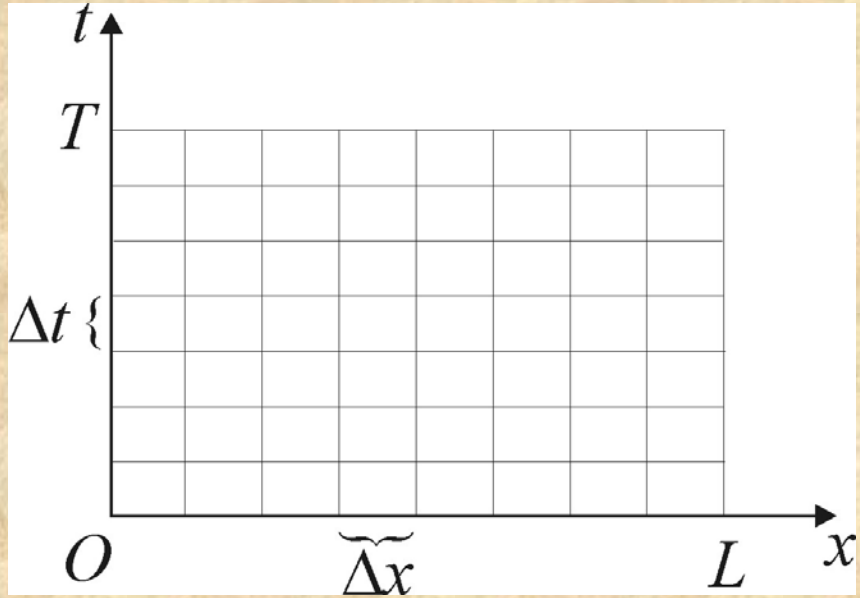
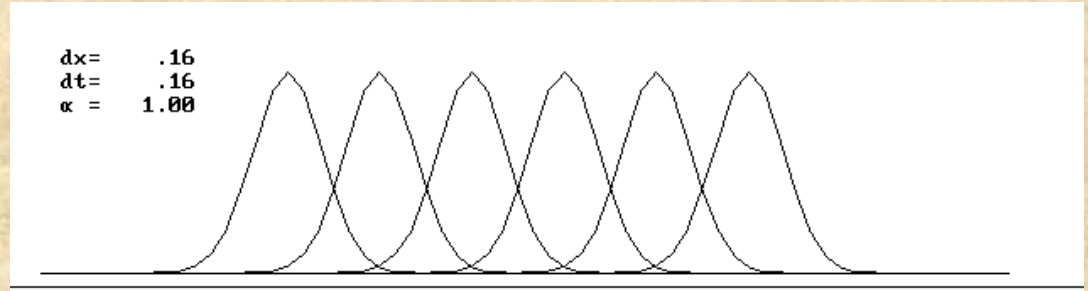
Уравнение переноса

$$\frac{\partial y}{\partial t} + V\frac{\partial y}{\partial x} = f(x,t), \quad y(x,0) = \varphi(x),$$

$$y(0,t) = \psi(t).$$



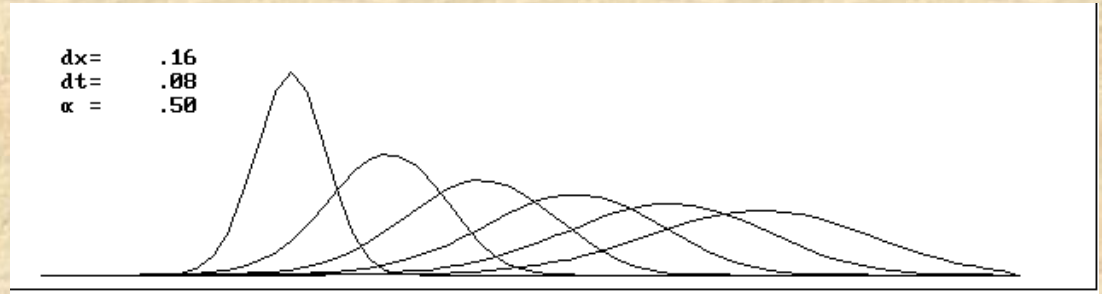
Дисперсия и диффузия на сетке



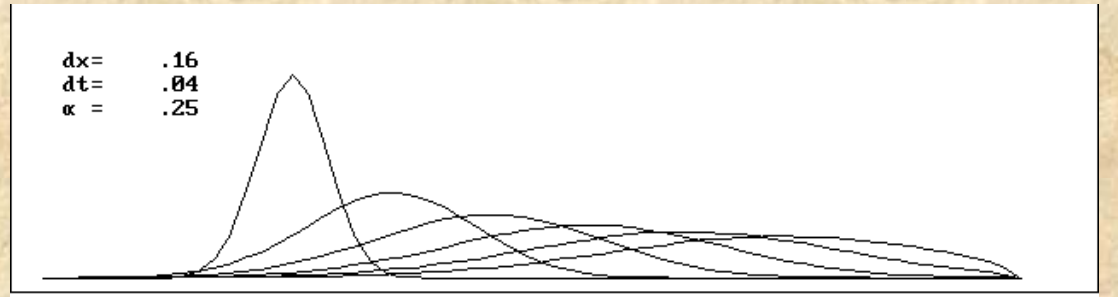

```
To select parameters use keys <↓>,<↑>
To vary  parameters  use keys <→>,<←>

  Solution by   Lax method
Grid size L=10, integration time T=5
  Spatial step number  N=      64
 Temporal step number M=       32
  Degree of steepness  p=       1
  After selection press <Enter>
  To view the solution press <S>
     Quit to main menu <Esc>
```


```
To select parameters use keys <↓>,<↑>
To vary  parameters  use keys <→>,<←>

  Solution by   Lax method
Grid size L=10, integration time T=5
  Spatial step number  N=      64
 Temporal step number M=       40
  Degree of steepness  p=       1
  After selection press <Enter>
  To view the solution press <S>
     Quit to main menu <Esc>
```

Дисперсия и диффузия на сетке




```
To select parameters use keys <↓>,<↑>
To vary  parameters  use keys <→>,<←>

  Solution by   Lax method
Grid size L=10, integration time T=5
 Spatial step number  N=      64
  Temporal step number M=      64
  Degree of steepness  p=       1
  After selection press <Enter>
  To view the solution press <S>
     Quit to main menu <Esc>
```




```
To select parameters use keys <↓>,<↑>
To vary  parameters  use keys <→>,<←>

  Solution by   Lax method
Grid size L=10, integration time T=5
  Spatial step number  N=      64
 Temporal step number M=     127
  Degree of steepness  p=       1
  After selection press <Enter>
  To view the solution press <S>
     Quit to main menu <Esc>
```

Дисперсия и диффузия на сетке

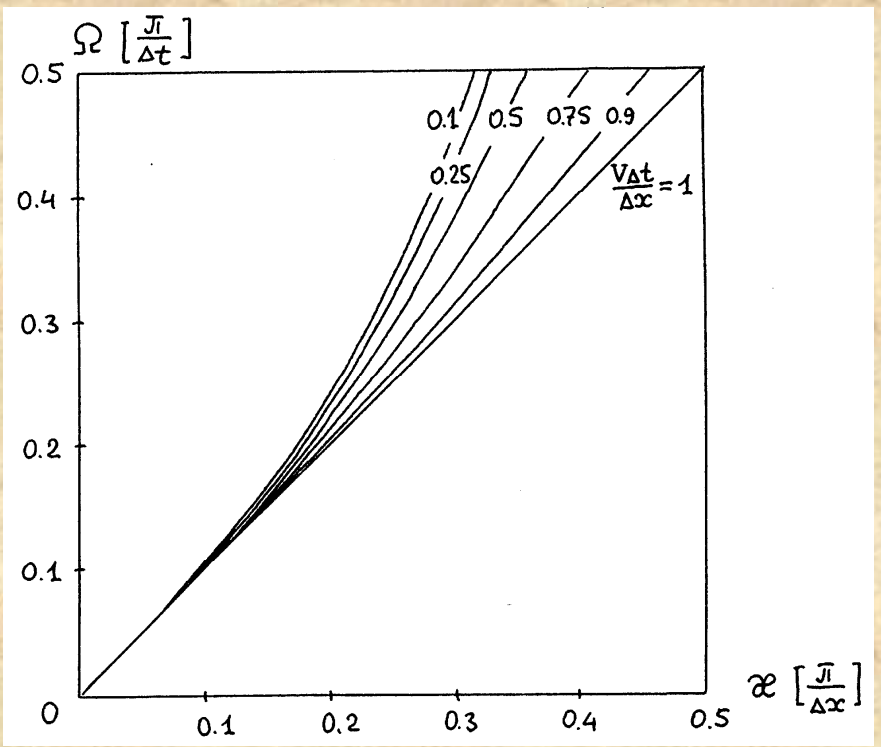
Схема Лакса: $\omega = \Omega + i\gamma,\ \alpha = \dfrac{V \cdot \Delta t}{\Delta x}$

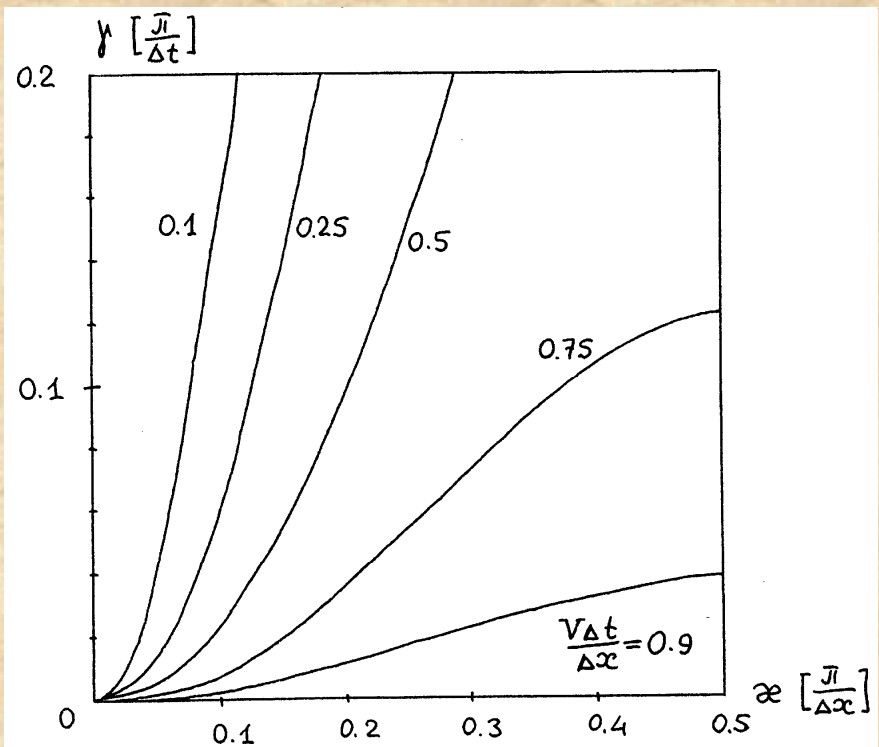
Дисперсия

$$\mathrm{tg}(\Omega \cdot \Delta t) = \alpha\, \mathrm{tg}(\kappa \cdot \Delta x),$$

