```
" FILE M3 "

"PROGRAM : HO3 flow and mass functions"

"This file is the third one of the suite working out calculations reported in :
  Comments on MECHANICS and THERMODYNAMICS of the BERNOULLI OSCILLATORS Parts I
  and II, (Google search : FEDOA Comments on), by G. Mastrocinque - Department
  of Physics - Engineering Faculty - University of Naples Federico II"

"Warning : Before this one, please be sure you have
  run the programs HO3 FS wave equation solve  and HO3 SS wave
  equation solve in the same library to pick up input data"

"CALCULATION OF THE NUMERICAL FLOW FUNCTION"

<< Graphics`Legend`
Clear[ν, τττ]
"eq. (30) :"
"en =="
en = (n - 1 / 2) h νc
"enf =="
enf = n h νc
"eni =="
eni = (n - 1) h νc
"νn0 (eqs. (12),(61)) :"
νn0 = (enf - eni) / (cn h)
"the value we give to τn is (eq.(60)) :"
τττ = 0.11740293629878387`
"evaluate the flow function ν[ξ] in Region II (eq.(13)) :"
1/2 m (2 νν[ξ] / ρ[ξ]) ^2 == μμμ Sqrt[ρ[ξ]] - τττ cn h νν[ξ];
Solve[%, νν[ξ]];
Expand[Simplify[νν[ξ] /. %[[2]]]];
%[[1]] + Sqrt[Expand[%[[2]] ^2]]
"continuity condition in ξn (evaluate μμ, eq. (14)) :"
(%% /. ρ[ξ] → ρmaax) == νnn0
μμμsol = Solve[%, μμμ]
Simplify[PowerExpand[%%%% /. %[[1]]]];
μμ =
 Chop[Simplify[PowerExpand[(μμμsol[[1]][[1]][[2]] Sqrt[ρmaax] / (h νnn0))]]] HoldForm[h νnn0 / Sqrt[ρmaax]]
"simplify μμ (eq. (62)) : "
μμ = Simplify[PowerExpand[(μμμsol[[1]][[1]][[2]] /. ρmaax → ρmax /. νnn0 → νn0)]]
"calculate ν[ξ] (eqs. (11)÷(14), Fig. 8 ) : "
ν1[ξ_] = νn0 UnitStep[ξn - ξ] UnitStep[n - 2] + (1 - UnitStep[ξn - ξ])
   PowerExpand[%%%%% /. ρ[ξ] → ρmaax ρgn[ξ] /. ρmaax → ρmax /. νnn0 → νn0];
nν[ξ_] = PowerExpand[Simplify[% / νn0]];
Print["ν[ξ] div νn0 (Fig. 8):"]
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Plot[nν[ξ], {ξ, 0, 0.8 ξfin[n]}, AxesLabel → {ξ, ν[ξ]/ν_n0 }]

ν[ξ_] = ν1[ξ];

"CALCULATION OF THE MASS FUNCTION"

"meff[ξ] (eqs. (9), (15), Fig. 9) : "
meff[ξ_] = (ρmax ρgn[ξ] h derphig[ξ])/(2 2 π λλ νn0 nν[ξ]) + (cn h (ρmax ρgn[ξ] )^2)/(8 νn0 nν[ξ]);
Print["meff[ξ] div m == "]
Plot[meff[ξ] / m, {ξ, 0, ξfin[n]}]
"check eqs.(17), (63) :"
2 ρmax λλ NIntegrate[ρgn[ξ] meff[ξ] / m, {ξ, 0, ξfin[n]},
  AccuracyGoal → ∞, MinRecursion → 4, MaxRecursion → 1000000];
SetPrecision[%, 8]

"CALCULATION OF DELTAx"
Off[Part::"pspec"]
"choose a number of integration points :"
numpts = 300
tab = Table[- nν[ξ]/ρgn[ξ] Sign[meff[ξ] / meff[0] - 1] Sqrt[Sqrt[(meff[ξ] / meff[0] - 1) ^2]] ,
  {ξ, 0, ξfin[n], ξfin[n] / numpts}];
"integraate :"
ξfin[n] / numpts Sum[(tab[[i]]), {i, 1, qq}]
% /. qq → Round[ξn / ξfin[n] numpts];
tabdelx = Table[Exp[%% - %], {qq, 1, numpts, 1}];
"plot deltax (arbitrary units, Fig. 10) :"
ListPlot[tabdelx]
"SUITE OF CALCULATIONS : is in file HO3 velocity
  fields in the same library. Warning : the following programs
  need to use data provided by the present and previuos ones"
```

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CALCULATION OF THE NUMERICAL FLOW FUNCTION

eq. (30) :

en ==

$$\frac{5\, h\, \nu c}{2}$$

enf ==

$3\, h\, \nu c$

eni ==

$2\, h\, \nu c$

$\nu n0$ (eqs. (12),(61)) :

$0.885181\, \nu c$

the value we give to τ_n is (eq.(60)) :

