" **FILE M1** "

"PROGRAM : HO3 FS wave eq solve"

"This file initiates a suite of programs 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"

"These *Comments* refer to the papers : "

"Annales de la Fondation de Broglie 36, 91 (2011) (http://aflb.ensmp.fr/AFLB-361/aflb361m726.pdf) "
"and "
"Annales de la Fondation de Broglie 36, 159 (2011) (http://aflb.ensmp.fr/AFLB-361/aflb361m727.pdf)"

"Numerical example : Harmonic oscillator, n == 3; math calculations relative to eqs. (29)÷(43) in the *Comments*"

"FIRST STEP CALCULATIONS"

```
Off[General::"spell"]
Off[General::"spell1"]
```

"INPUT DATA (cf. eqs. (31)÷(38),(55))"

```
n = 3
```

$$\lambda\lambda = \frac{\sqrt{h}}{2\sqrt{m}\,\pi\sqrt{\nu c}}$$

```
ξn = 1.5811388300841898`
cn = 1.1901196373307197`
ρmax = 0.371461 / λλ
σn = 2.1363708827170136` λλ^2
ξfin[n] = 3.9111226611226613`
"equations to be solved :(39),(40) ⟹"
derphi[ξ_] =
```

$$2\,\pi\,\frac{cn\,\rho max\,\lambda\lambda}{4}\left(\frac{1}{\rho n[\xi]} - \rho n[\xi] + \frac{\sigma n\,(cn-1)}{\lambda\lambda^2\,\rho n[\xi]}\left(\partial_\xi \rho n[\xi]\sqrt{(\partial_\xi \rho n[\xi])^2}\right)\right) \text{UnitStep}[\xi n - \xi];$$

```
eq39 = derphi[ξ]^2 == 5 - ξ^2 + Expand[
```

$$\frac{\partial_\xi \partial_\xi \sqrt{\rho n[\xi]}}{\sqrt{\rho n[\xi]}}]$$

```
"END INPUT DATA"
"keep in memory :"
cn0 = cn
ρmax0 = ρmax
σn (cn0 - 1) / λλ^2

"SOLVE"
solveq =
 NDSolve[{eq39, ρn[ξn] == 1, ρn'[ξn] == 0}, ρn, {ξ, 0, ξfin[n]}, MaxSteps → 100000]
```

```
"RESULTS"
"density, normalised to max value ρmax (Fig. 1) :"
ρ1n[ξ_] = Evaluate[ρn[ξ] /. solveq][[1]];
Plot[ρ1n[ξ], {ξ, 0, ξfin[n]}, AxesLabel → {ξ, ϱ1n[ξ]}]
"derivative in ξ = 0 (eq. (41)) :"
ρ1n'[0]
"density norm (eq. (2)) :"
norm = 2 λλ ρmax NIntegrate[ρ1n[ξ], {ξ, 0, ξfin[n]},
   AccuracyGoal -> ∞, MinRecursion -> 4, MaxRecursion -> 1000000]
"phase derivative φ1'[ξ] (Fig. 2) :"
derphi1[ξ_] = Evaluate[derphi[ξ] /. solveq][[1]];
Plot[derphi1[ξ], {ξ, 0, 1.1 ξn}, AxesLabel → {ξ, φ1'[ξ]}]
"phase difference over a round trip (eq.(43)) :"
fasdif = 4 NIntegrate[derphi1[ξ], {ξ, 0, ξfin[n]},
   AccuracyGoal → ∞, MinRecursion → 4, MaxRecursion → 1000000];
fasdif / (2 π) HoldForm[2 π]
"(relative) phase error compared to expected value of eq. (43):"
relfas = Simplify[(fasdif - (n - 1) 2 π) / ((n - 1) 2 π)]

"SUITE OF CALCULATIONS : is in file HO3 SS wave eq solve in the same library.
  Warning : the following programs use data provided by the present one"
```

FILE M1

PROGRAM : HO3 FS wave eq solve

This file initiates a suite of programs 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

These *Comments* refer to the papers :

Annales de la Fondation de Broglie 36, 91
(2011) (http://aflb.ensmp.fr/AFLB-361/aflb361m726.pdf)

and

Annales de la Fondation de Broglie 36, 159
(2011) (http://aflb.ensmp.fr/AFLB-361/aflb361m727.pdf)

Numerical example : Harmonic oscillator, n == 3;
math calculations relative to eqs. (29)÷(43) in the *Comments*

