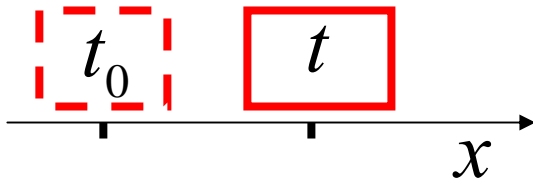
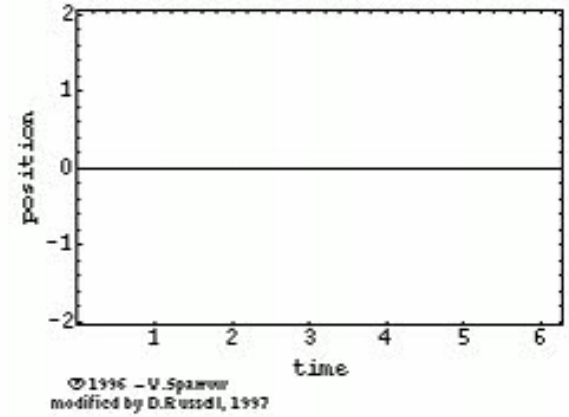
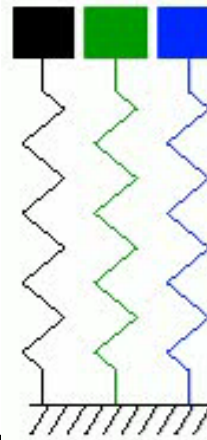
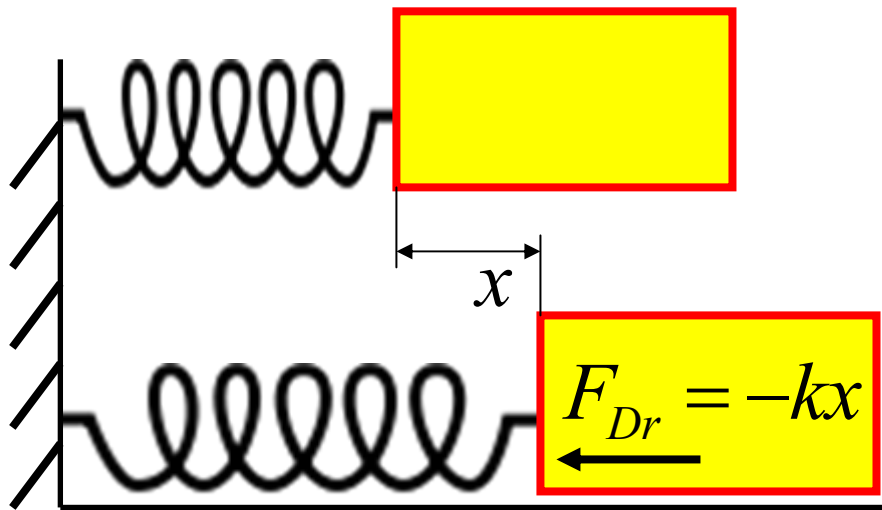


რამაზ ხომერიკი

არაწრფივი რხევები და ტალღები





$$ma = F_{Dr} \Rightarrow ma = -kx$$

$$x = x_0 \cos(\Omega t) \quad \Omega = \sqrt{k/m}$$

$$v(t) = \frac{x(t) - x(t_0)}{t - t_0}; \quad a(t) = \frac{v(t) - v(t_0)}{t - t_0}$$

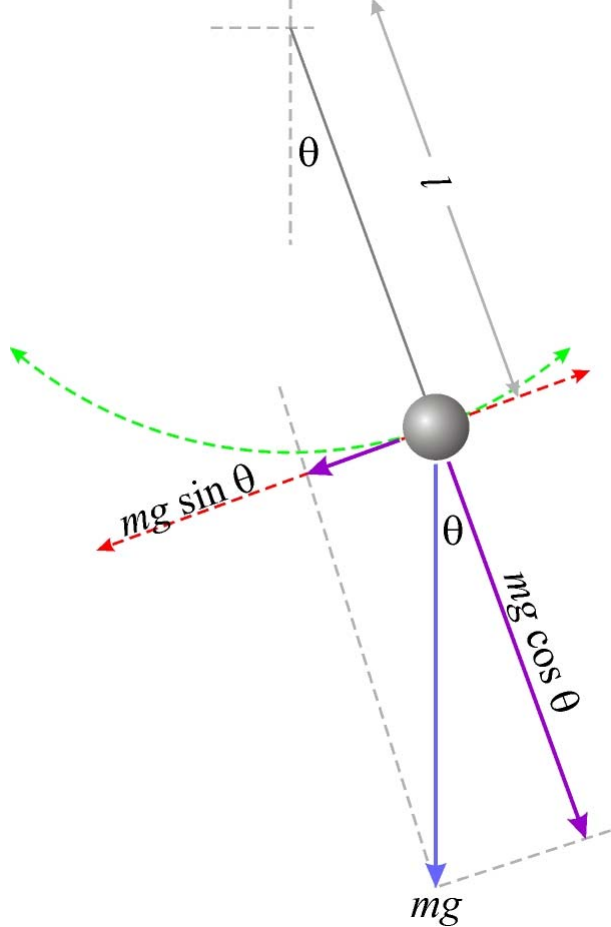
$$\lim_{t \rightarrow t_0} \frac{x(t) - x(t_0)}{t - t_0} \equiv \frac{dx(t)}{dt} \quad \Rightarrow \quad v(t) = \frac{dx(t)}{dt};$$

