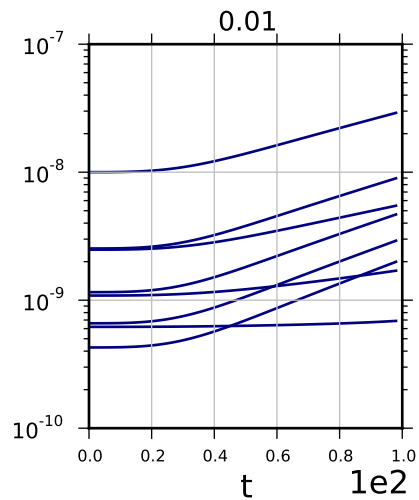


Dominant mode behavior for rho

rho amp, all runs, linear yscale

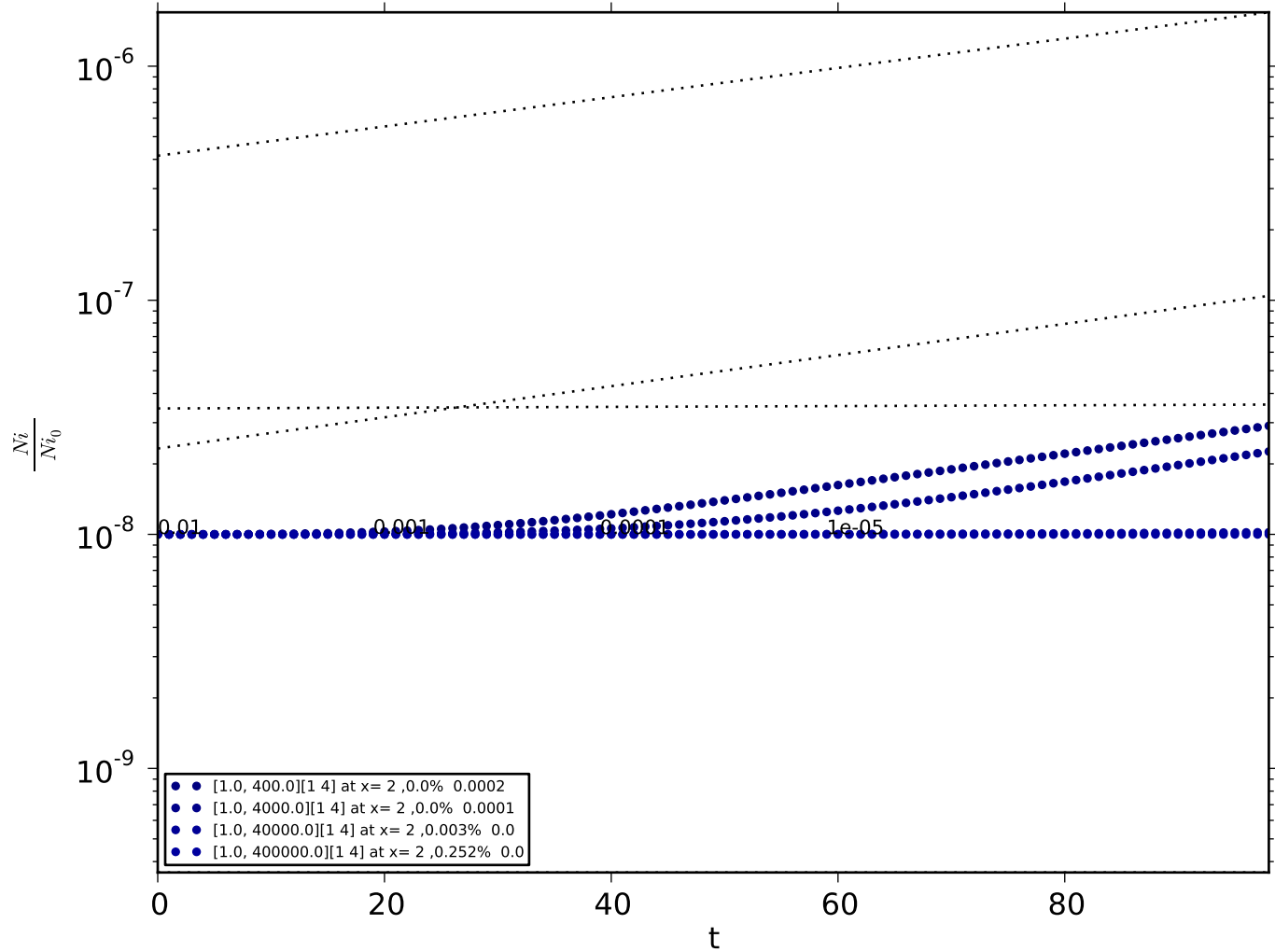


Dominant mode amp for Ni

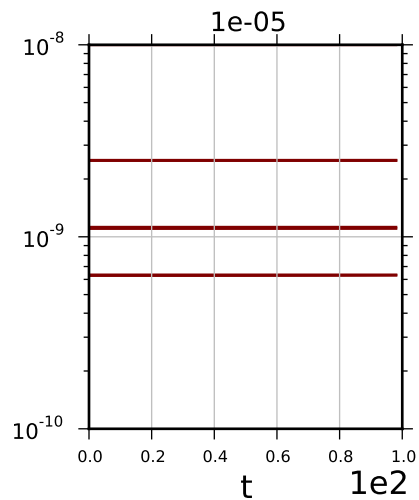
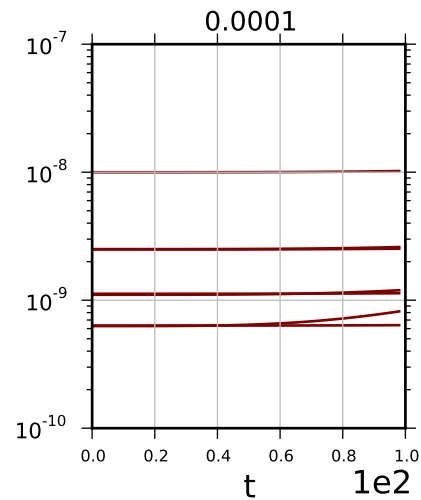
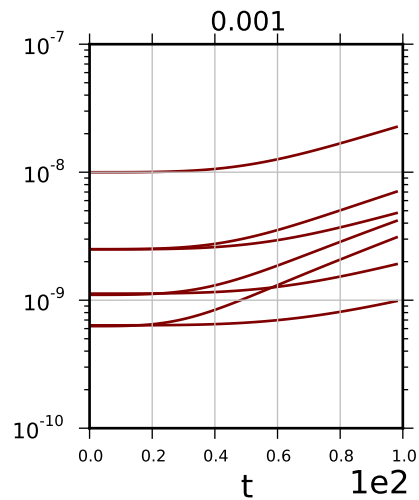
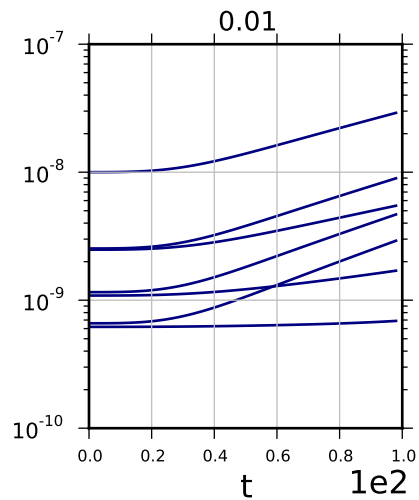