Диффузия

$$\exp(-2\gamma \cdot \Delta t) = \cos^2(\kappa \cdot \Delta x) + \\ + \alpha^2 \sin^2(\kappa \cdot \Delta x).$$





Дисперсия и диффузия на сетке

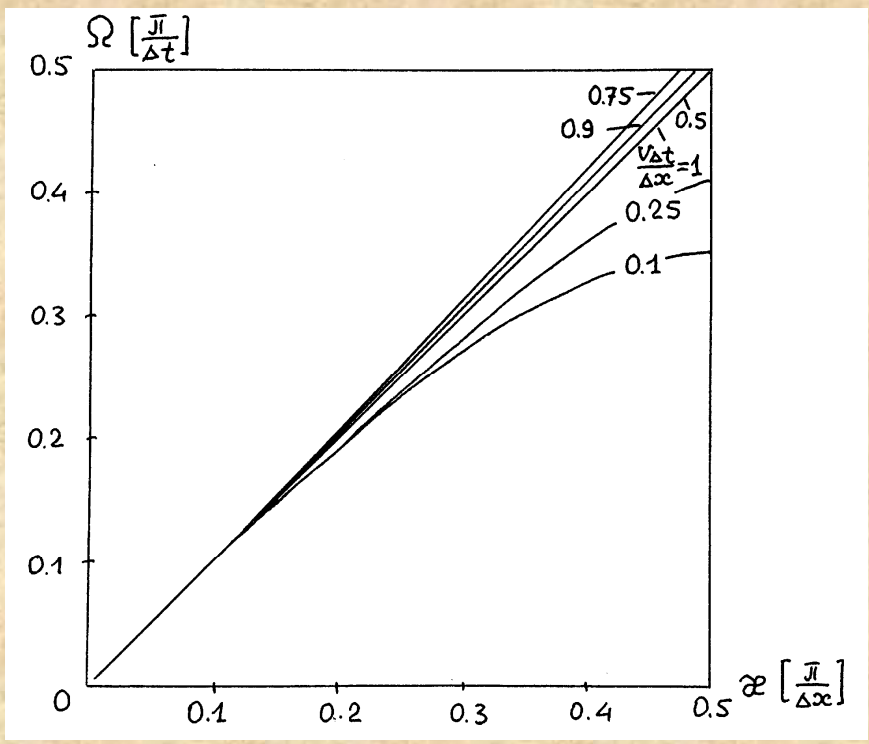
Схема бегущего счета: $\omega = \Omega + i\gamma,\ \alpha = \dfrac{V \cdot \Delta t}{\Delta x}$

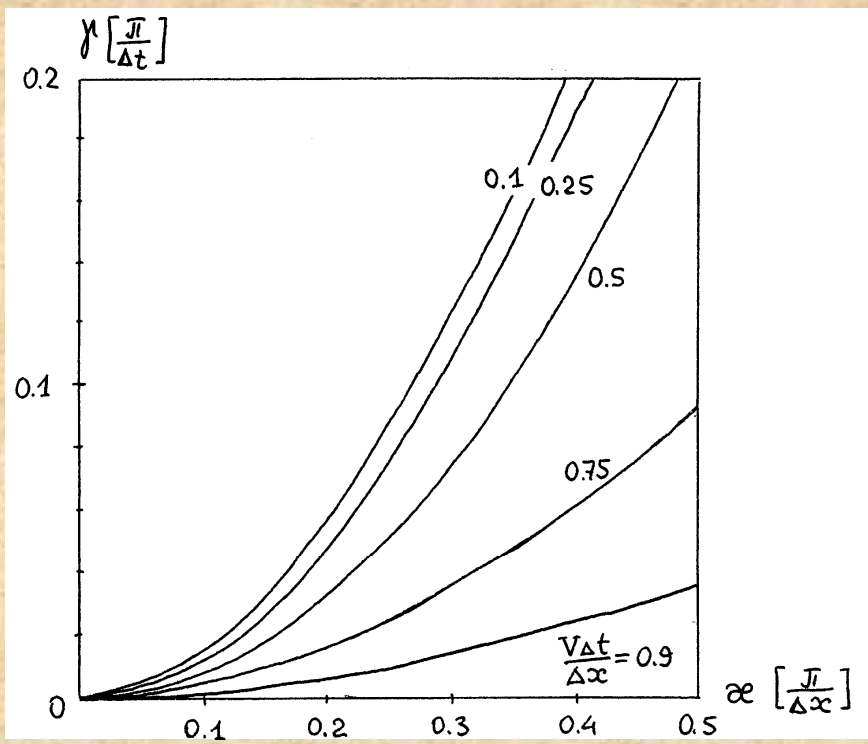
Дисперсия

$$\operatorname{tg}(\Omega \cdot \Delta t) = \frac{\alpha \sin(\kappa \cdot \Delta x)}{1 - \alpha\left(1 - \cos(\kappa \cdot \Delta x)\right)},$$

Диффузия

$$\exp(-2\gamma \cdot \Delta t) = 1 - 2\alpha(1-\alpha) \times$$
$$\times\left(1 - \cos(\kappa \cdot \Delta x)\right).$$



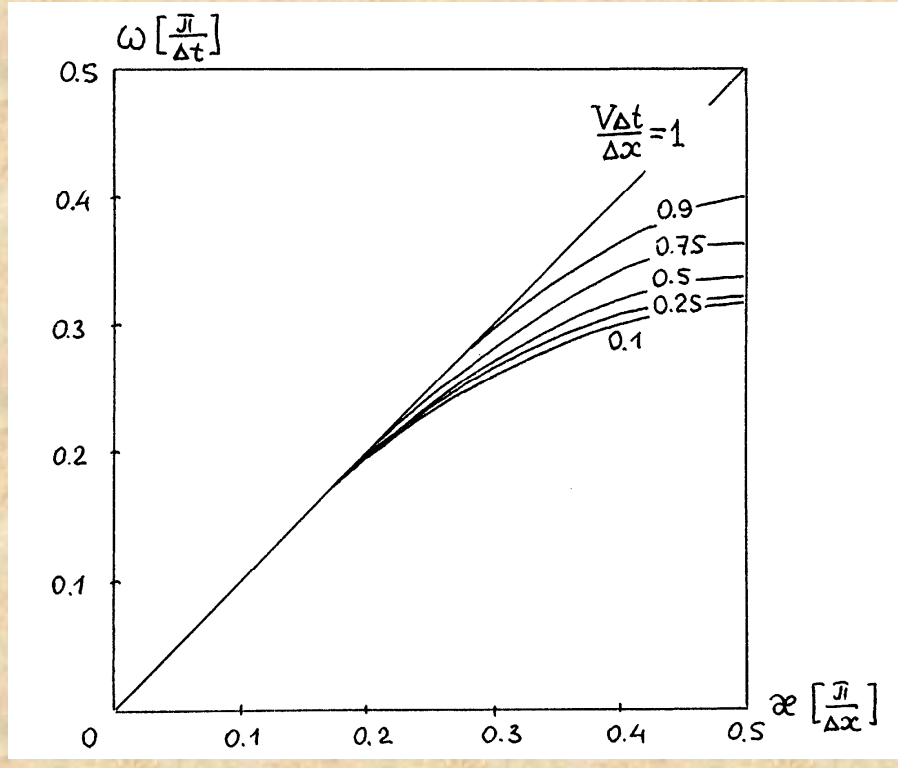


Дисперсия и диффузия на сетке

Схема с перешагиванием: $\alpha = \dfrac{V \cdot \Delta t}{\Delta x}$

Дисперсия

$$\sin(\omega \cdot \Delta t) = \alpha \sin(\kappa \cdot \Delta x).$$



Дисперсия и диффузия на сетке

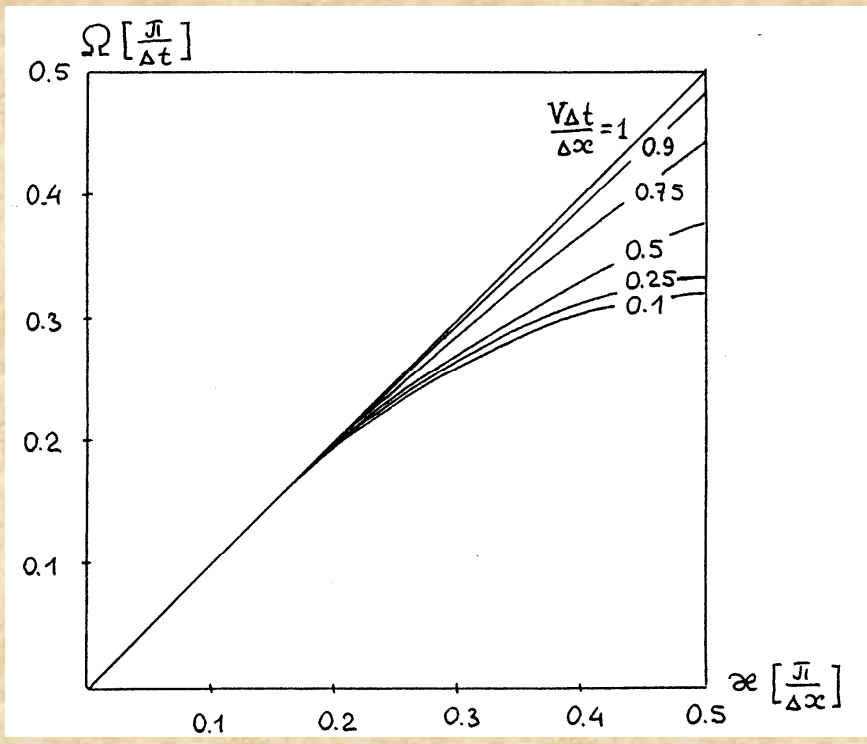
Метод Лакса-Ведроффа: $\omega = \Omega + i\gamma, \quad \alpha = \dfrac{V \cdot \Delta t}{\Delta x}$