$$a(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2} \quad \Rightarrow \quad m \frac{d^2x(t)}{dt^2} = -kx$$

$$x = x_0 \cos(\Omega t) \quad \Omega = \sqrt{k/m}$$

$$F_{Dr} = -kx - k_3x^3$$

$$m \frac{d^2x}{dt^2} = -kx - k_3x^3$$



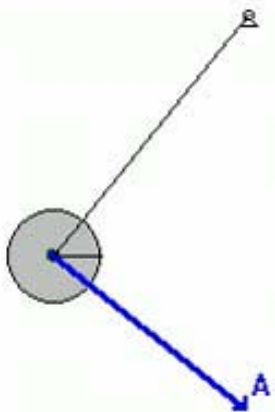
$$ma = F_g$$

$$a(t) = \frac{dv(t)}{dt}; \quad F_g = -mg \sin \theta$$

$$v(t) = l \cdot \omega(t); \quad \omega(t) = \frac{\theta(t) - \theta(t_0)}{t - t_0}$$

$$\omega(t) = \frac{d\theta(t)}{dt} \Rightarrow a(t) = l \frac{d^2\theta(t)}{dt^2}$$

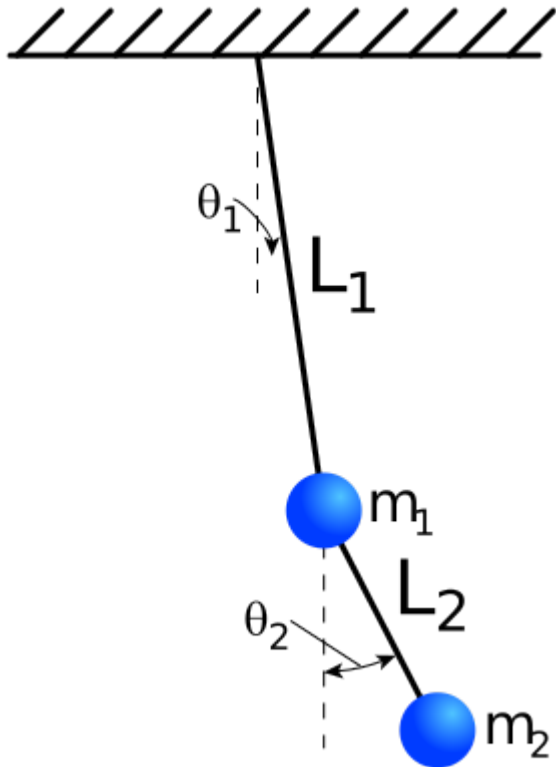
$$l \frac{d^2\theta}{dt^2} = -g \sin \theta$$



$$\sin \theta \approx \theta \quad \Rightarrow \quad \frac{d^2 \theta}{dt^2} = -\frac{g}{l} \theta$$