Dominant mode behavior for Ni

Ni amp, all runs, log yscale

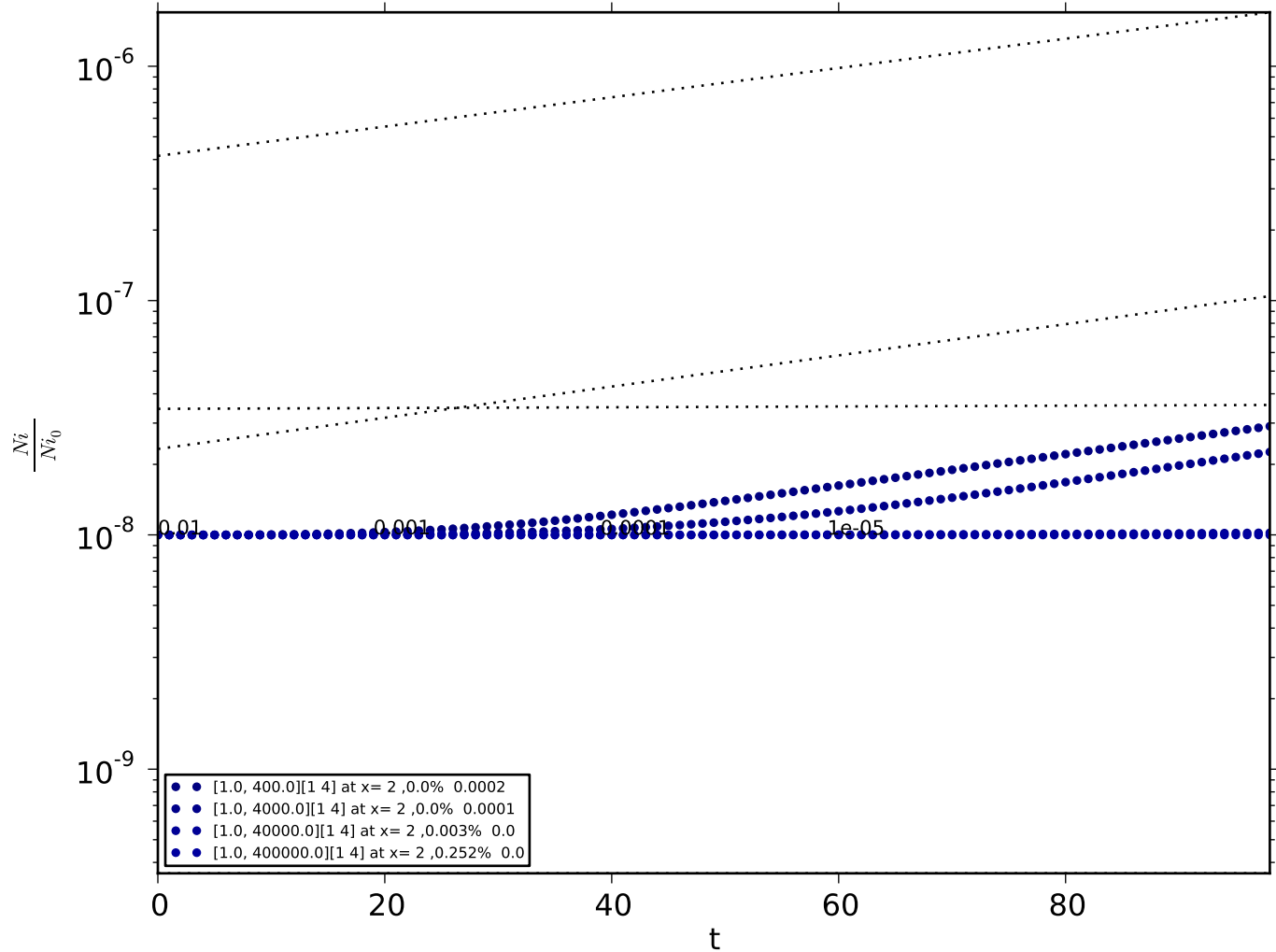


Dominant mode amp for Ni

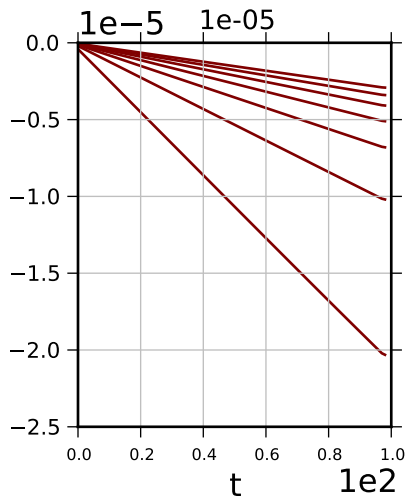
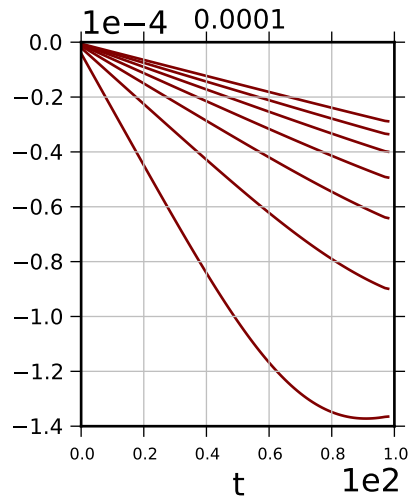
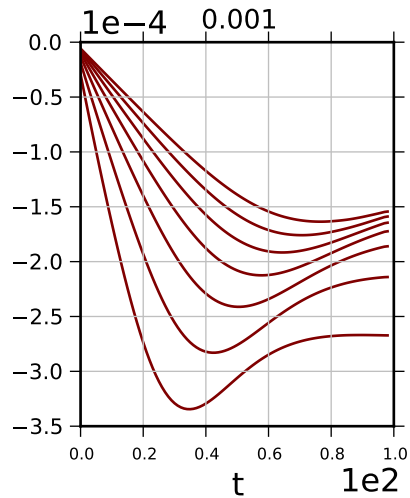
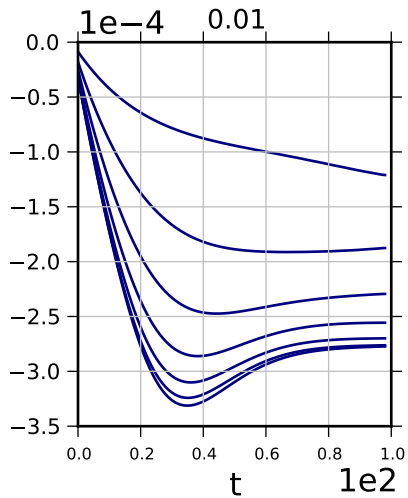