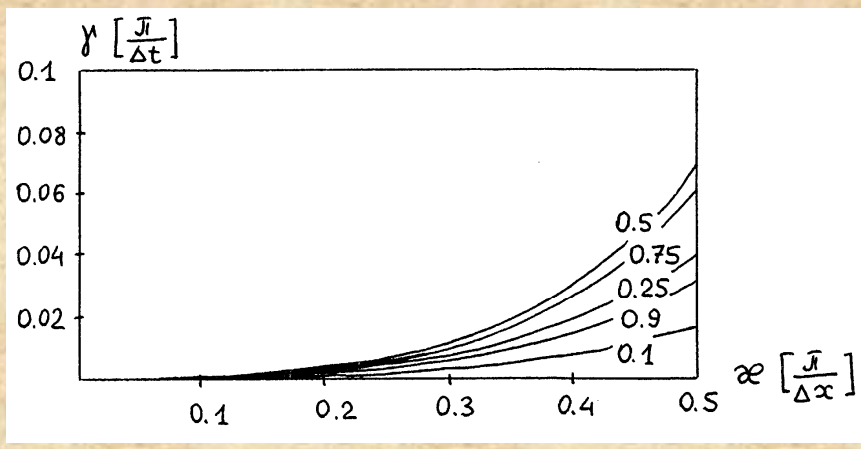
Дисперсия

$$\operatorname{tg}(\Omega \cdot \Delta t) = \frac{\alpha \sin(\kappa \cdot \Delta x)}{1 - \alpha^2 \left(1 - \cos(\kappa \cdot \Delta x)\right)}$$

Диффузия

$$\exp(-2\gamma \cdot \Delta t) = 1 - \alpha^2 (1 - \alpha^2) \times$$
$$\times \left(1 - \cos(\kappa \cdot \Delta x)\right)$$






DOSBox 0.74.lnk

Уравнение переноса

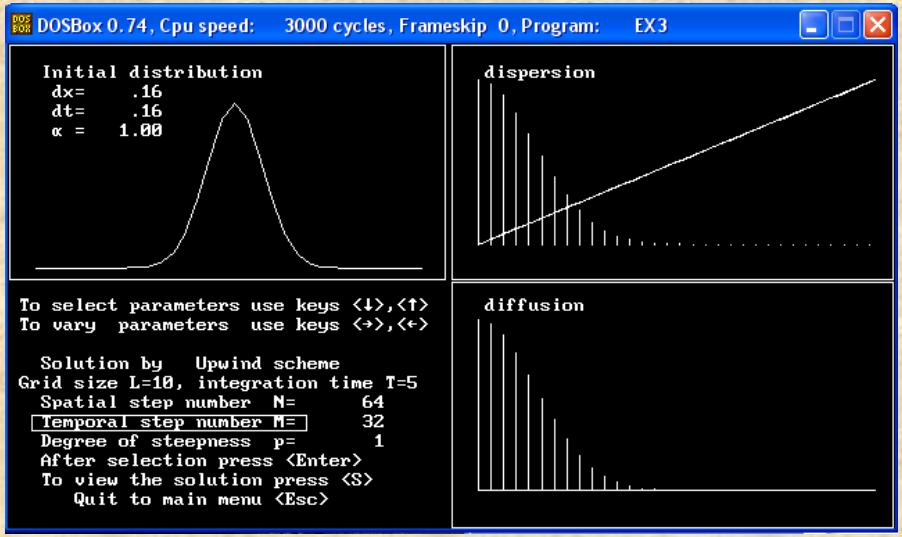
$$\frac{\partial y}{\partial t} + V\frac{\partial y}{\partial x} = 0, \quad y(x,0) = \exp\left(-\left(x - \frac{L}{4}\right)^{2p}\right),$$

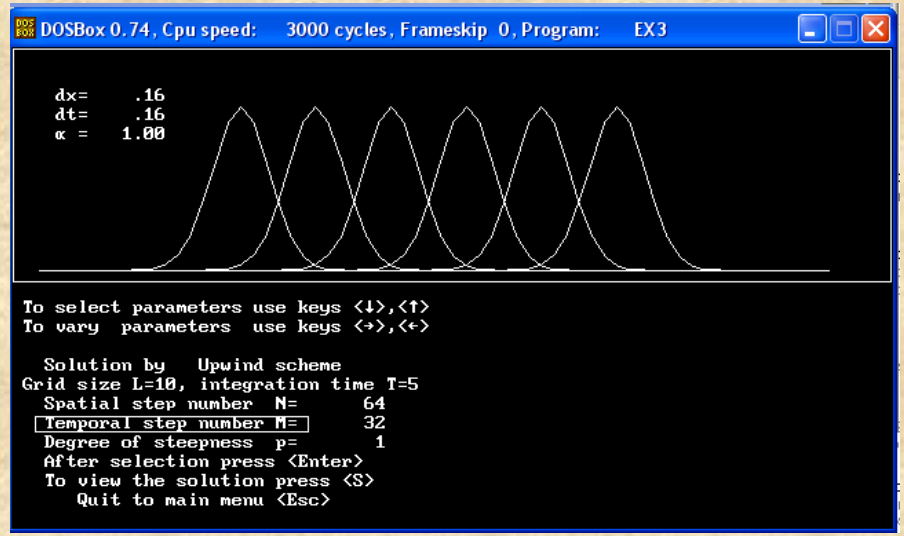
$$y(0,t) = 0.$$

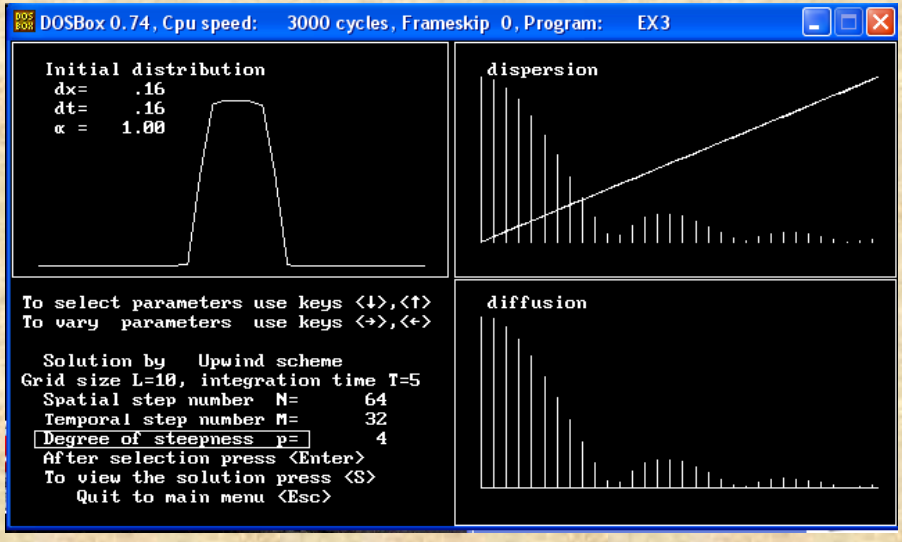
Методы решения:

1. **Схема бегущего счета (upwind)**
2. **Метод Лакса**
3. **Метод Лакса-Вендроффа**