0.117403

evaluate the flow function ν[ξ] in Region II (eq.(13)) :

$$-\frac{0.0331579\,h\,\rho[\xi]^2}{m}+\sqrt{\frac{0.5\,\mu\mu\,\rho[\xi]^{5/2}}{m}+\frac{0.00109945\,h^2\,\rho[\xi]^4}{m^2}}$$

continuity condition in ξn (evaluate μμ, eq. (14)) :

$$-\frac{0.0331579\,h\,\rho maax^2}{m}+\sqrt{\frac{0.5\,\mu\mu\,\rho maax^{5/2}}{m}+\frac{0.00109945\,h^2\,\rho maax^4}{m^2}}==\nu nn0$$

$$\{\{\mu\mu\to\frac{1}{\rho maax^3}\left(4.80793\times10^{-28}\left(4.15979\times10^{27}\,m\,\nu nn0^2\sqrt{\rho maax}+2.7586\times10^{26}\,h\,\nu nn0\,\rho maax^{5/2}+\frac{5.69889\times10^{8}\,h^2\,\rho maax^{9/2}}{m}\right)\right)\}\}$$

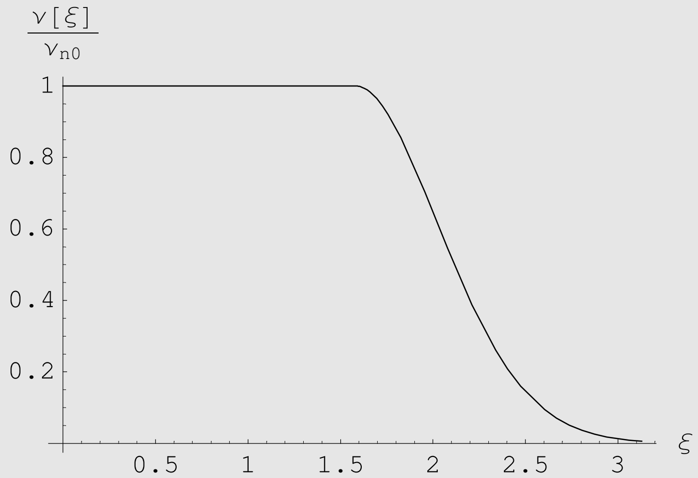
$$\left(0.132632+\frac{2.\,m\,\nu nn0}{h\,\rho maax^2}\right)\frac{h\,\nu nn0}{\sqrt{\rho maax}}$$

simplify μμ (eq. (62)) :

$$\frac{0.278696\,h^{5/4}\,\nu c^{3/4}}{m^{1/4}}$$

calculate ν[ξ] (eqs. (11)÷(14), Fig. 8) :

ν[ξ] div νn0 (Fig. 8):

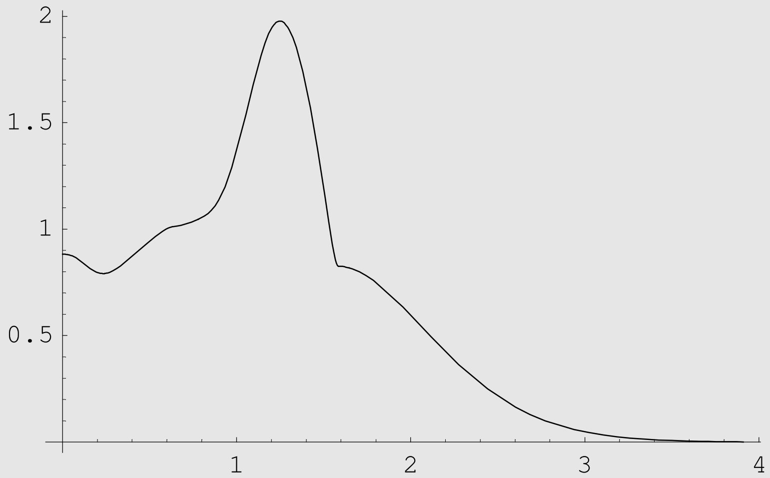


- Graphics -

CALCULATION OF THE MASS FUNCTION

meff[ξ] (eqs. (9), (15), Fig. 9) :

meff[ξ] div m ==



- Graphics -

check eqs.(17), (63) :

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0.99999766
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CALCULATION OF DELTAx

choose a number of integration points :

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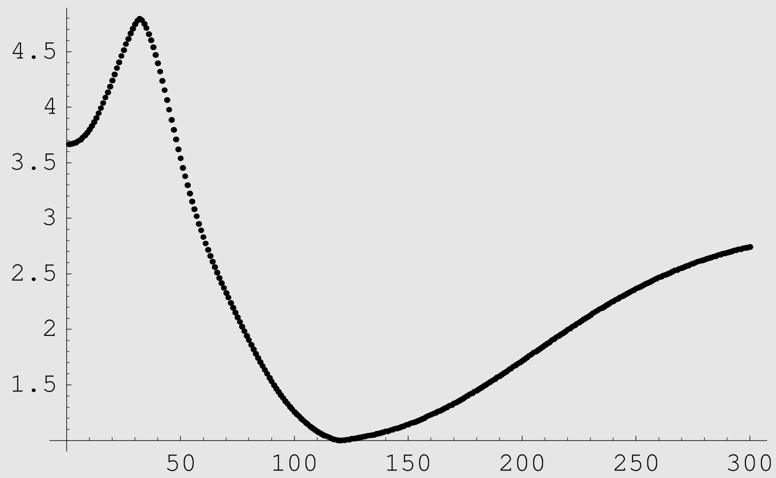
300
```

integraate :

$0.0130371 \sum_{i=1}^{qq} tab[[i]]$

plot deltax (arbitrary units, Fig. 10) :



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- Graphics -
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SUITE OF CALCULATIONS : is in file HO3 velocity fields in the same library. Warning : the following programs need to use data provided by the present and previuos ones