Dominant mode behavior for Ni

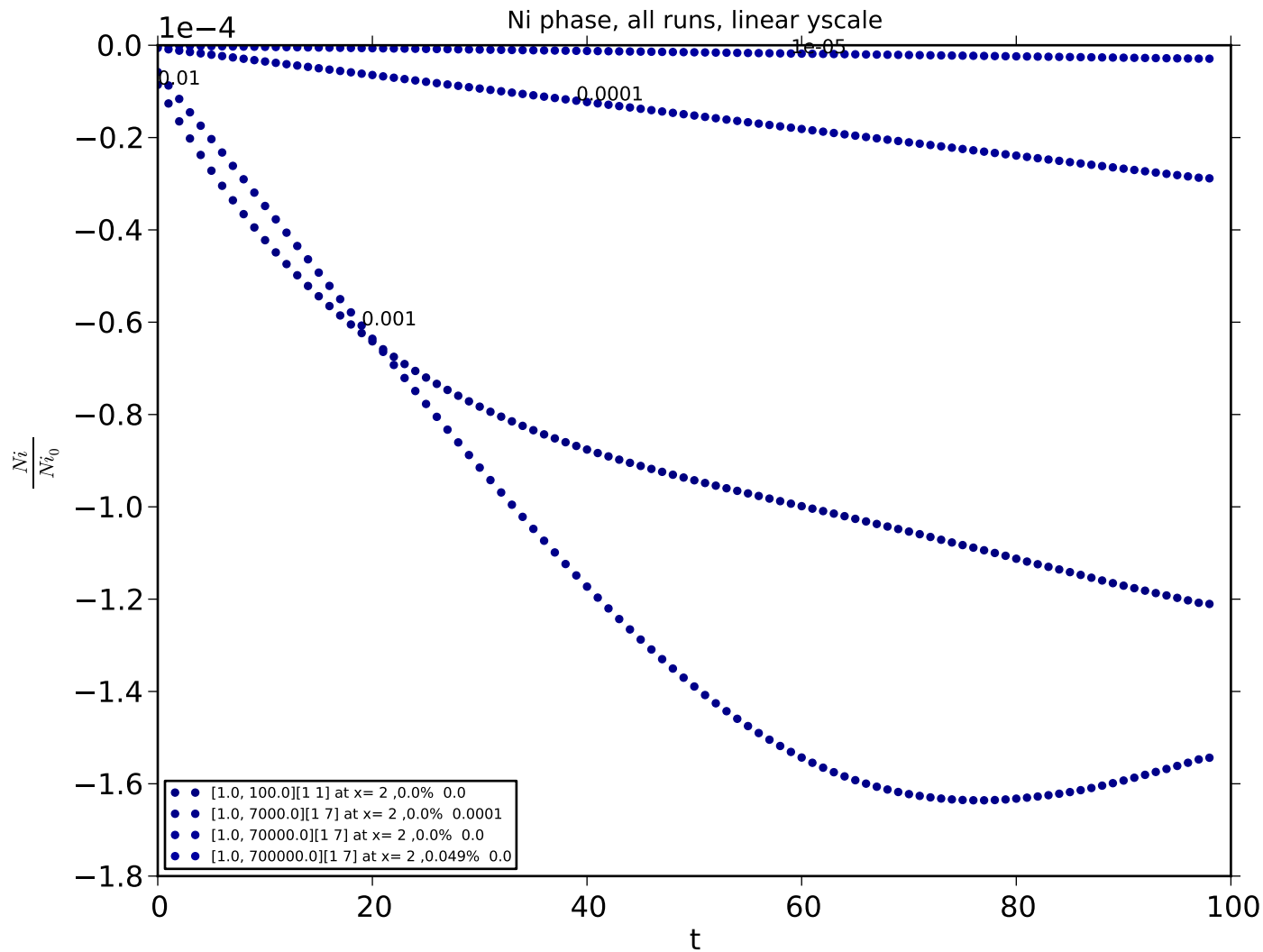
Ni amp, all runs, log yscale



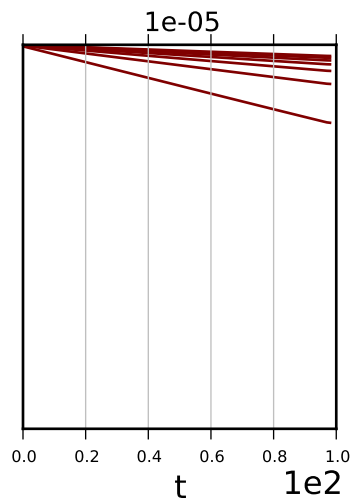
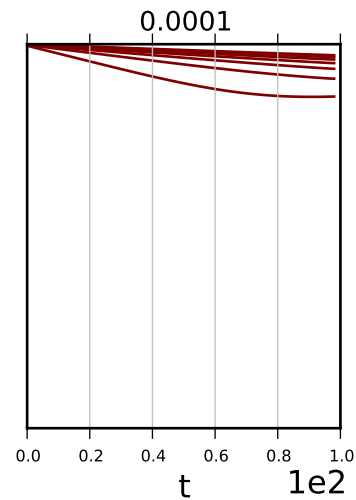
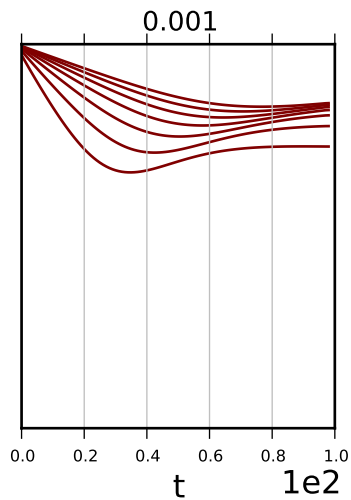
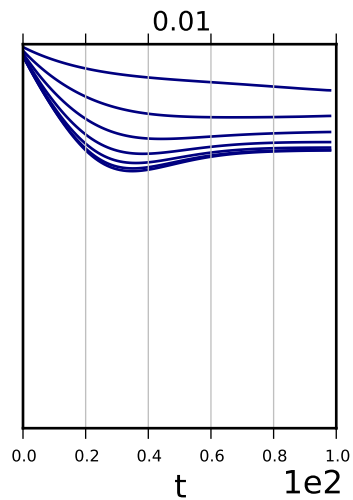
Dominant mode phase for Ni