Схема бегущего счета







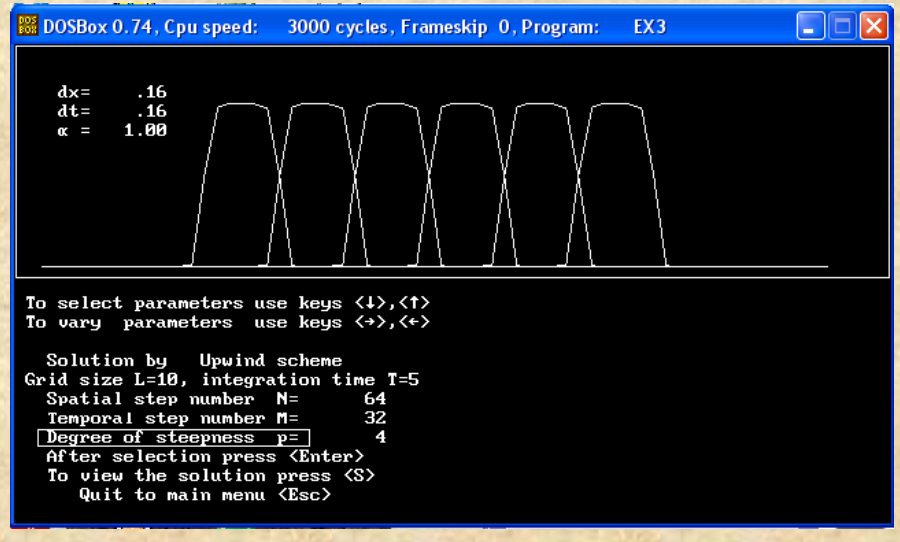
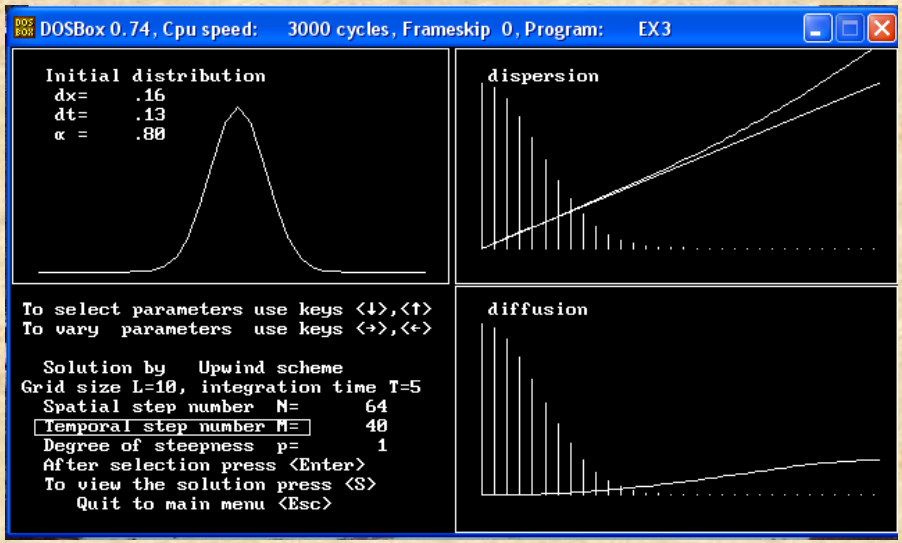
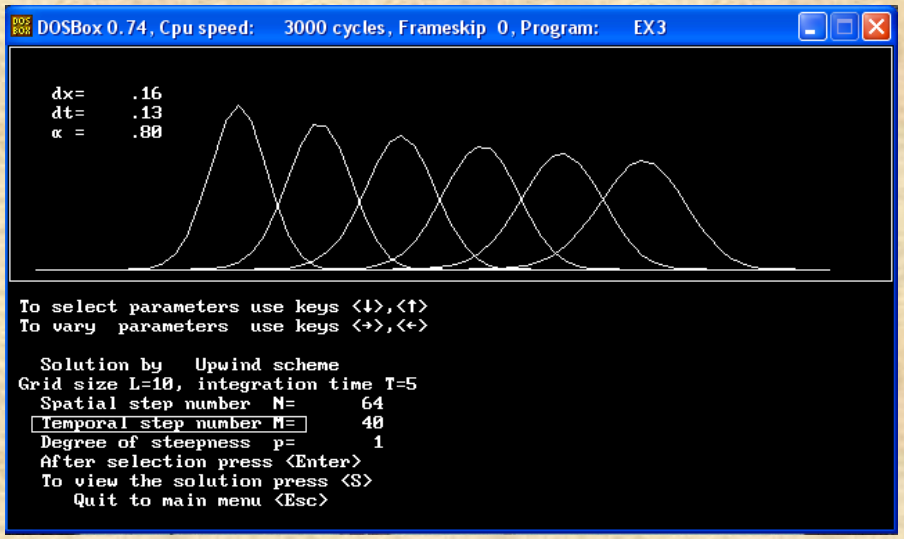
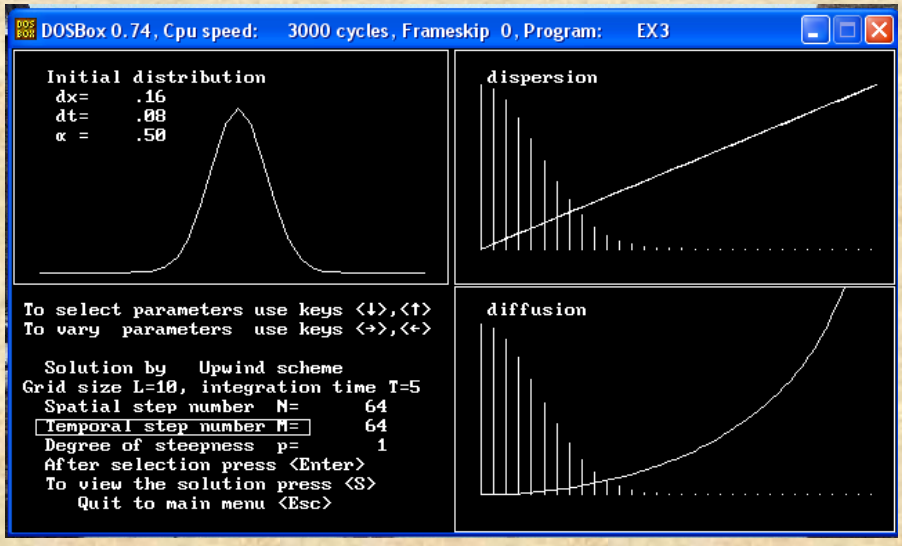


Схема бегущего счета







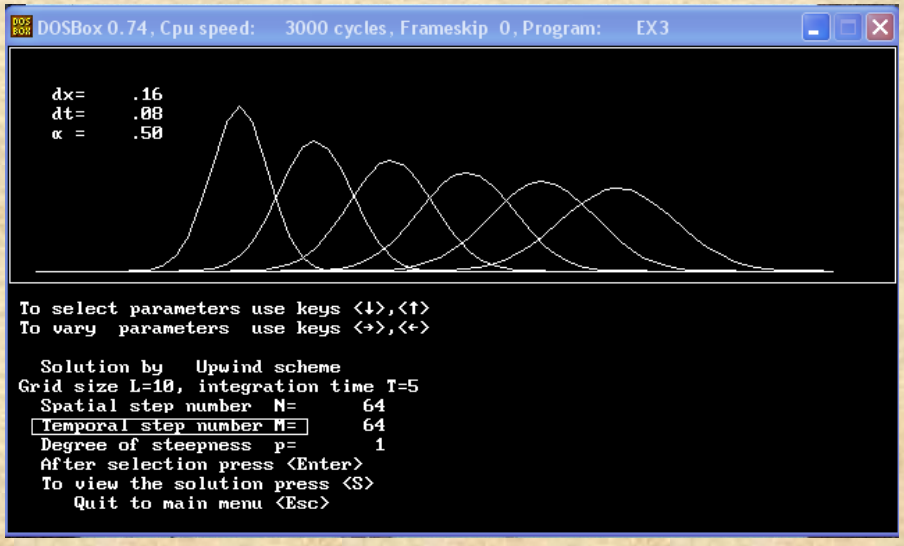
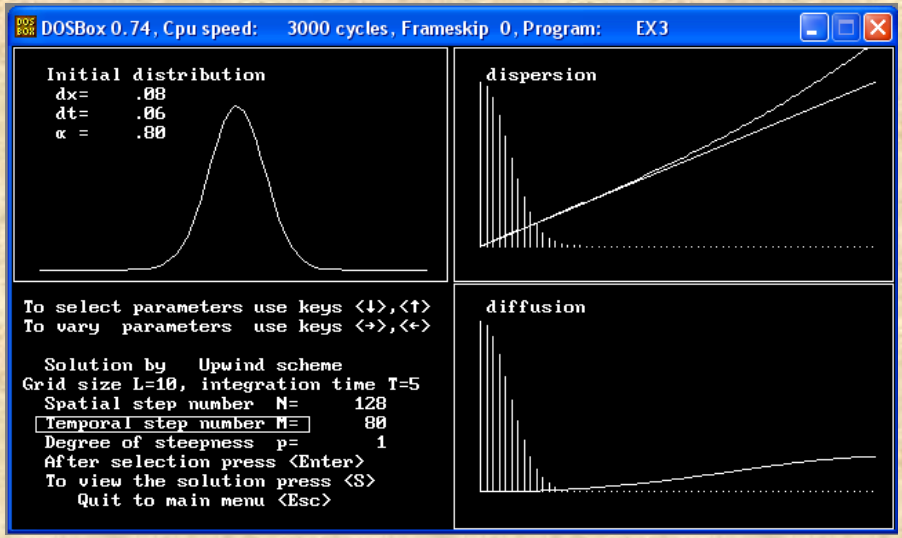
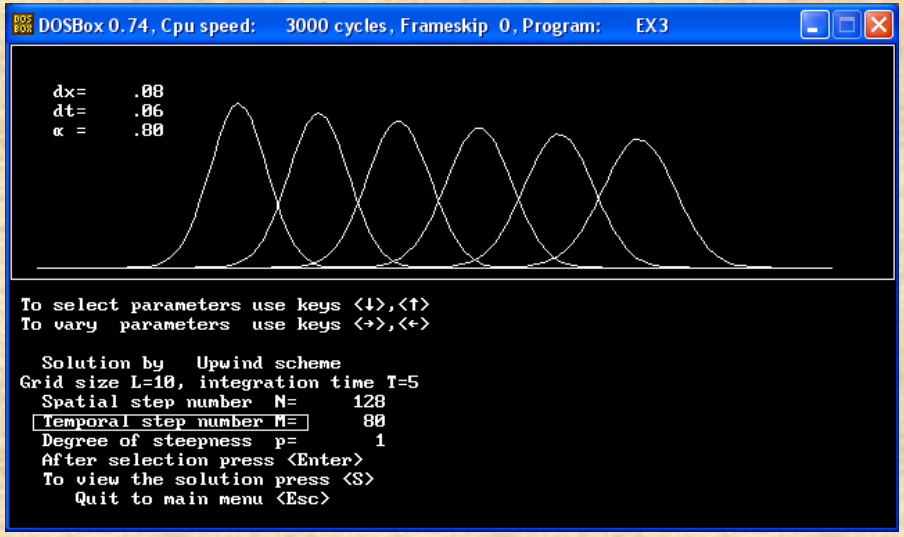
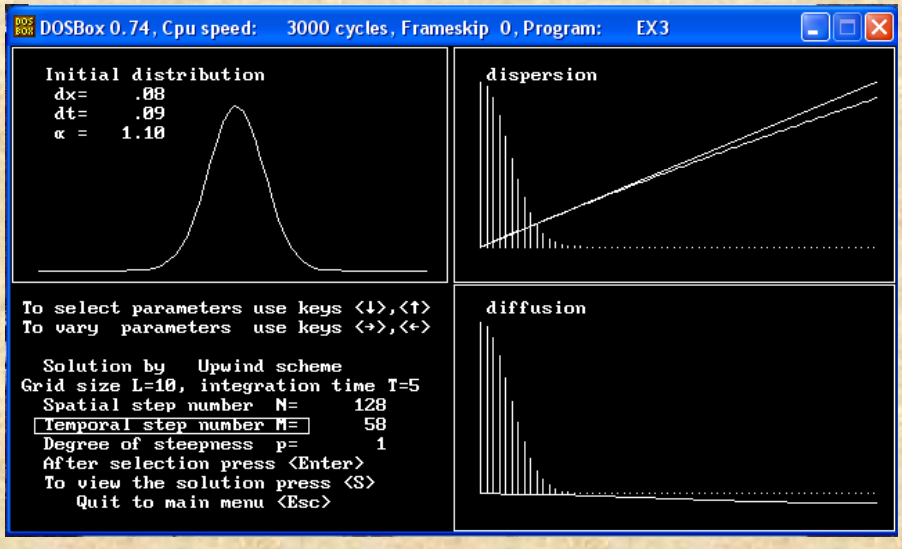