$$\theta = \theta_0 \cos(\Omega t); \quad \Omega = \sqrt{g/l}$$

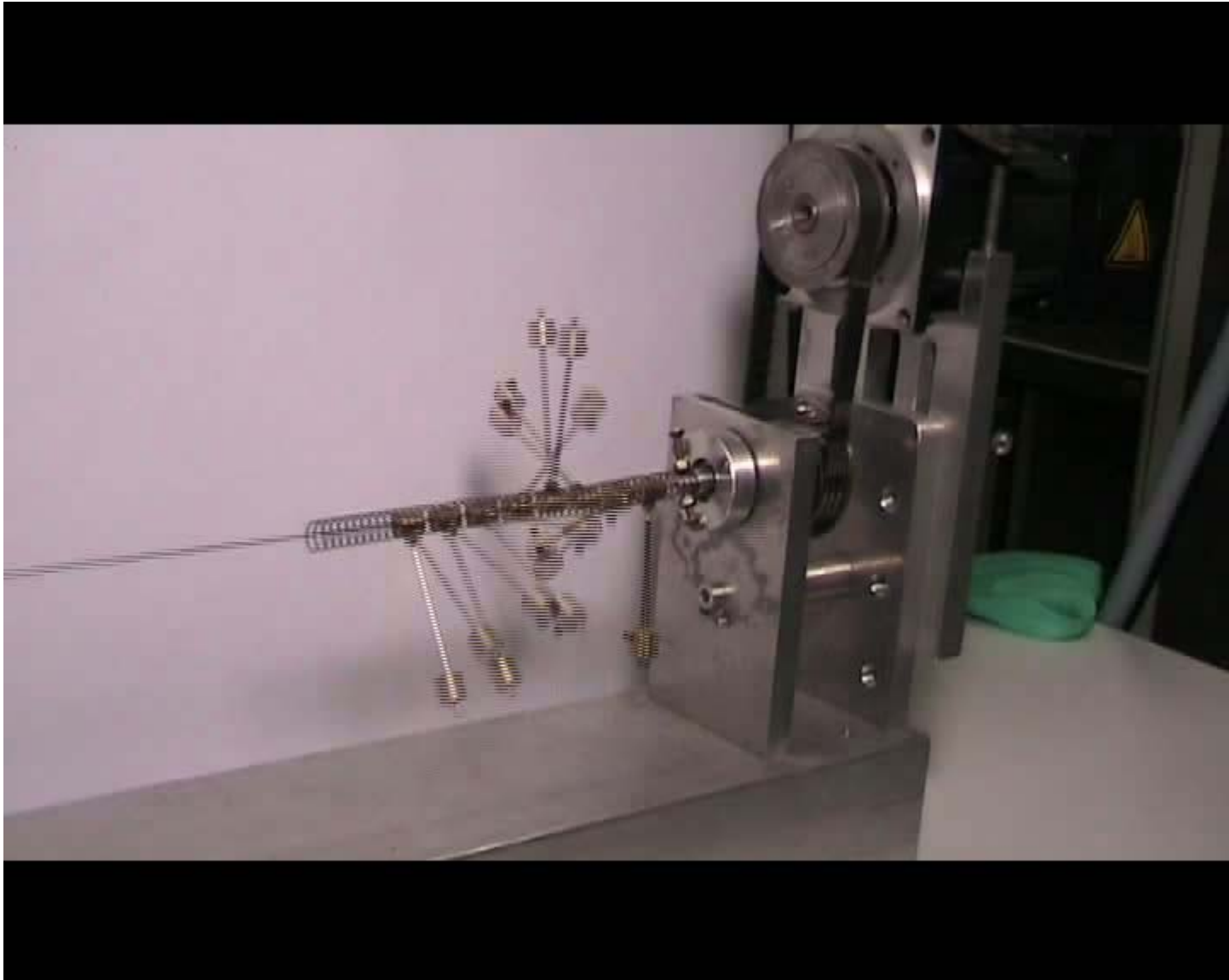
## ორმაზი ქანქარა



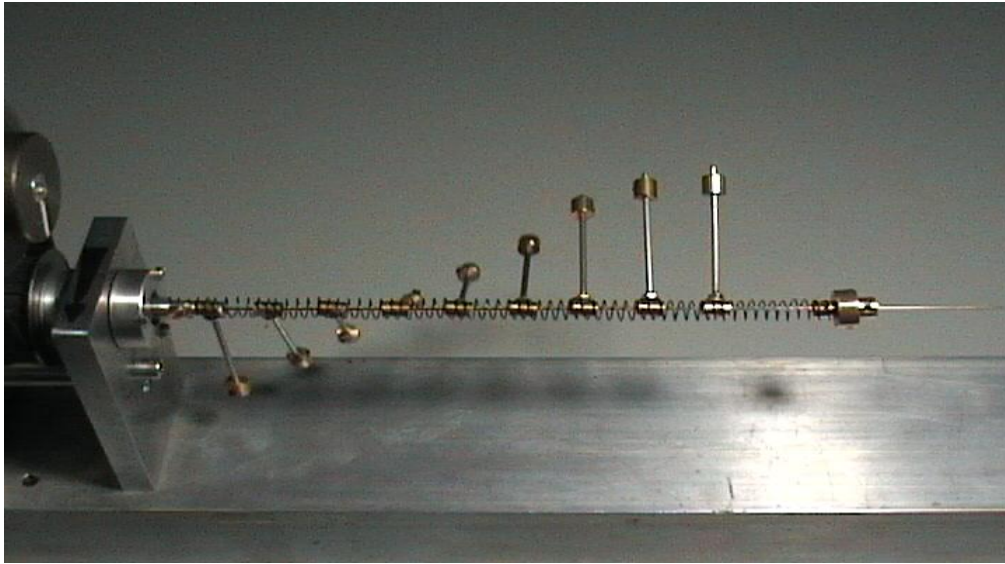
# ქანქარების კოლექტიური რხევები

Pendulum Waves  
starring Allen

# არაწრფივი რხევები ქანქარების ჯაჭვში



# ქანქარების ჯაჭვი



$$ma_n = F_{Dr}^L + F_{Dr}^R + F_g$$

$$F_{Dr}^L = k(\theta_{n-1} - \theta_n)$$

$$F_{Dr}^R = k(\theta_{n+1} - \theta_n)$$

$$F_g = -mgsin\theta_n$$

$$ml \frac{d^2\theta_n}{dt^2} = k(\theta_{n+1} + \theta_{n-1} - 2\theta_n) - mgsin\theta_n,$$