Dominant mode behavior for Ni

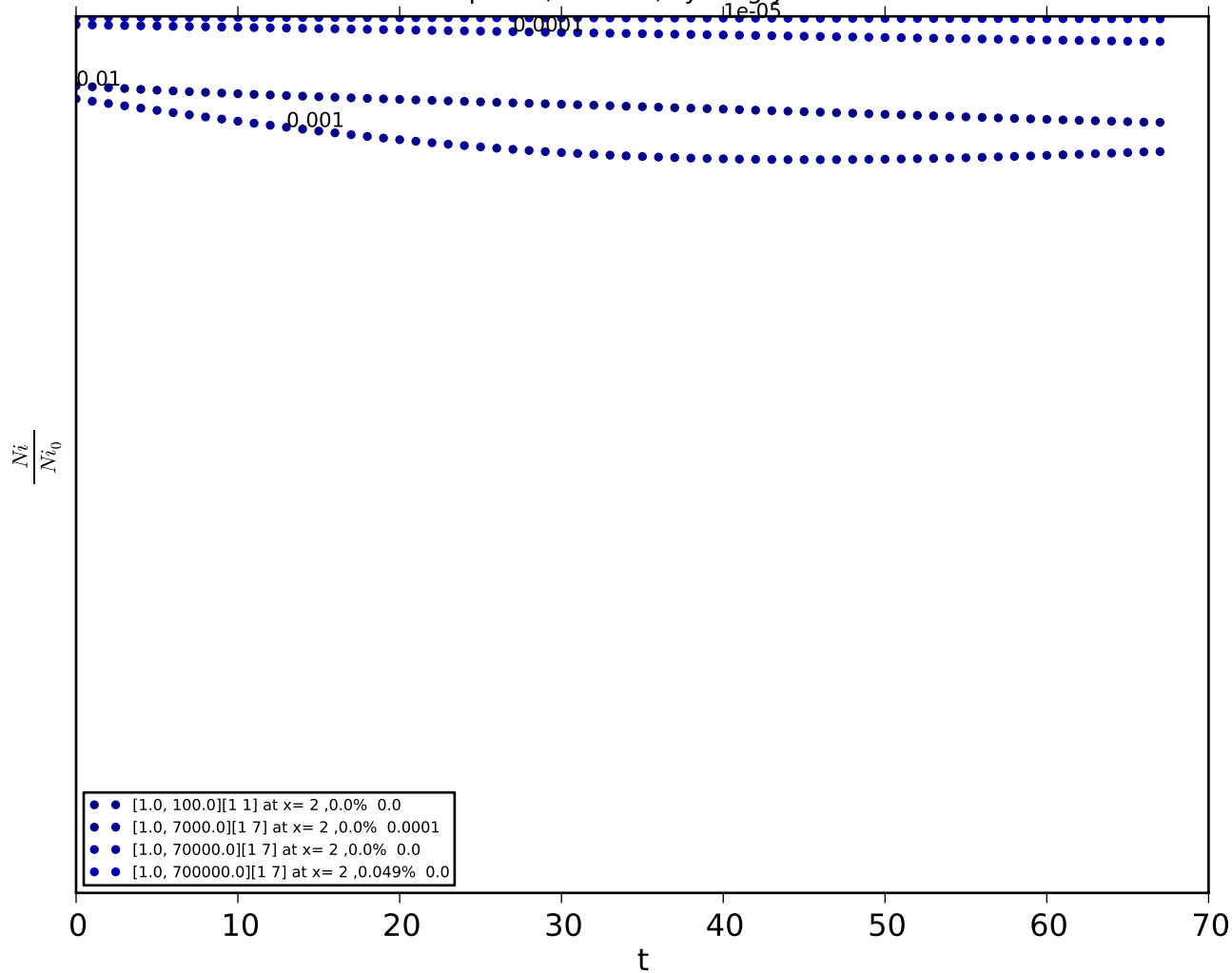


Dominant mode phase for Ni

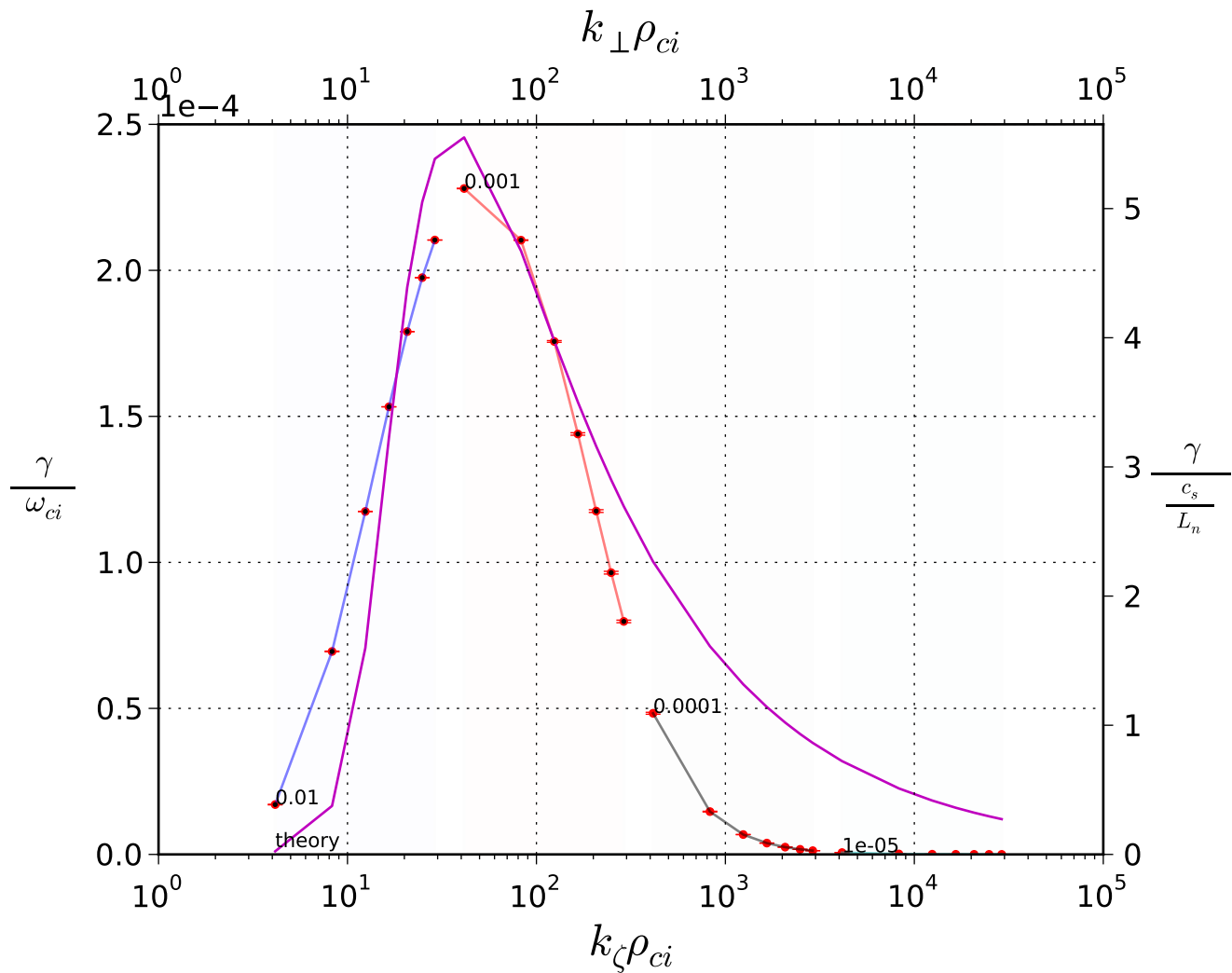


Dominant mode behavior for Ni

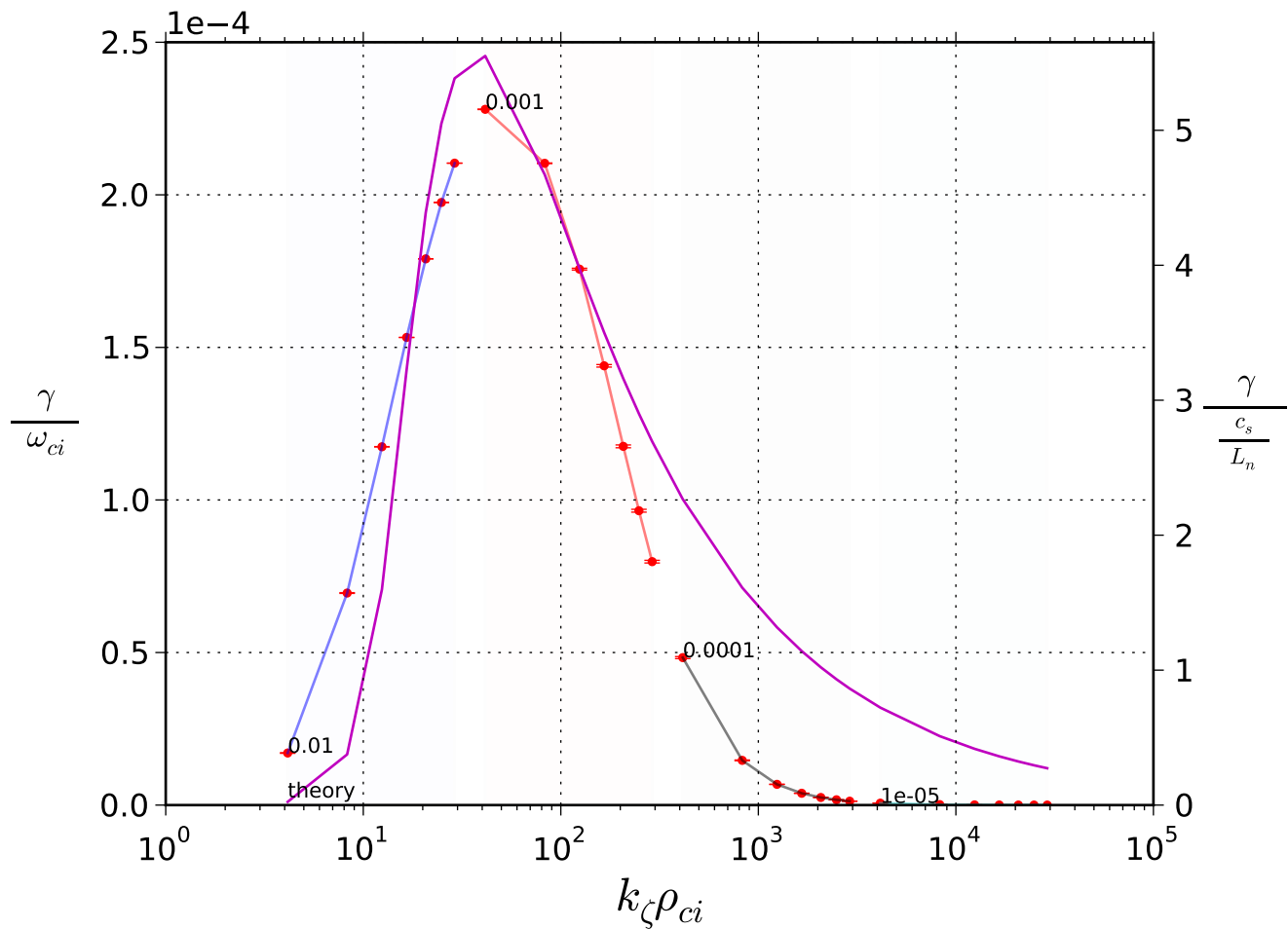
Ni phase, all runs, symlog yscale



gamma computed from Ni