Схема бегущего счета







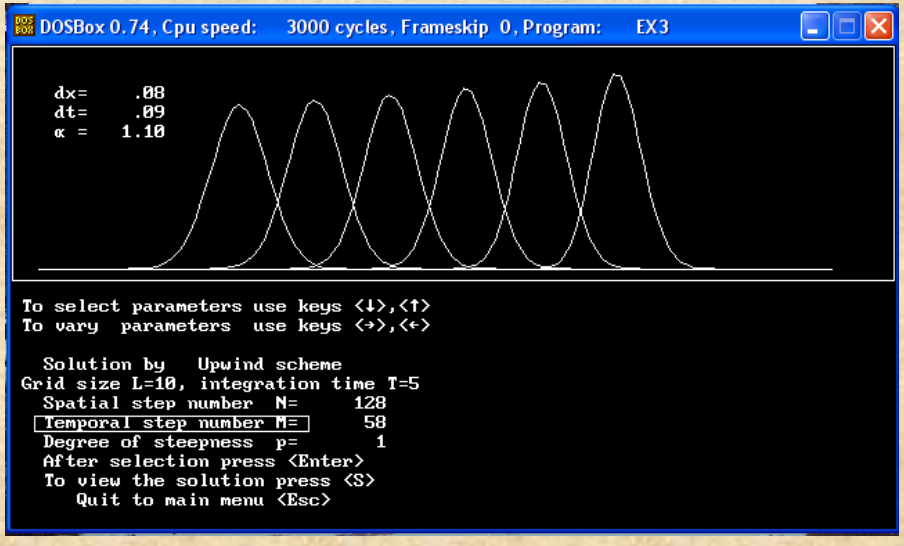
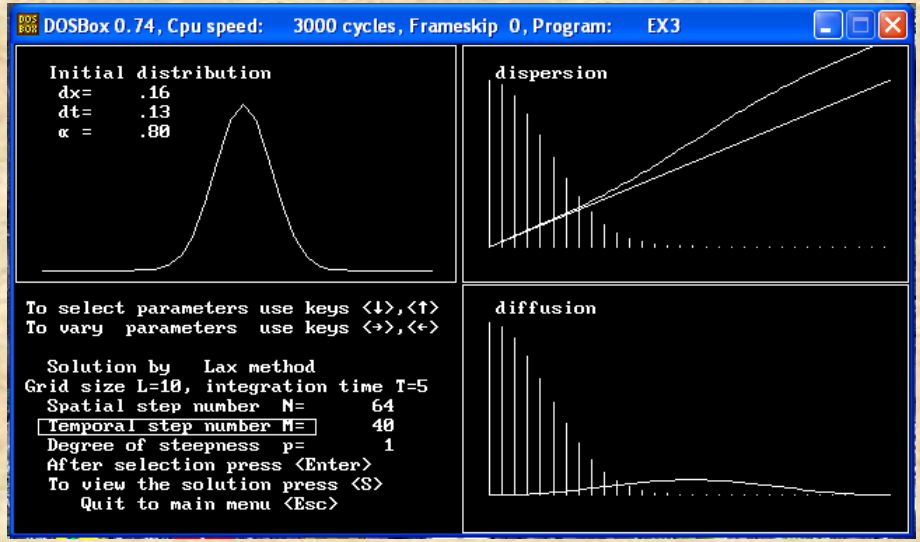
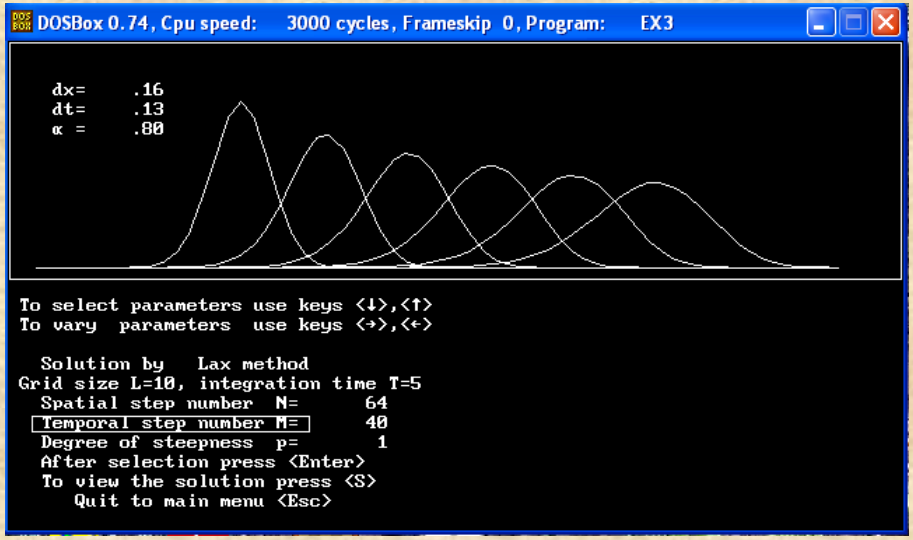
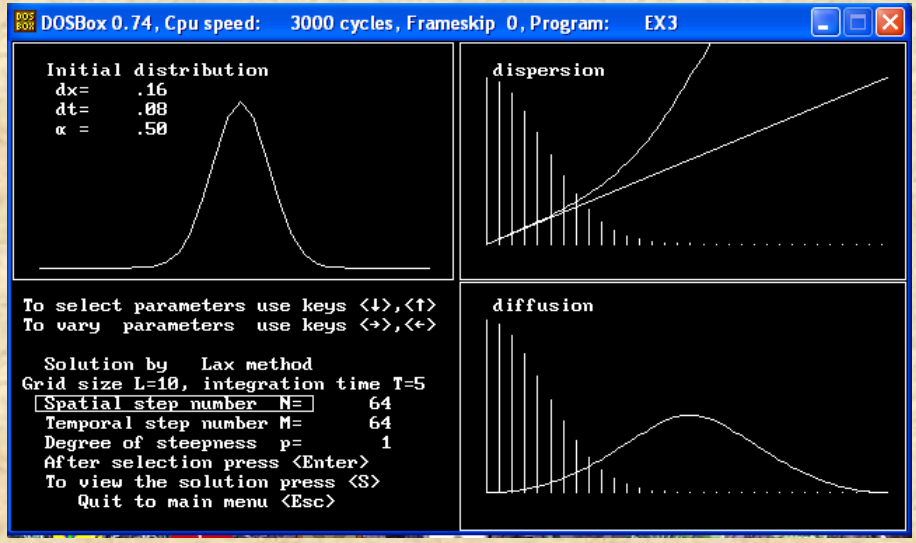


Схема Лакса


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .16
dt= .13
α = .80
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 40
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .16
dt= .13
α = .80
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 40
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .16
dt= .08
α = .50
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 64
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

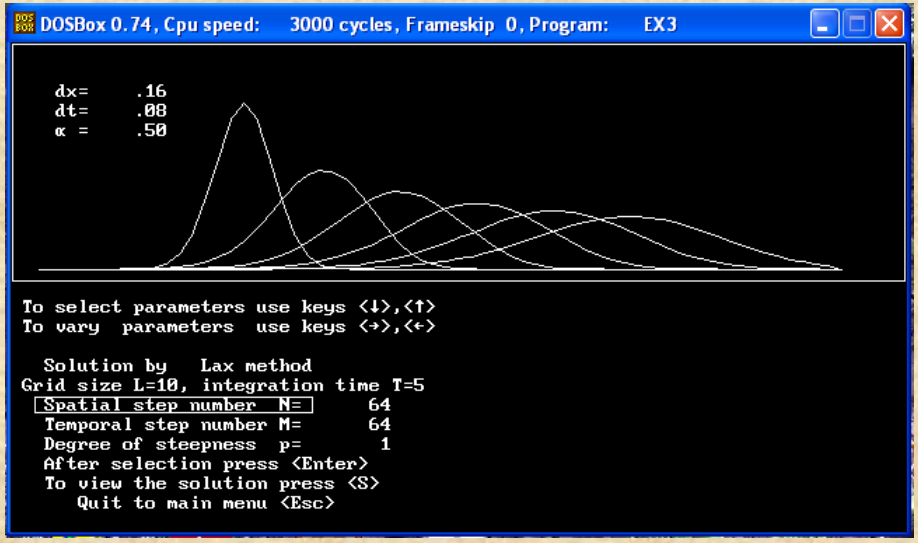
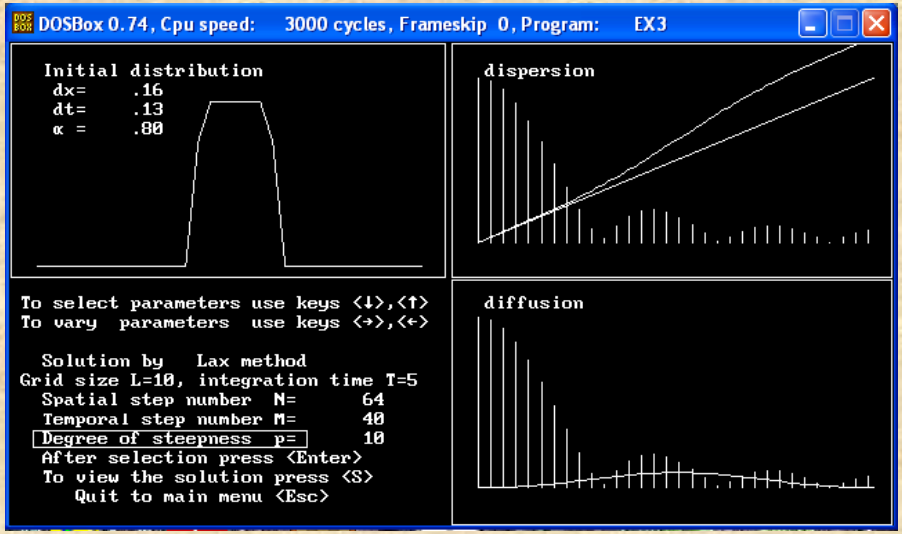
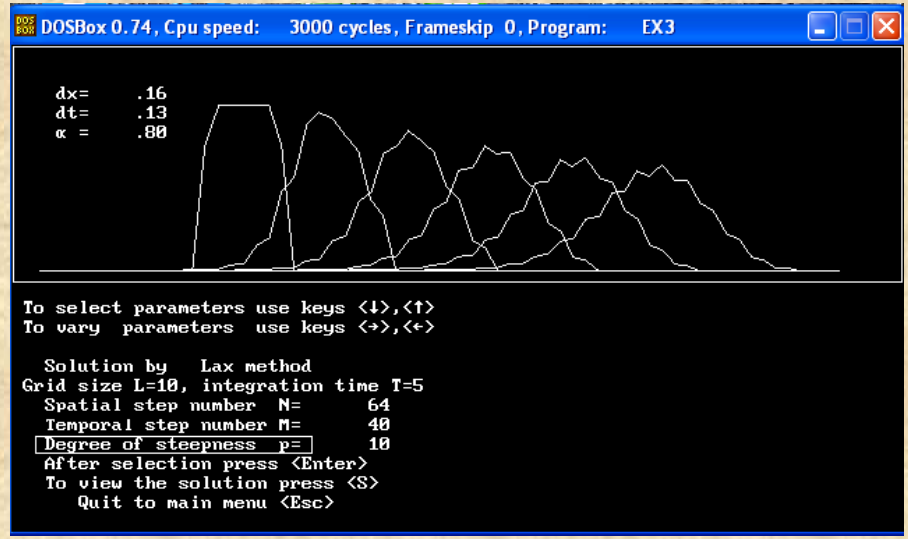
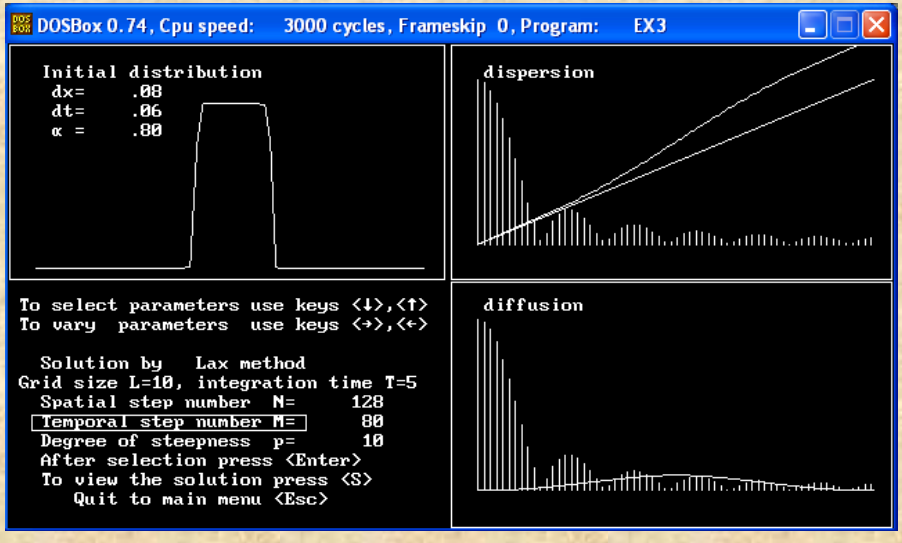

DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .16
dt= .08
α = .50
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 64
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

Схема Лакса


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .16
dt= .13
α = .80
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 40
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .16
dt= .13
α = .80
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 40
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .08
dt= .06
α = .80
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 80
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

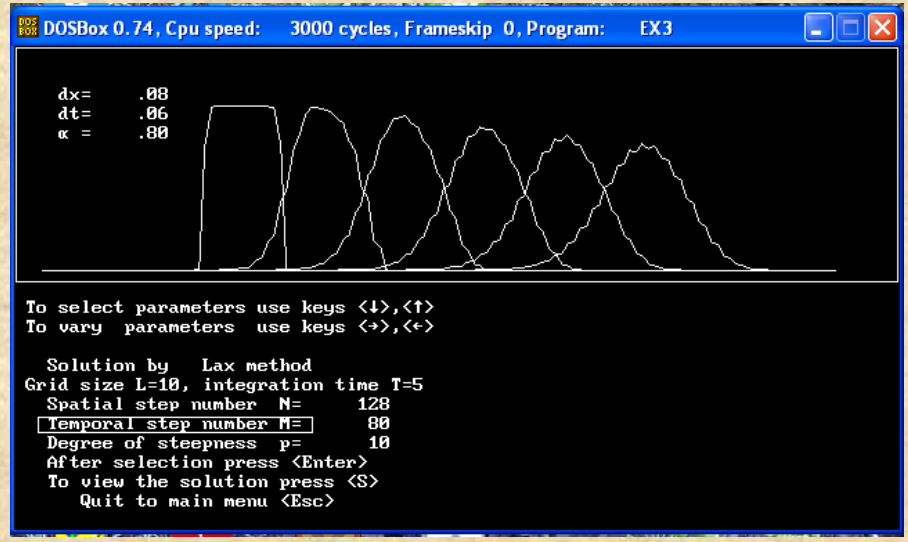
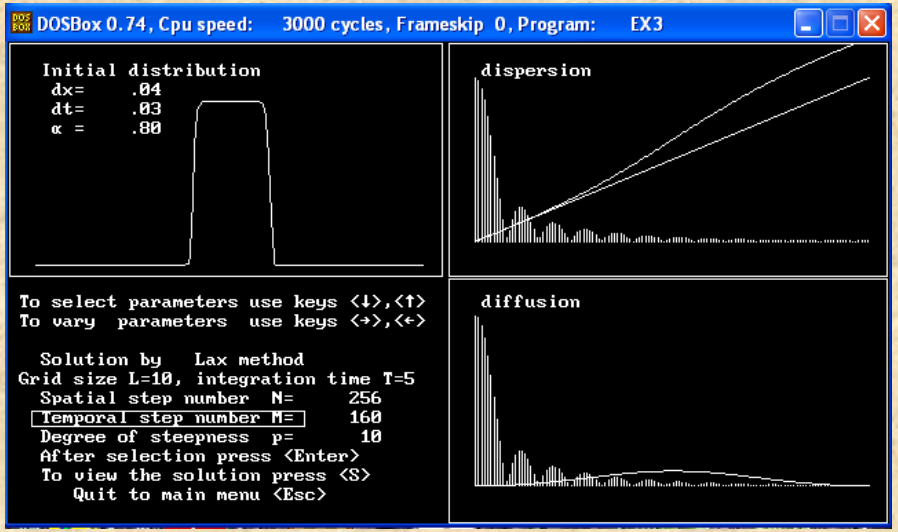
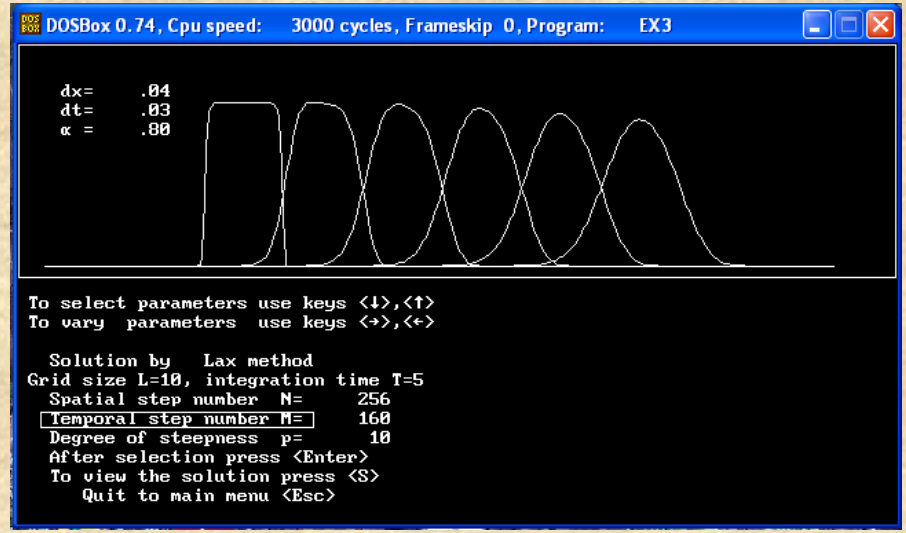
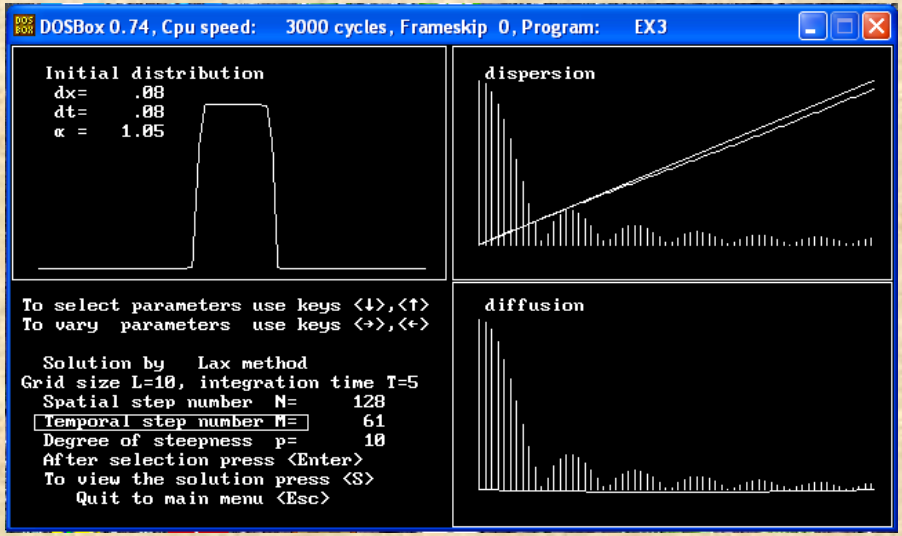

DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .08
dt= .06
α = .80
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 80
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

Схема Лакса


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .04
dt= .03
α = .80
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 256
Temporal step number M= 160
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .04
dt= .03
α = .80
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 256
Temporal step number M= 160
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .08
dt= .08
α = 1.05
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 61
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