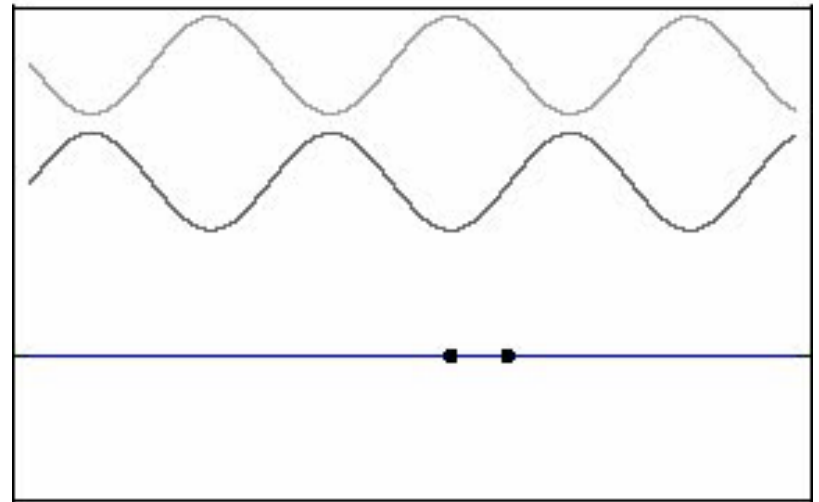
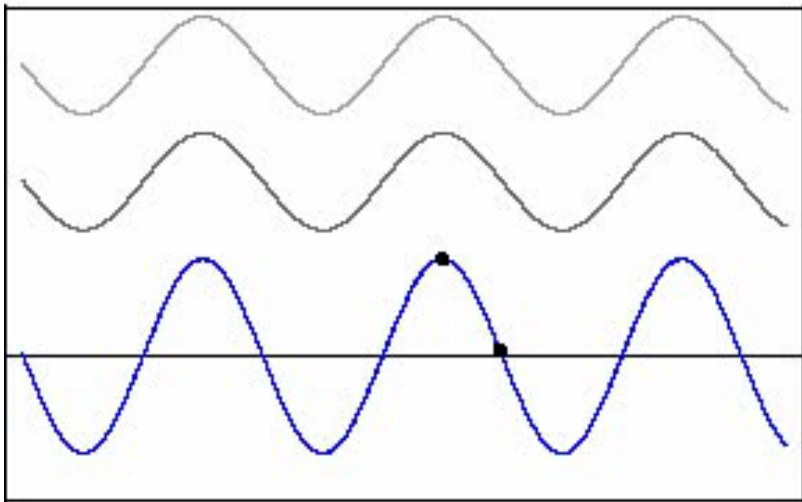
$$\theta_{n+1} = \theta_n + \frac{d\theta_n}{dt} + \frac{1}{2} \frac{d^2\theta_n}{dt^2} + \dots \quad \theta_{n-1} = \theta_n - \frac{d\theta_n}{dt} + \frac{1}{2} \frac{d^2\theta_n}{dt^2} + \dots$$

$$\frac{d^2\theta_n}{dt^2} - \frac{k}{ml} \frac{d^2\theta_n}{dn^2} + \frac{g}{l} \sin\theta_n = 0$$

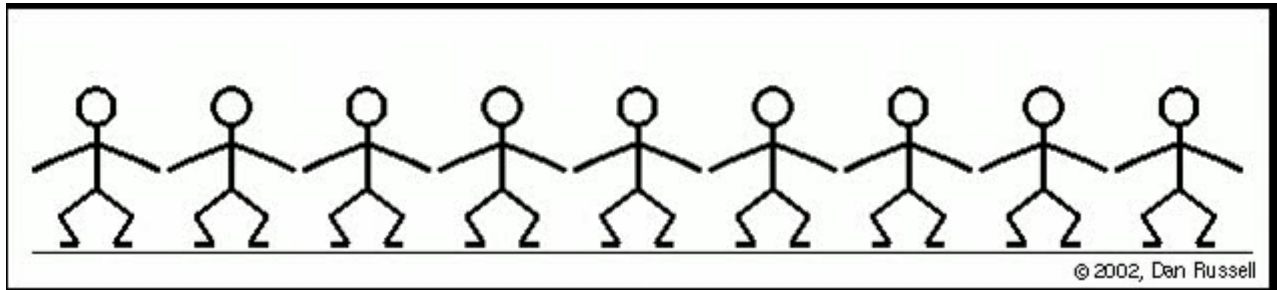
# საინ-გორდონის განტოლება

$$\frac{d^2\theta}{dt^2} - \sigma^2 \frac{d^2\theta}{dn^2} + \omega_0^2 \sin(\theta) = 0 \quad \sigma = \sqrt{\frac{k}{ml}}; \quad \omega_0 = \sqrt{\frac{g}{l}}$$

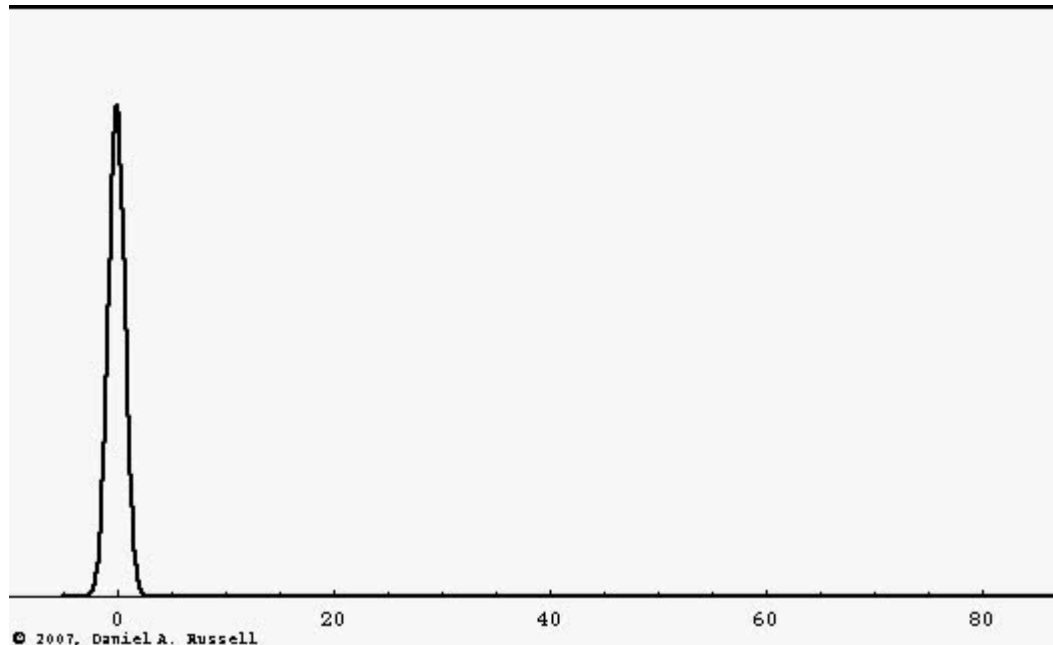
$$\sin\theta_n \approx \theta_n \quad \Rightarrow \quad \theta_n = B \cos(\omega t - kn) \quad \Rightarrow \quad \omega^2 = \omega_0^2 + \sigma^2 k^2$$