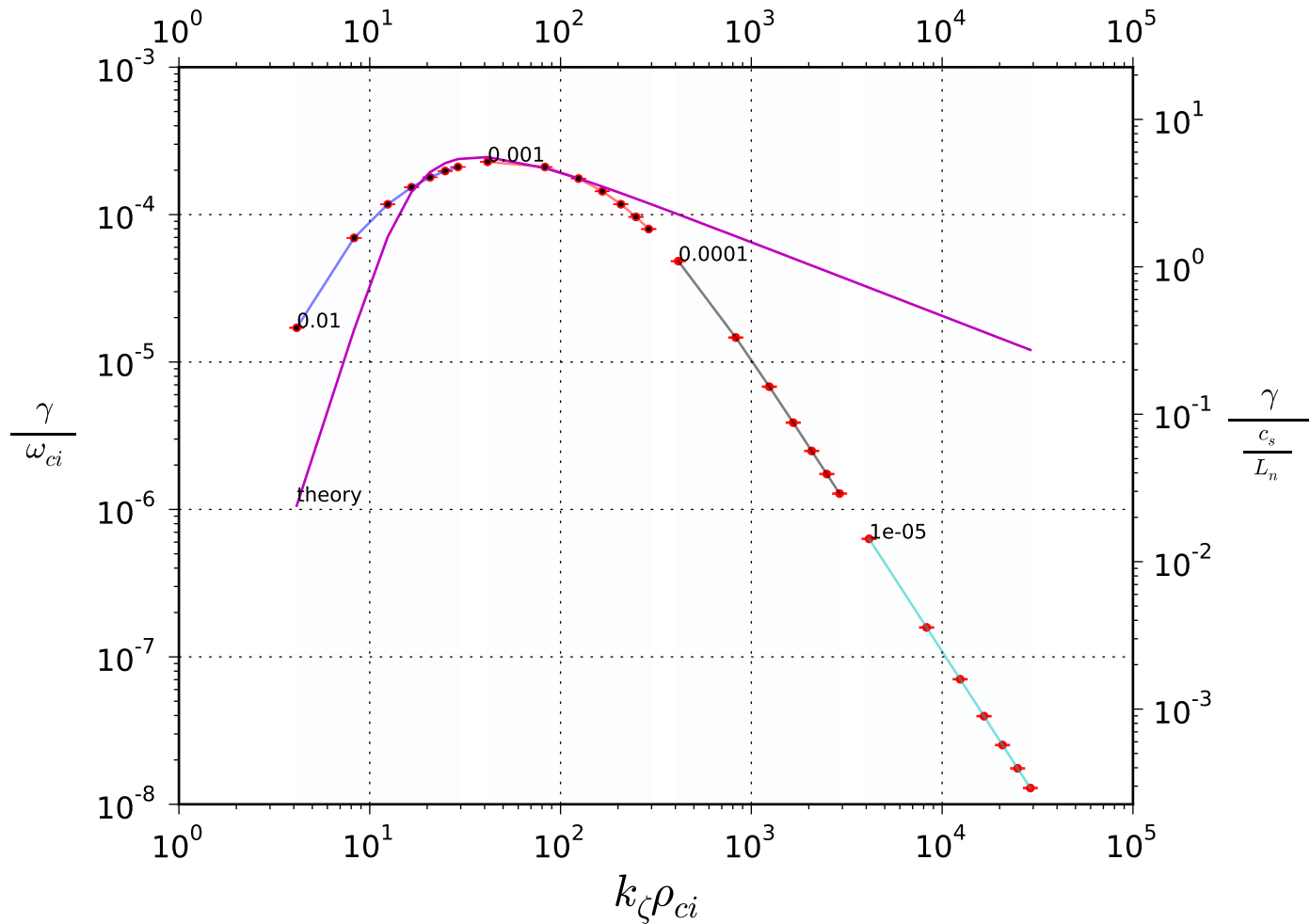


gamma computed from Ni



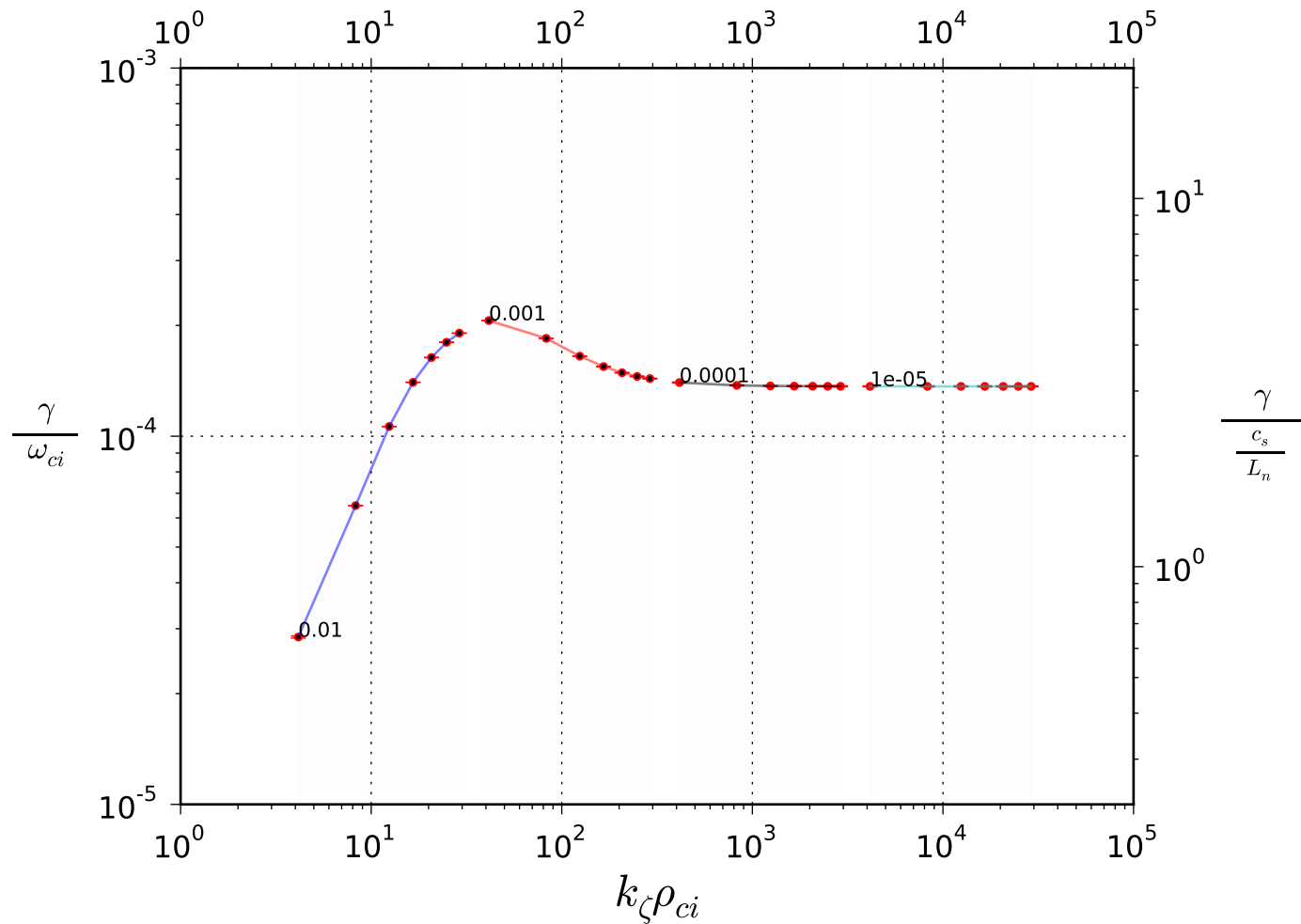
gamma computed from Ni

$$k_{\perp} \rho_{ci}$$

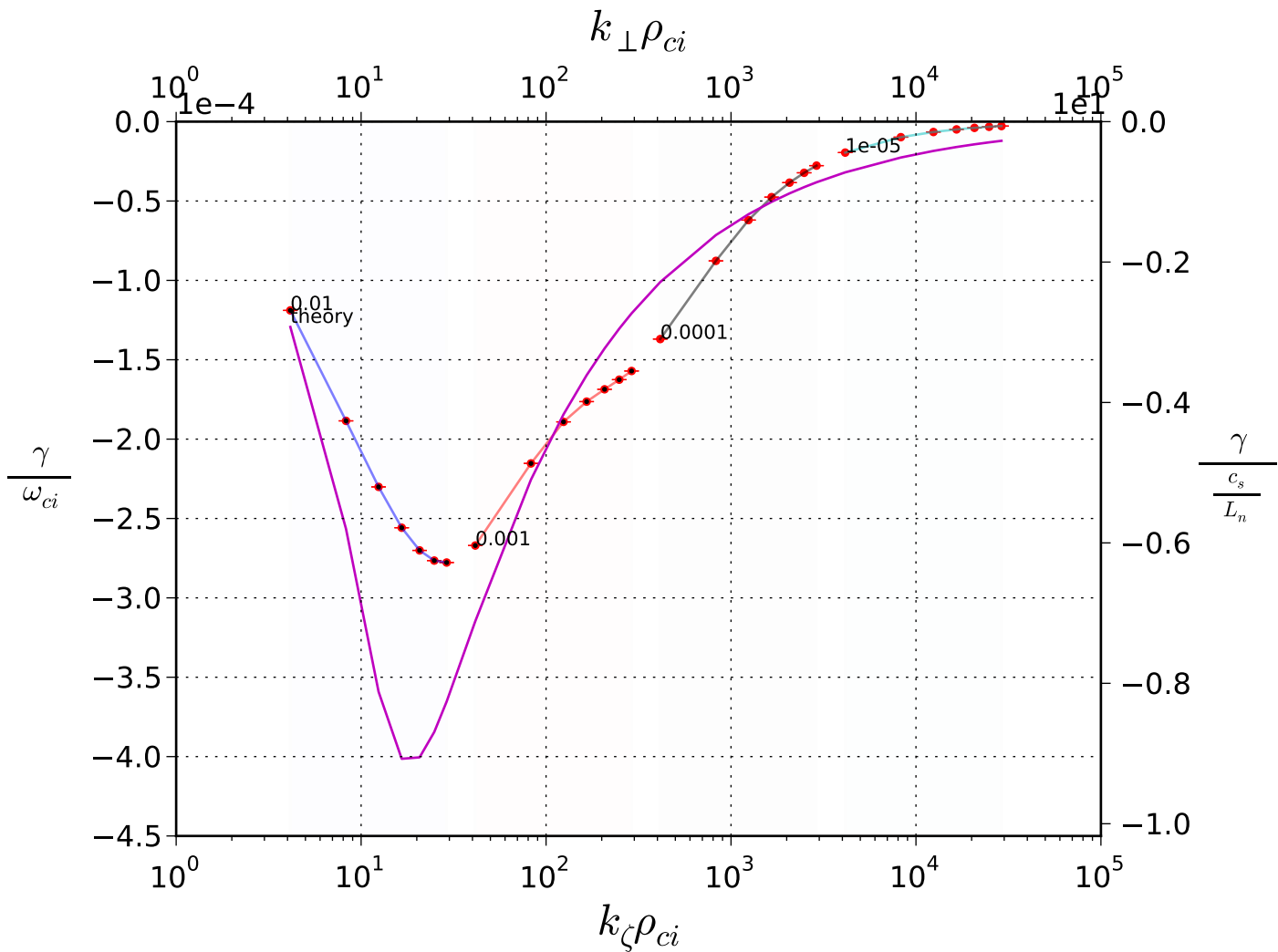


gamma computed from rho

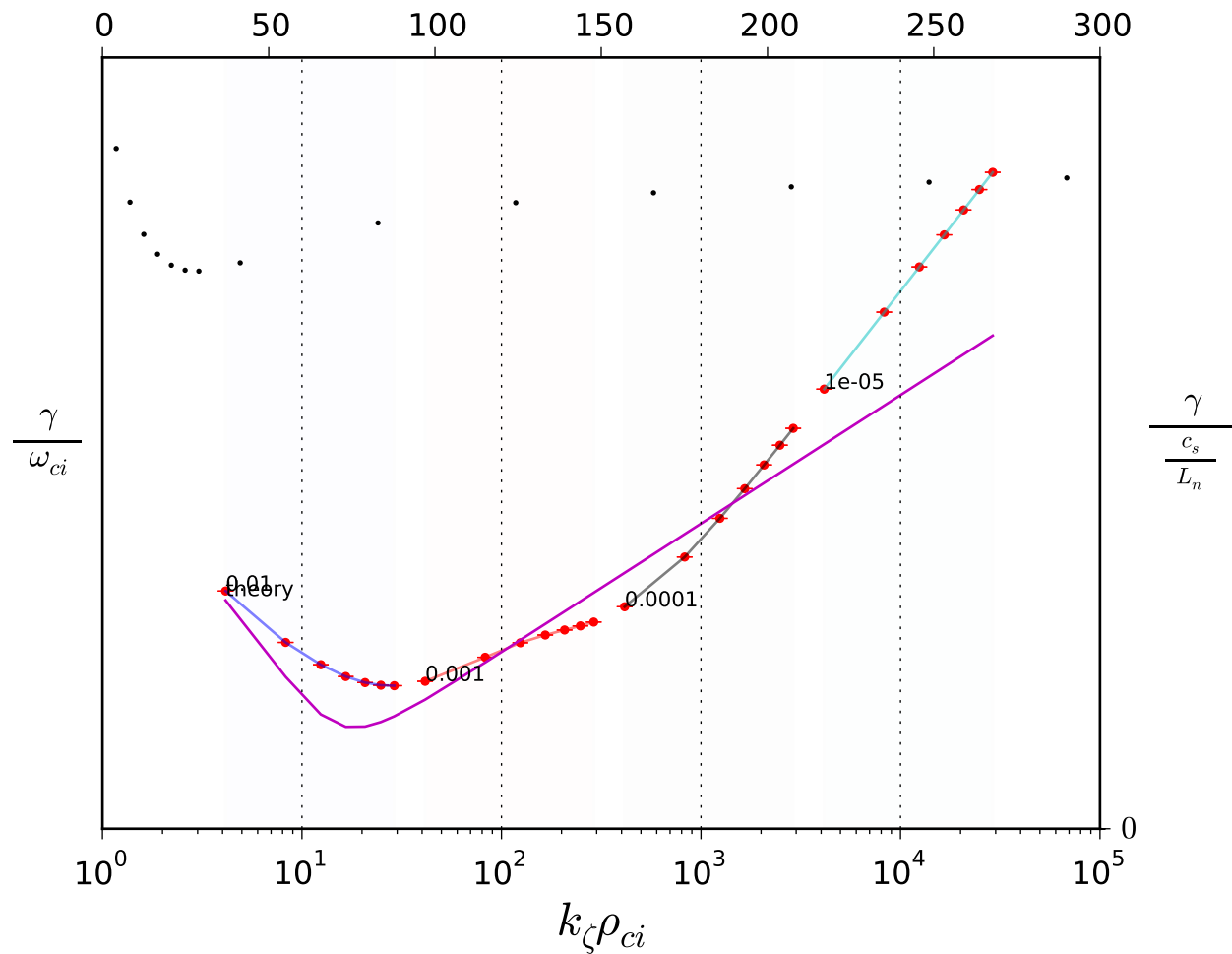
$$k_{\perp} \rho_{ci}$$