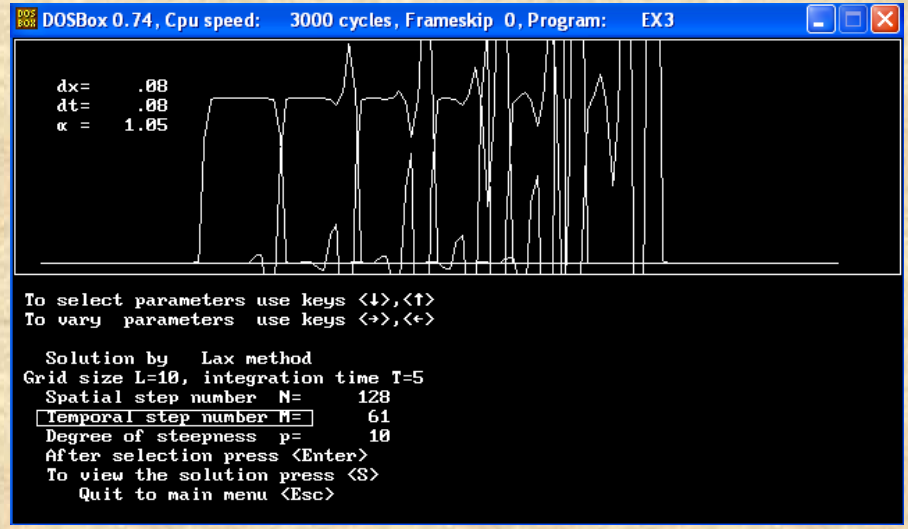
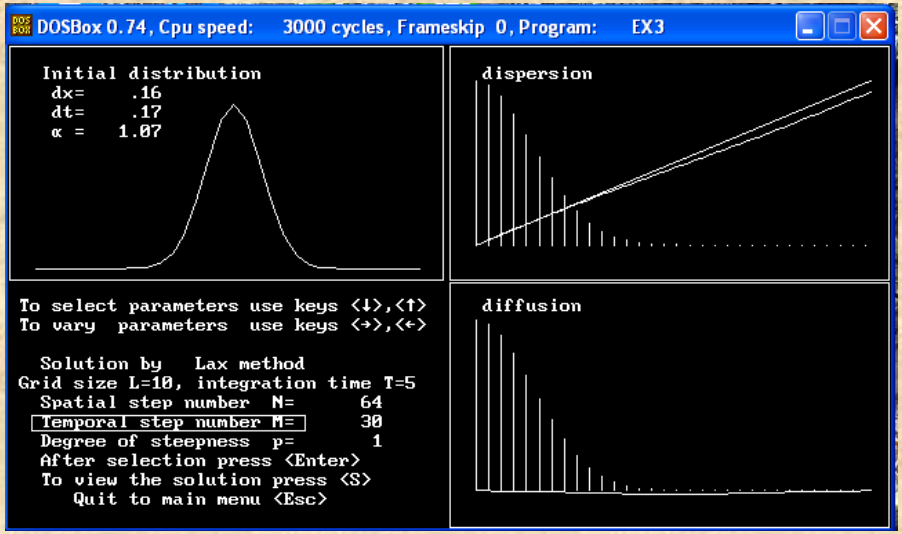
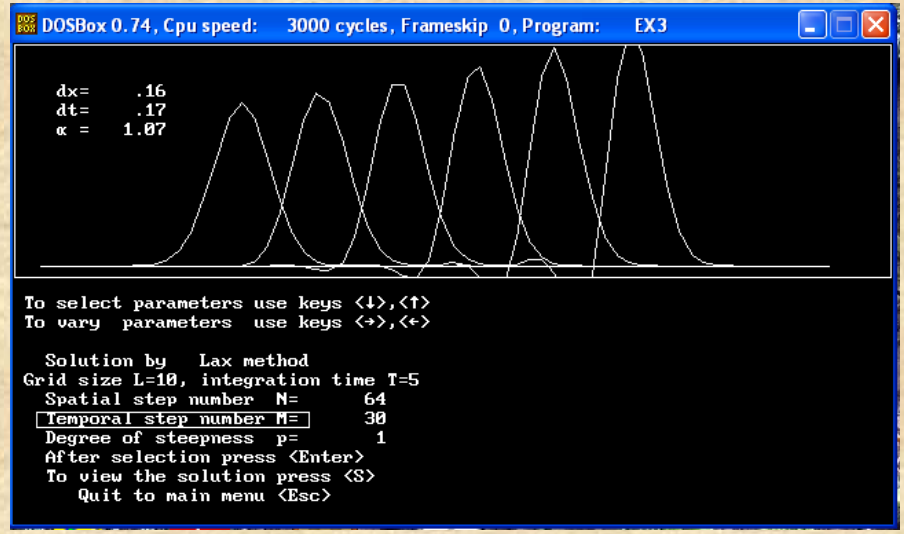
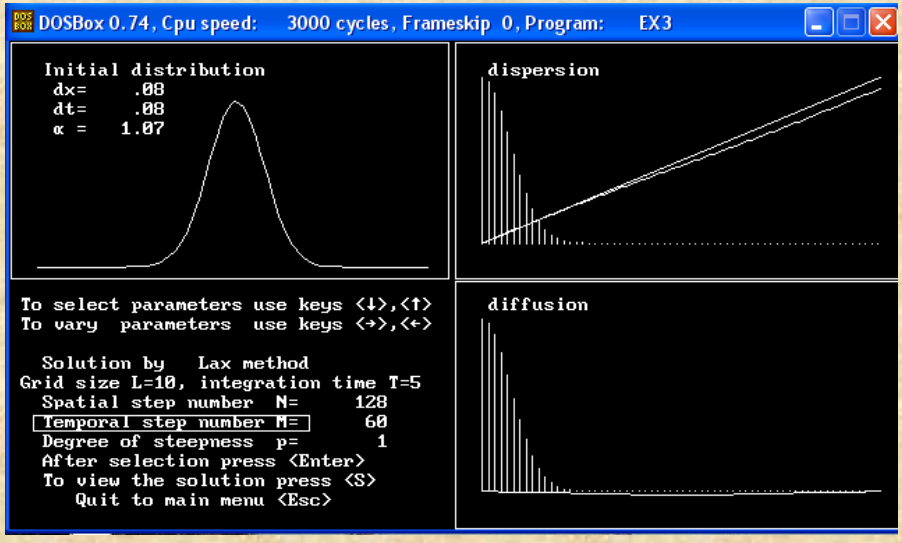

DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .08
dt= .08
α = 1.05
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 61
Degree of steepness p= 10
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

Схема Лакса


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .16
dt= .17
α = 1.07
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 30
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .16
dt= .17
α = 1.07
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 64
Temporal step number M= 30
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
Initial distribution
dx= .08
dt= .08
α = 1.07
dispersion
diffusion
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 60
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

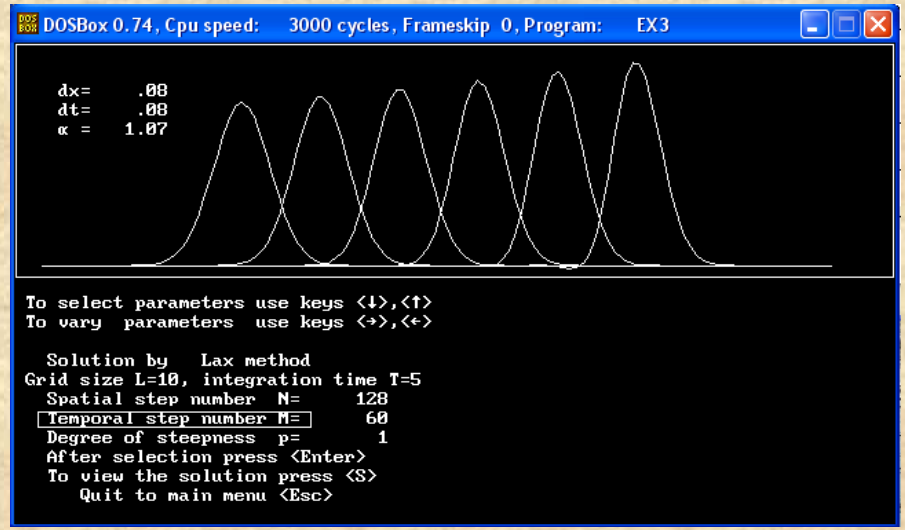
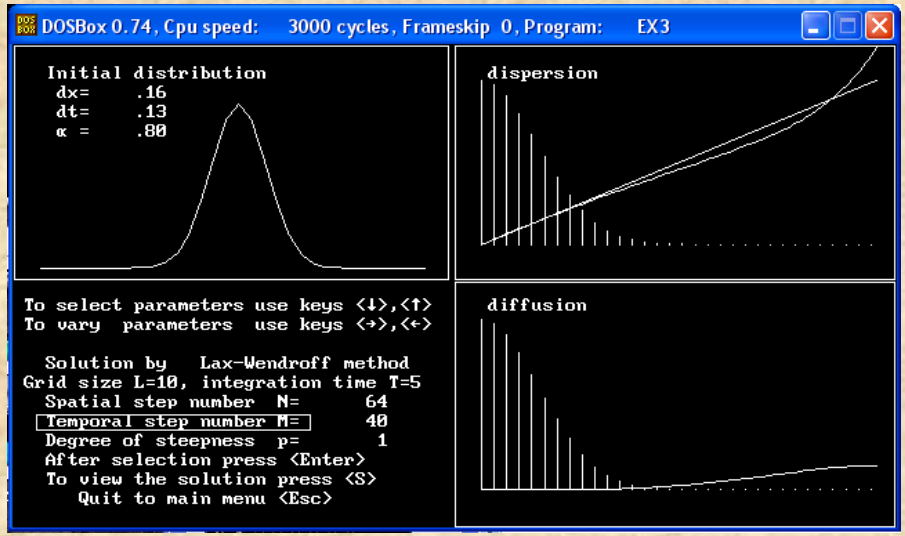
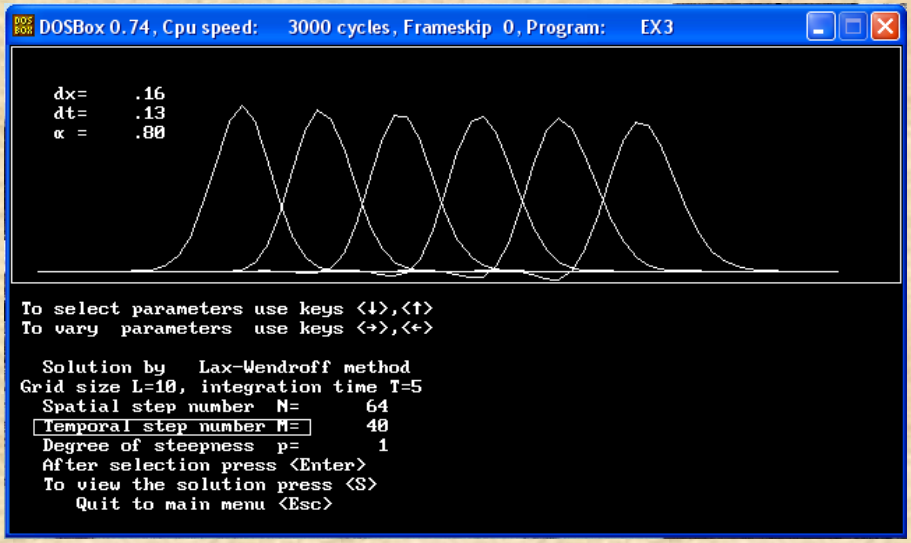
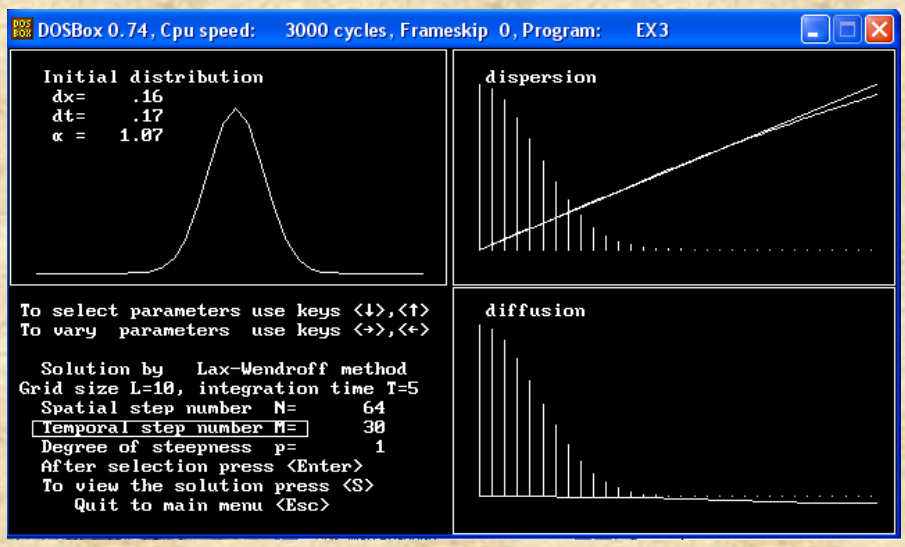

DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: EX3
dx= .08
dt= .08
α = 1.07
To select parameters use keys <↓>,<↑>
To vary parameters use keys <→>,<←>
Solution by Lax method
Grid size L=10, integration time T=5
Spatial step number N= 128
Temporal step number M= 60
Degree of steepness p= 1
After selection press <Enter>
To view the solution press <S>
Quit to main menu <Esc>

Схема Лакса-Вендроффа







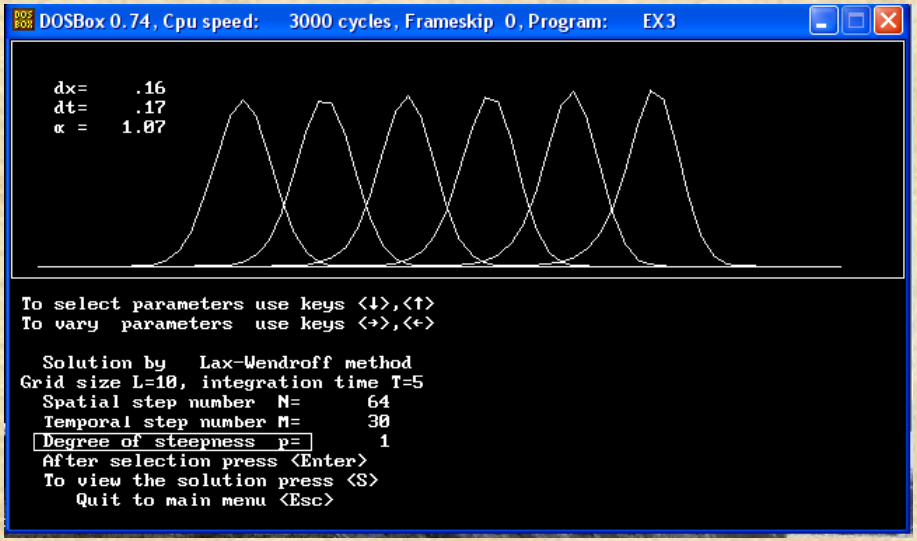
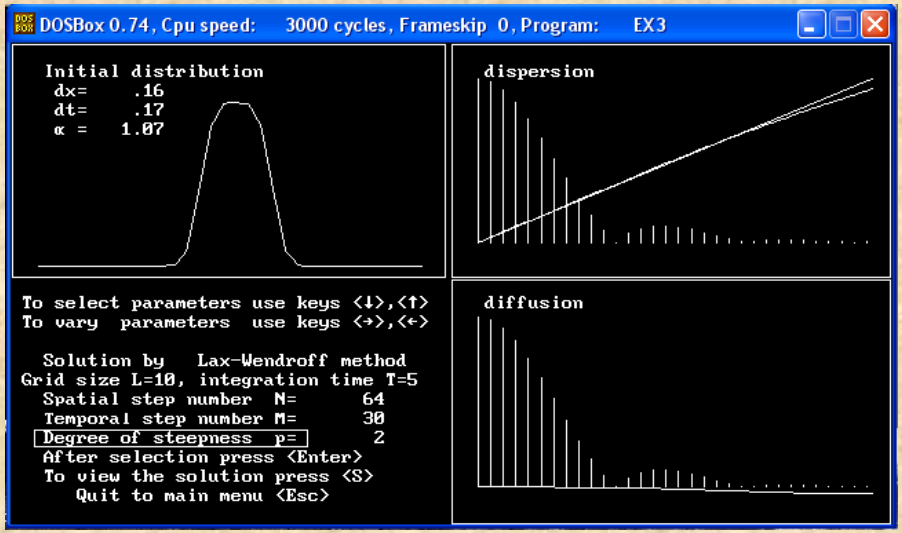
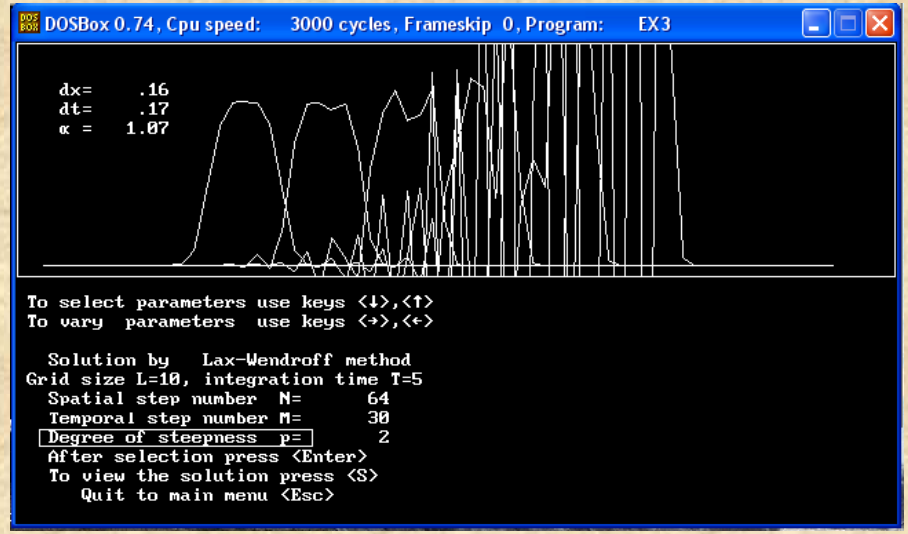
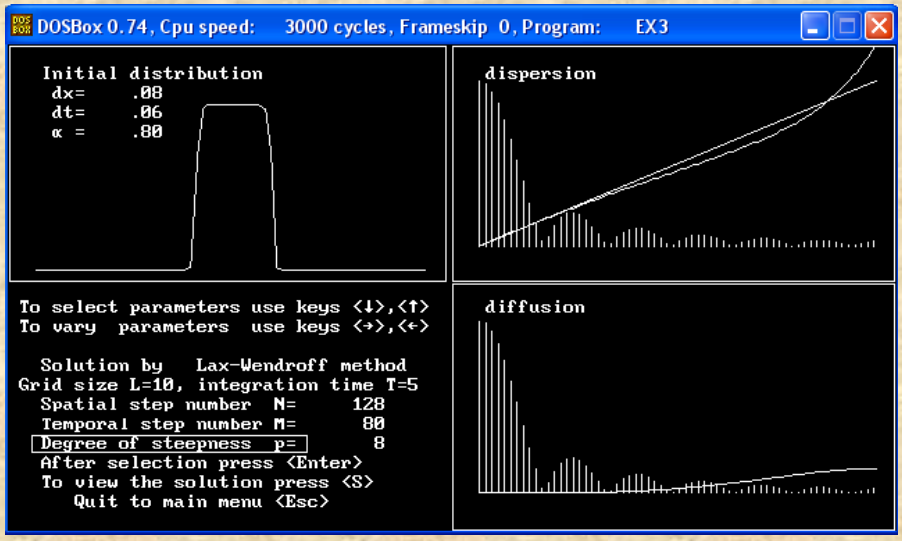


Схема Лакса-Вендроффа







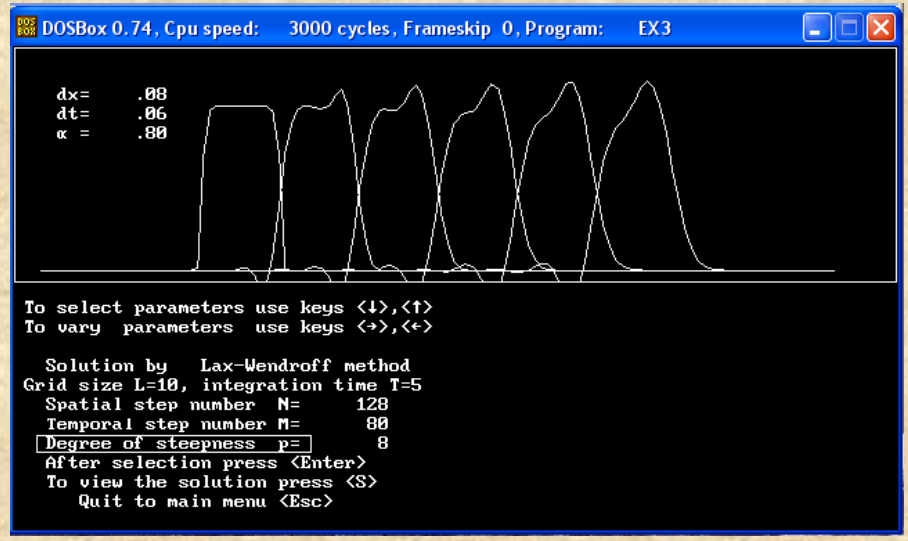


Схема Лакса-Вендроффа