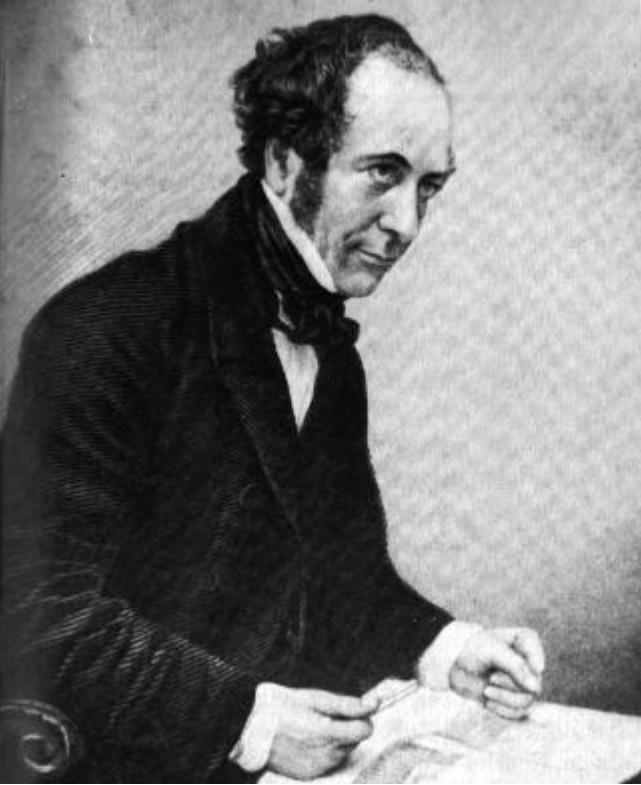


# არაწრფივი განმხორციელებელი ტალღა - სოლიტონი

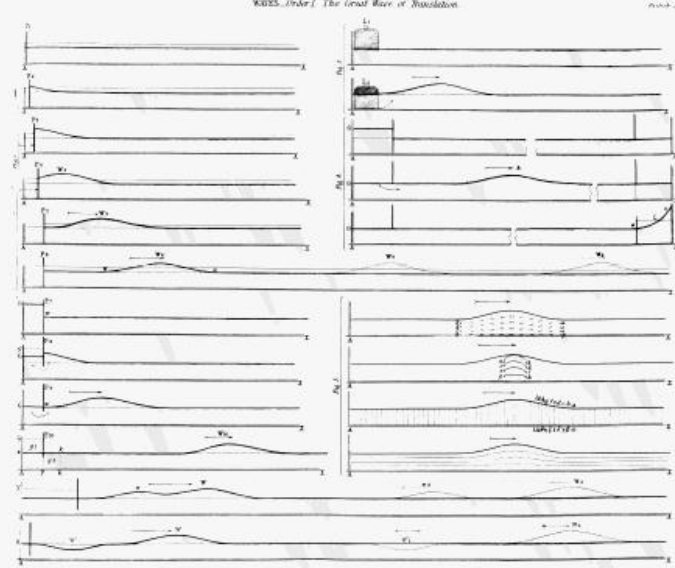


● \_\_\_\_\_ ©2002, Dan Russell





ჯონ სკოტ  
რასელი 1834



12 ივლისი 1995

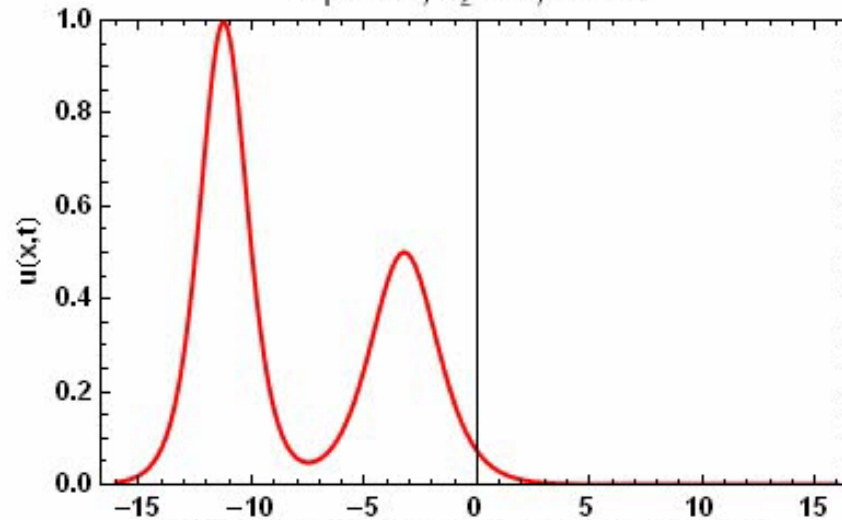