FIRST STEP CALCULATIONS

INPUT DATA (cf. eqs. (31)÷(38),(55))

```
3
```

$$\frac{\sqrt{h}}{2\sqrt{m}\,\pi\sqrt{\nu c}}$$

```
1.58114
```

```
1.19012
```

$$\frac{2.33396\sqrt{m}\,\sqrt{\nu c}}{\sqrt{h}}$$

$$\frac{0.0541149\,h}{m\,\nu c}$$

```
3.91112
```

equations to be solved :(39),(40) ⟹

$$0.482222\,\text{UnitStep}[1.58114-\xi]^2\left(\frac{1}{\rho n[\xi]}-\rho n[\xi]+\frac{0.406166\,\rho n'[\xi]\sqrt{\rho n'[\xi]^2}}{\rho n[\xi]}\right)^2 ==$$
$$5-\xi^2-\frac{\rho n'[\xi]^2}{4\,\rho n[\xi]^2}+\frac{\rho n''[\xi]}{2\,\rho n[\xi]}$$

END INPUT DATA

keep in memory :

1.19012

$$\frac{2.33396\sqrt{m}\ \sqrt{\nu c}}{\sqrt{h}}$$

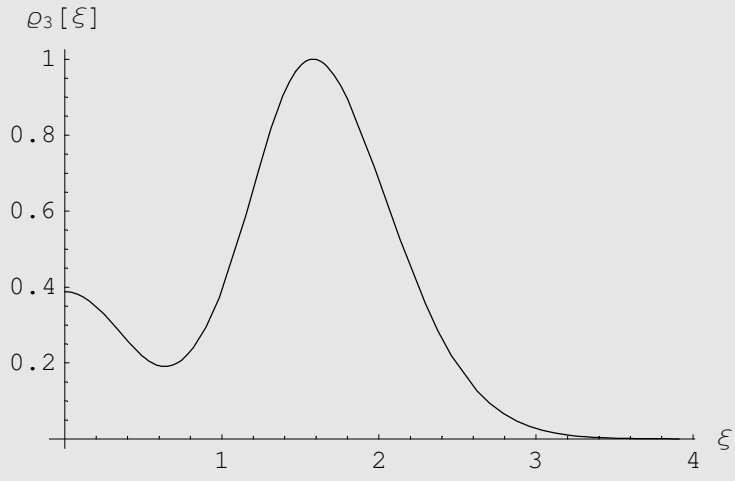
0.406166

SOLVE

{{ρn → InterpolatingFunction[{{0., 3.91112}}, <>]}}

RESULTS

density, normalised to max value ρmax (Fig. 1) :



- Graphics -

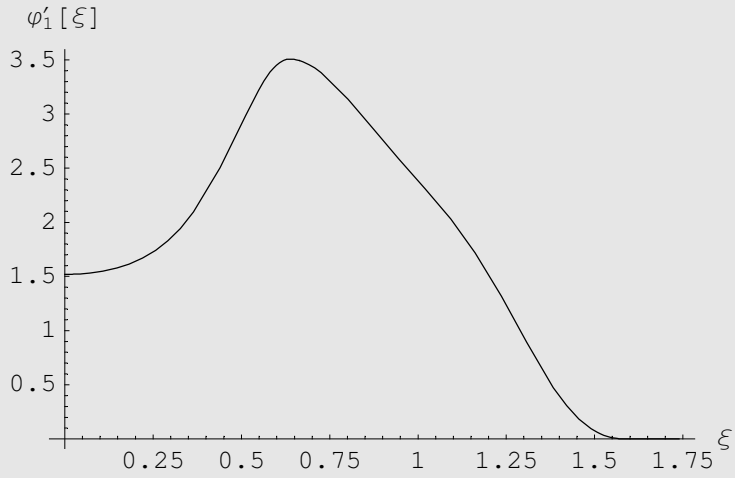
derivative in ξ = 0 (eq. (41)) :

2.70866×10^{-6}

density norm (eq. (2)) :

1.

phase derivative $\varphi_1'[\xi]$ (Fig. 2) :



- Graphics -

phase difference over a round trip (eq.(43)) :

1.97856 (2 π)

(relative) phase error compared to expected value of eq. (43):

-0.0107177

```
SUITE OF CALCULATIONS : is in file HO3 SS wave eq solve in the same library.
  Warning : the following programs use data provided by the present one
```