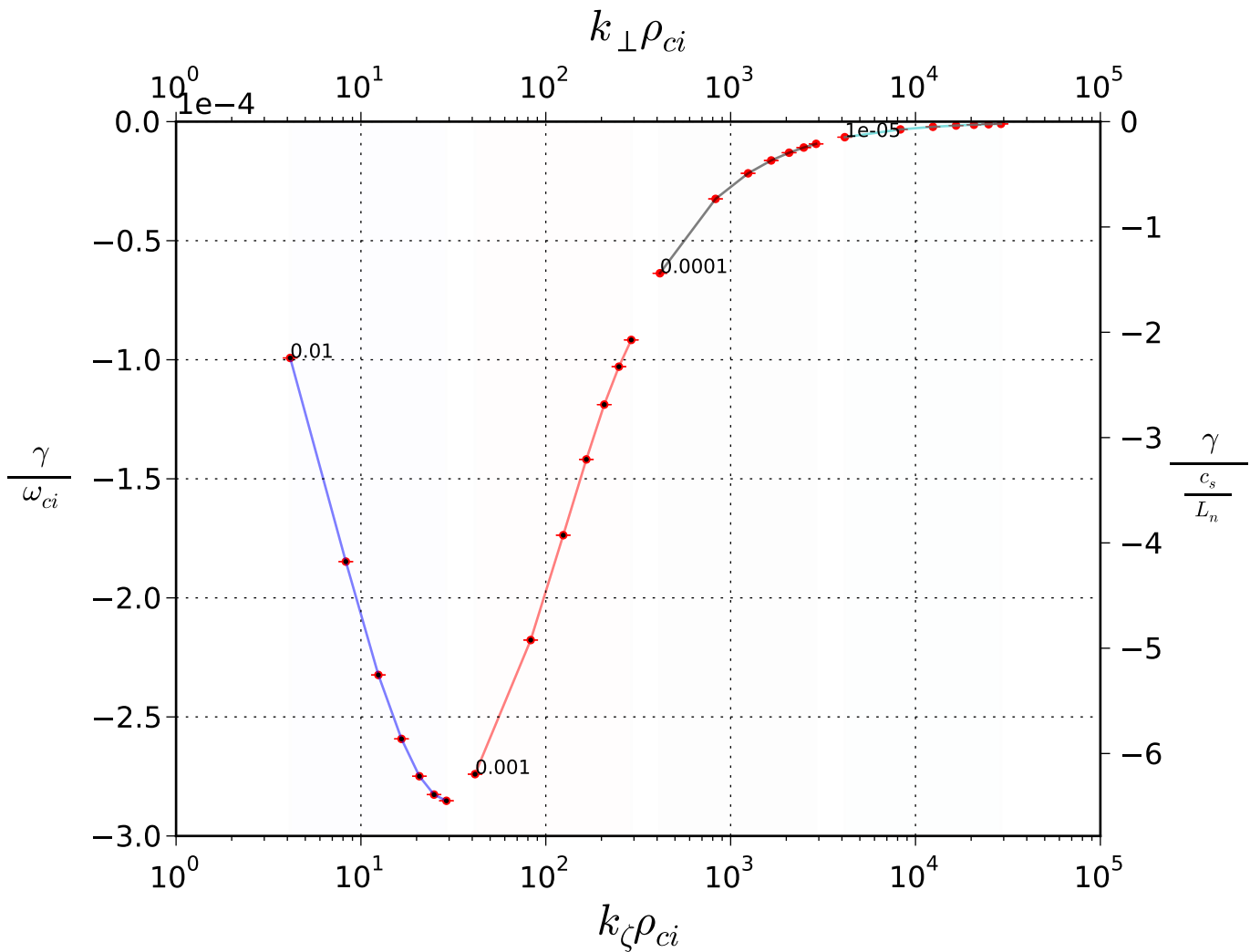
freq computed from Ni



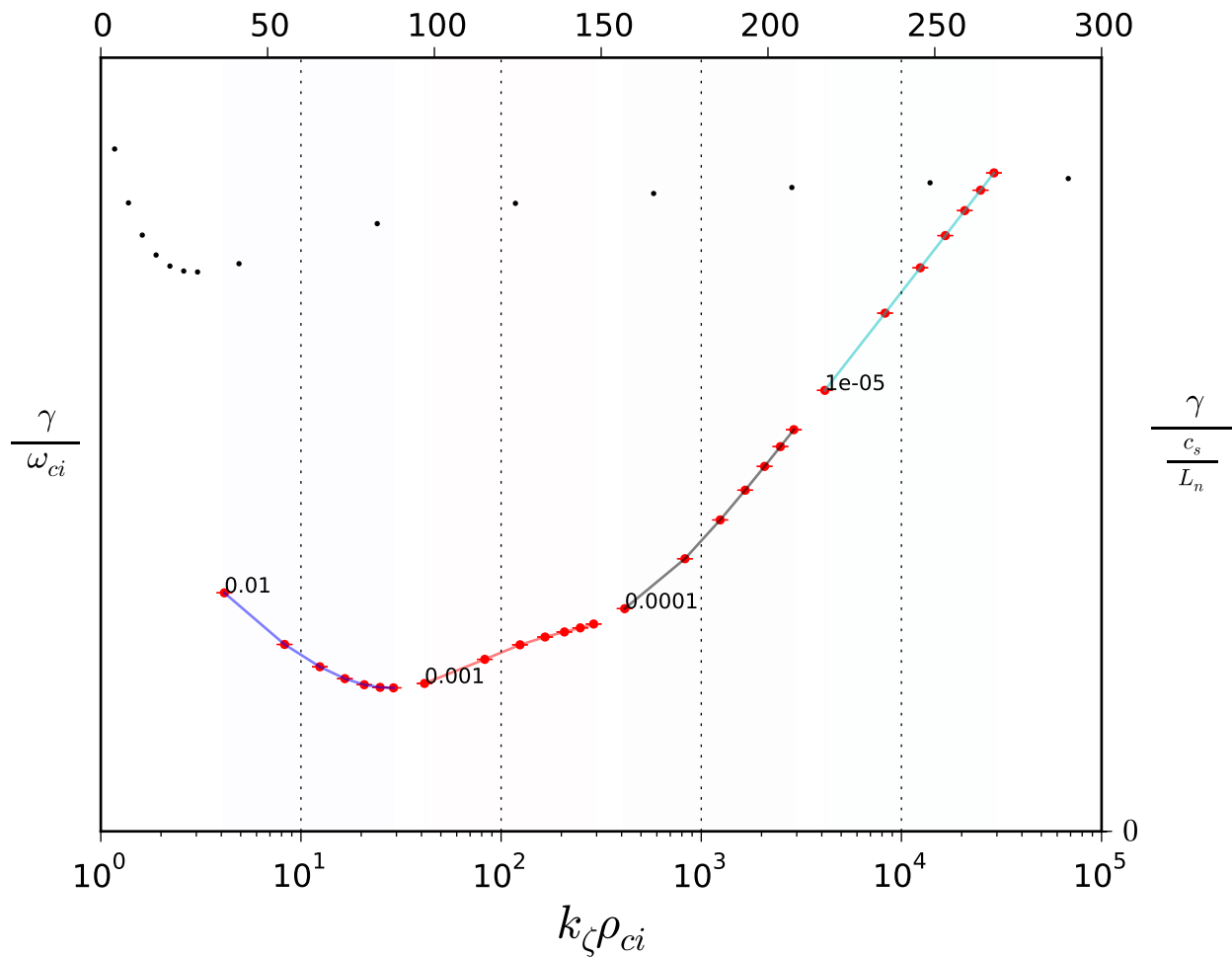
freq computed from Ni



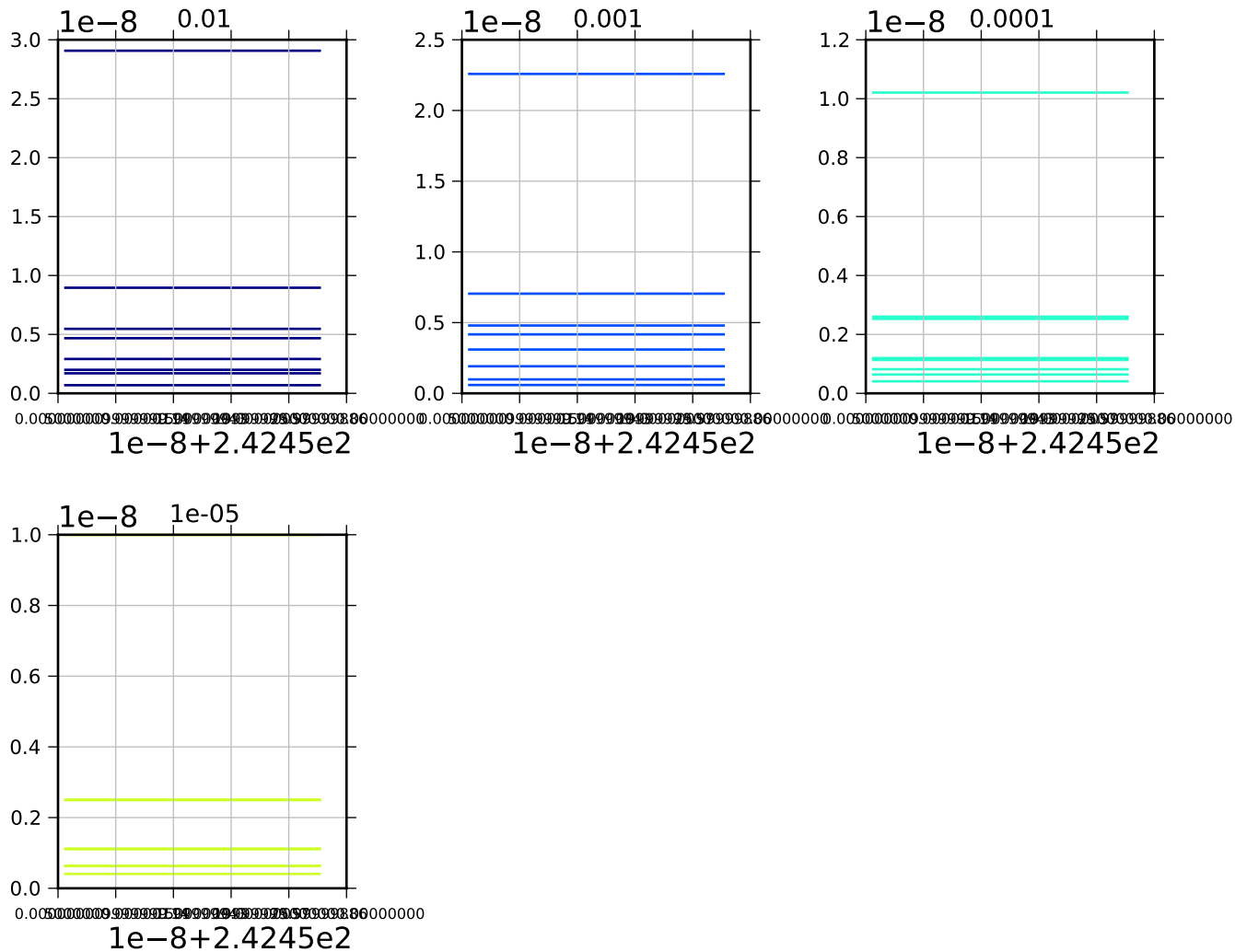
freq computed from rho



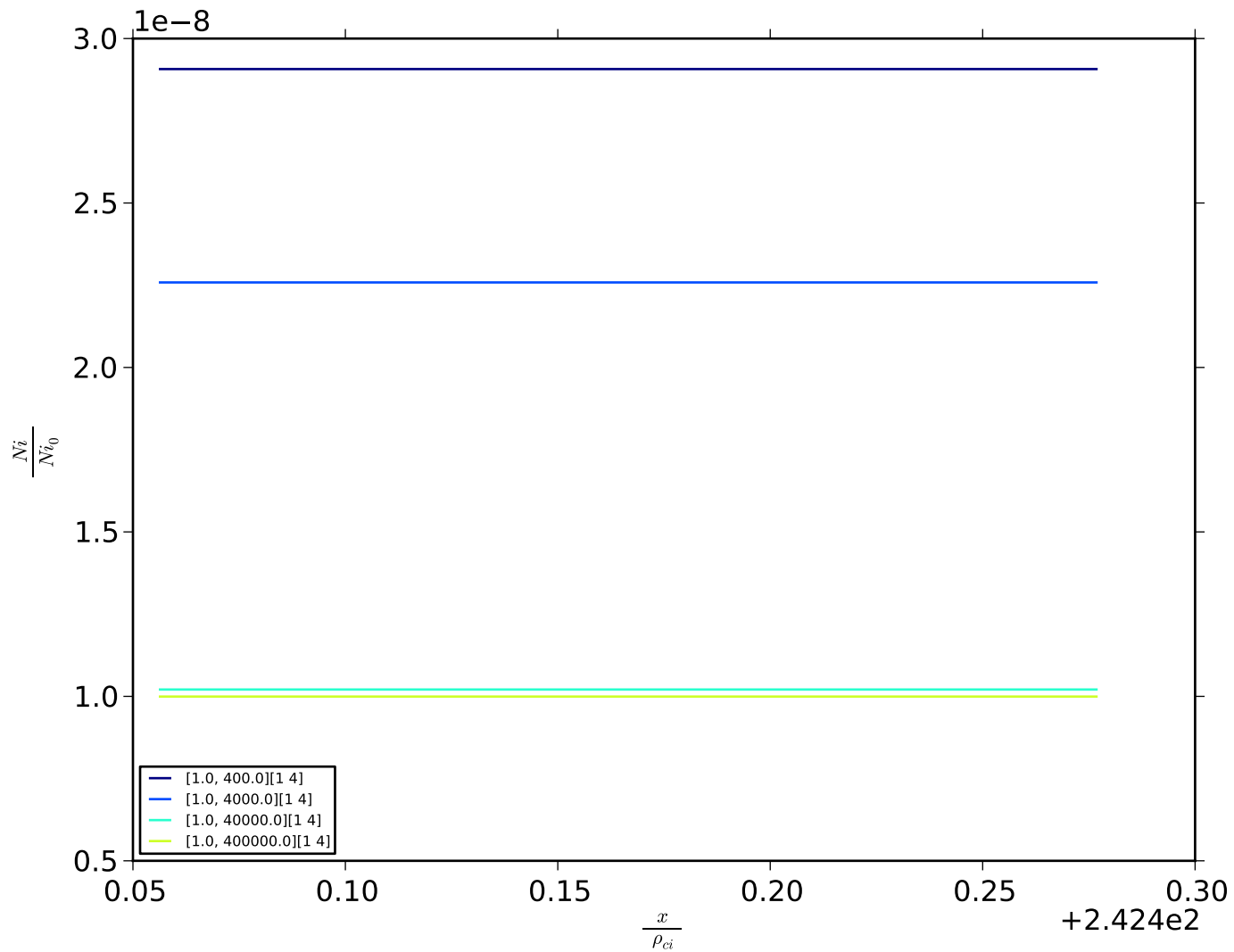
freq computed from Ni