# სოლიტონების ღაჯახემა

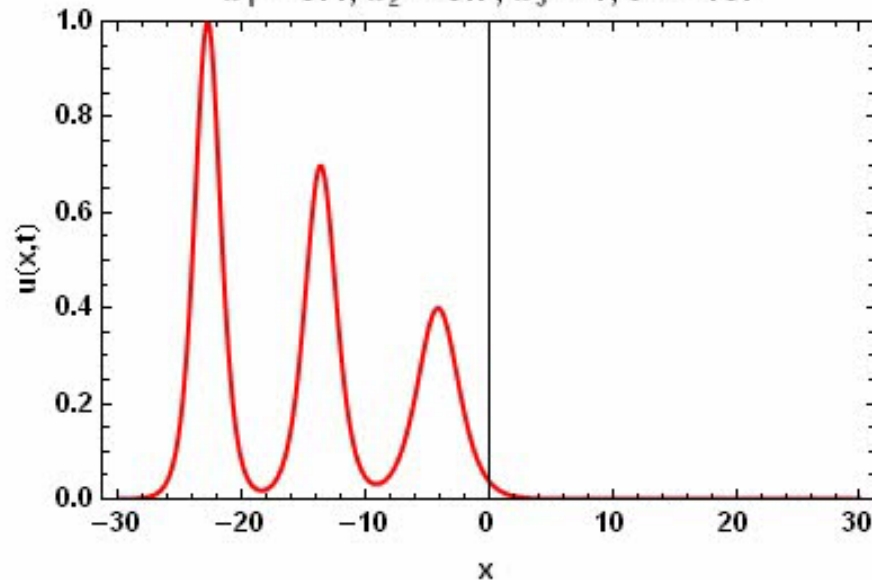
Solution of KdV Equation, 2 Solitons

$$b_1 = 0.5, b_2 = 1, t = -5.$$



Solution of KdV Equation, 3 Solitons

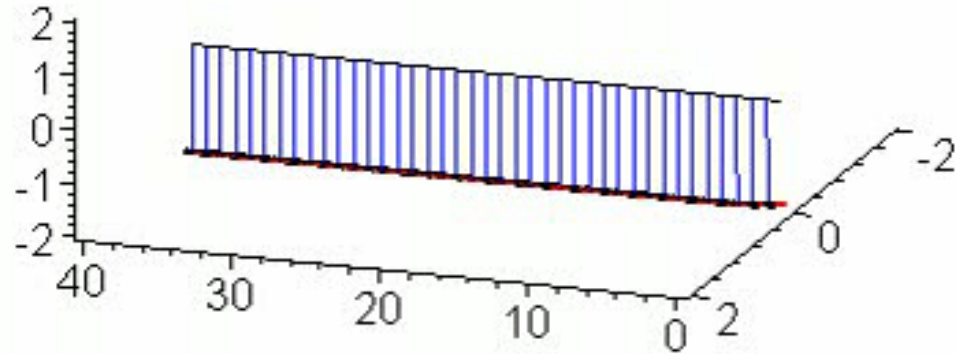
$$b_1 = 0.4, b_2 = 0.7, b_3 = 1, t = -10.$$



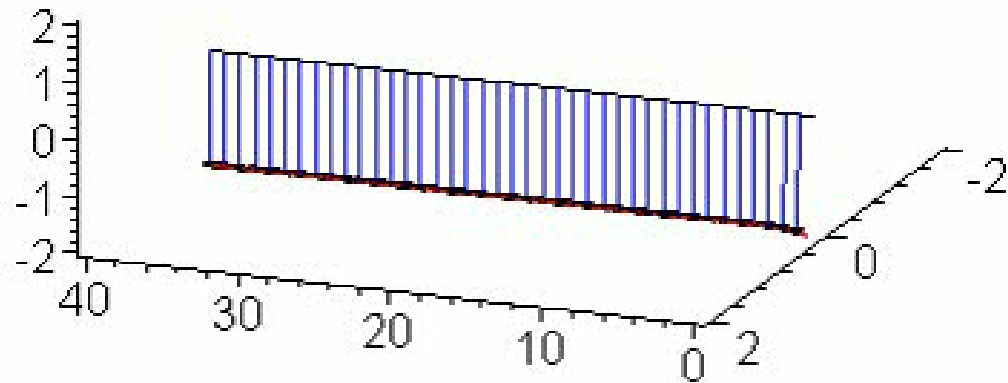


# ქანქარების ჯაჭვის სოლიტონური ამოხსნები

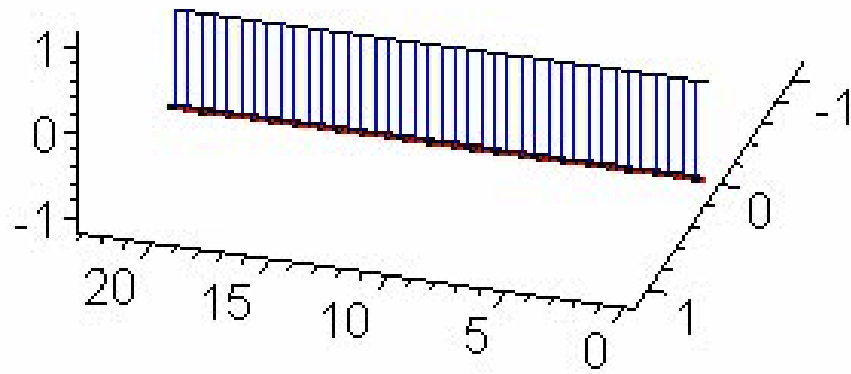
Kink



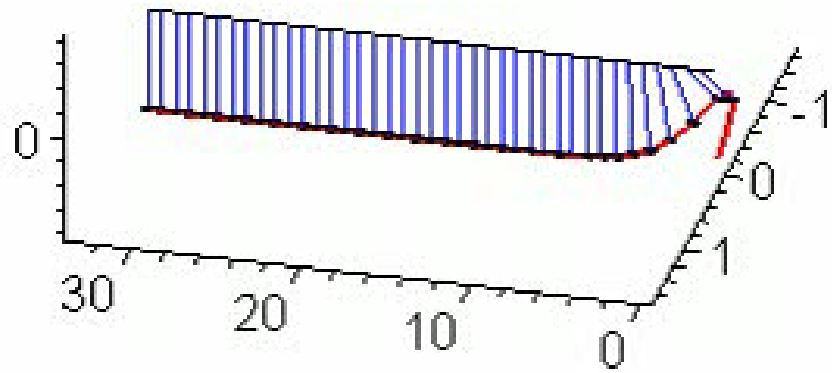
AntiKink



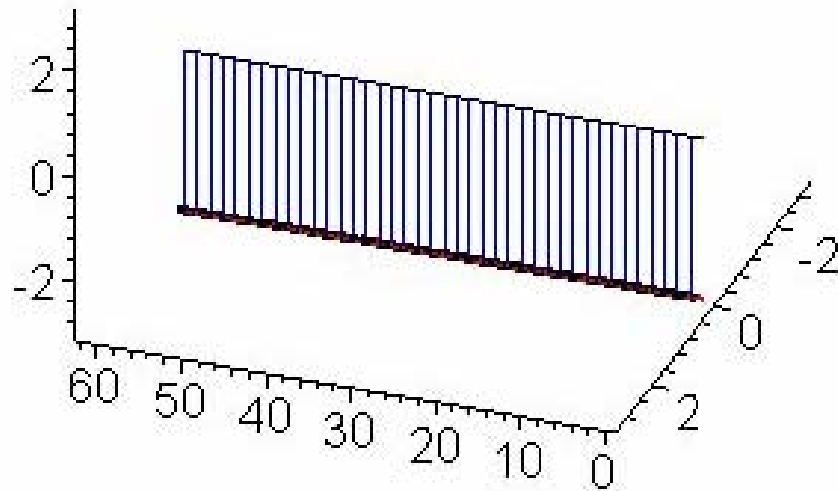
### Standing Breather



### Large amplitude Breather

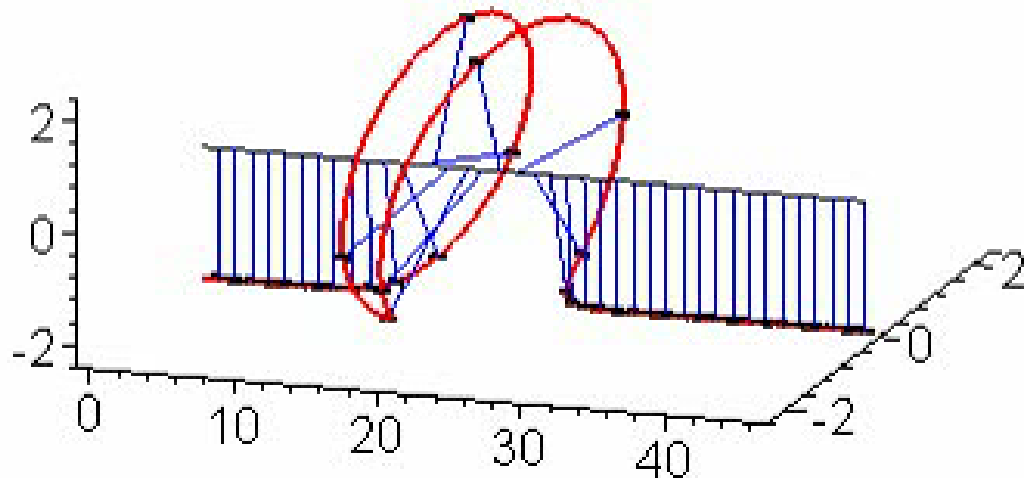


# კინკებისა და ბრიზერების დაჯახება



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Standing Breather Moving Kink collision