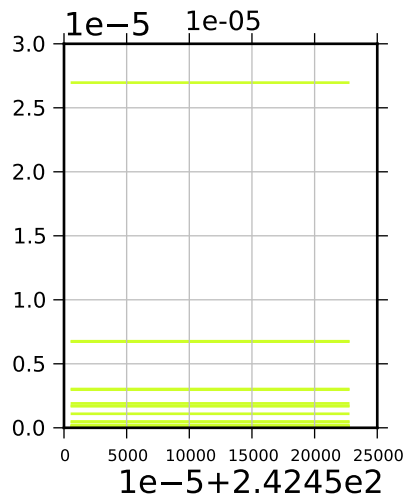
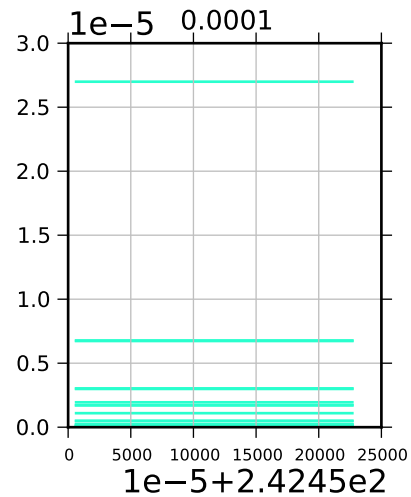
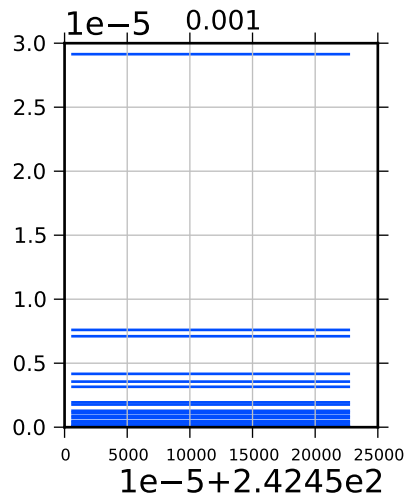
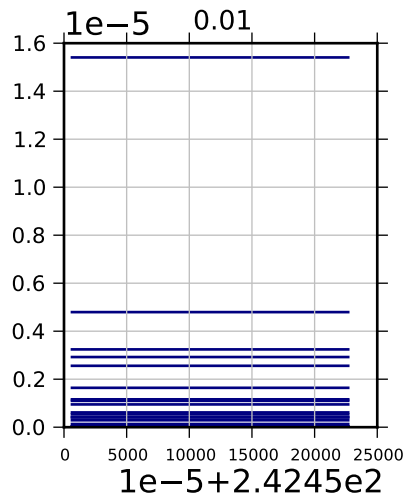
Dominant mode behavior for Ni



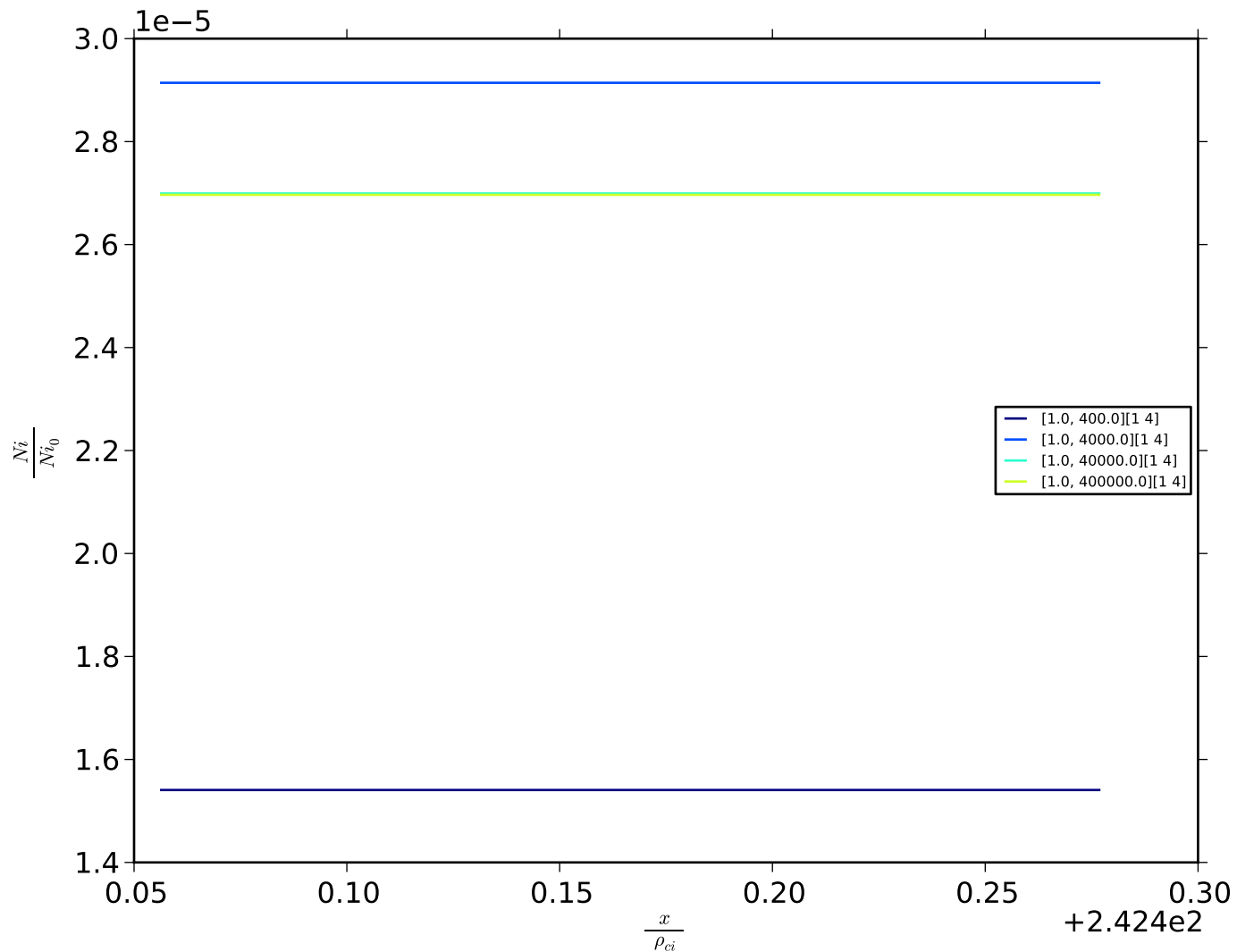
Dominant mode behavior for Ni



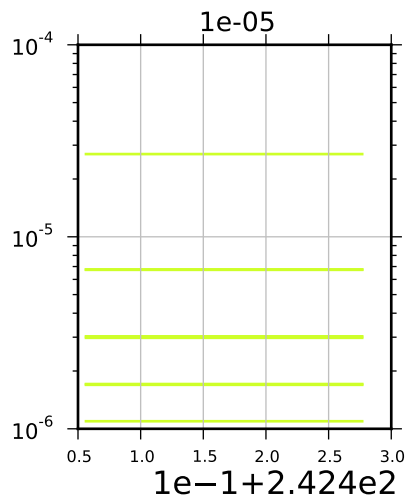
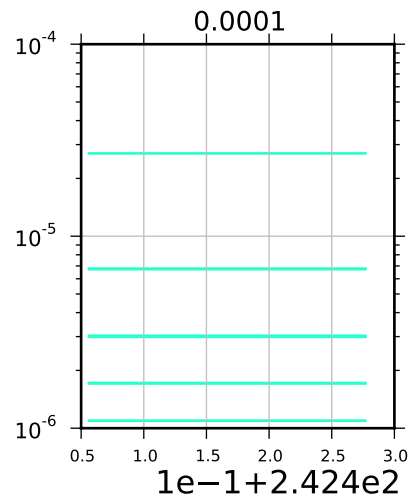
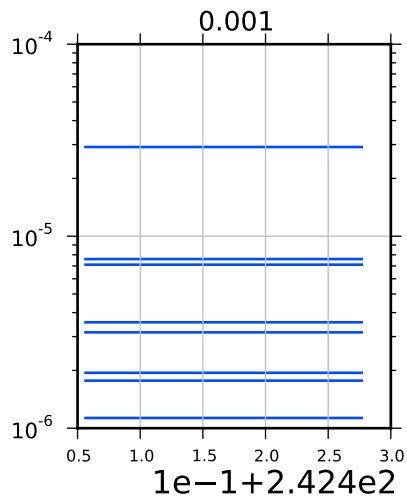
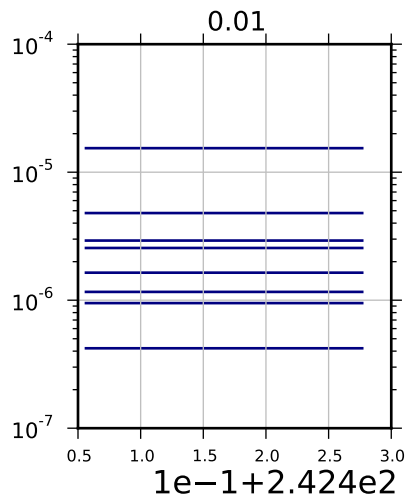
Dominant mode behavior for V_i



Dominant mode behavior for Vi



Dominant mode behavior for rho



Dominant mode behavior for rho