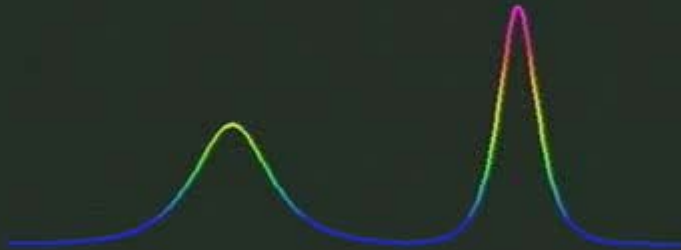
# ნახევარ ბრძვილი ქანქარების ჯაჭვი



Example:  
Nonlinear Schrodinger equation

$$iu_t + u_{xx} + |u|^2 u = 0$$

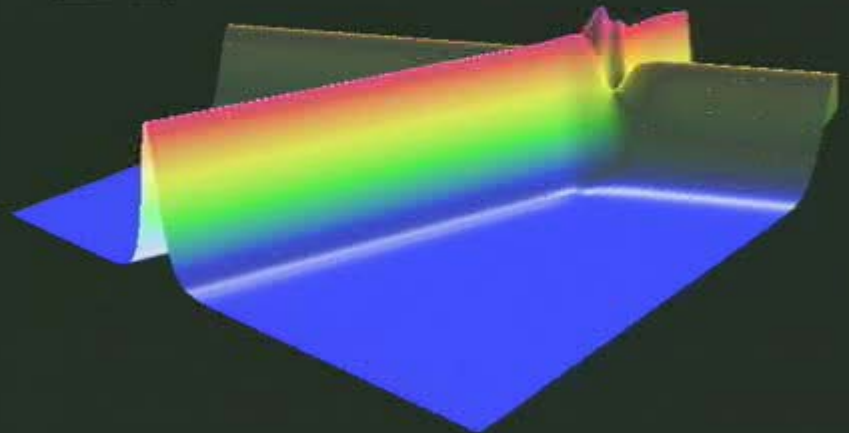
Time: -2.00



Only the Davey-Stewartson equation

$iu_t + u_{xx} + u_{yy} + 2uw = 0$ ,  $w_{xy} = |u|_{xx}^2 + |u|_{yy}^2$   
can have intersecting plane waves.

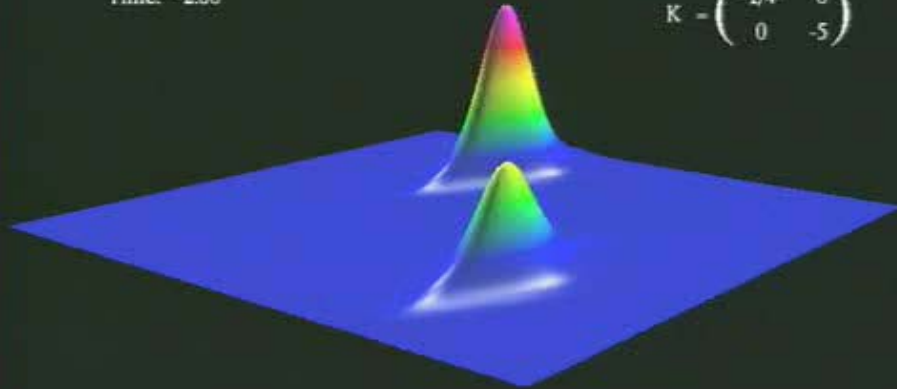
Time: -2.00



(2,2)-dromion solutions Case 1

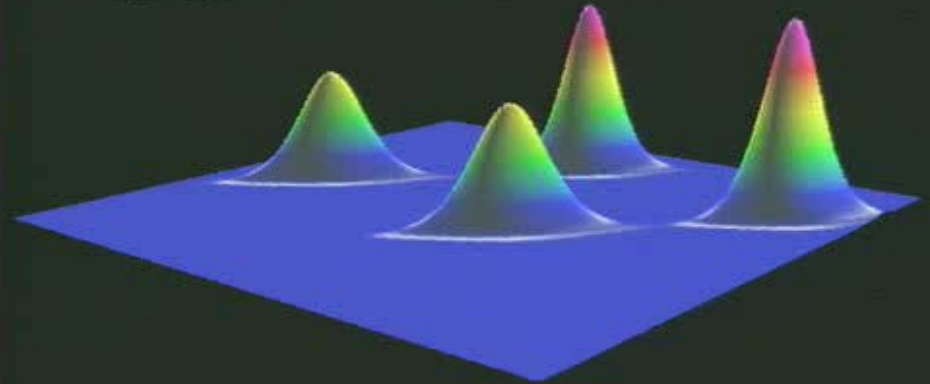
$$B = \begin{pmatrix} 2 & 0 \\ 0 & 1/2 \end{pmatrix}$$
$$H = \begin{pmatrix} -2 & 0 \\ 0 & -1/5 \end{pmatrix}$$
$$K = \begin{pmatrix} -1/4 & 0 \\ 0 & -5 \end{pmatrix}$$

Time: -2.00



4-dromion solution to KP

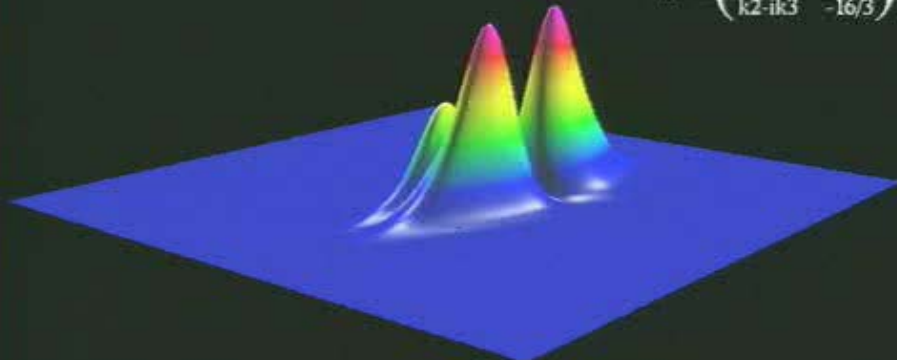
Time: -2.00



(2,2)-dromion solutions Case 4:  
Parameter dependence

$$B = \begin{pmatrix} 1 & ib4 \\ 0 & 1 \end{pmatrix}$$
$$H = \begin{pmatrix} -8 & -1 \\ -1 & -3/16 \end{pmatrix}$$
$$K = \begin{pmatrix} -1/8 & k2+ik3 \\ k2-ik3 & -16/3 \end{pmatrix}$$

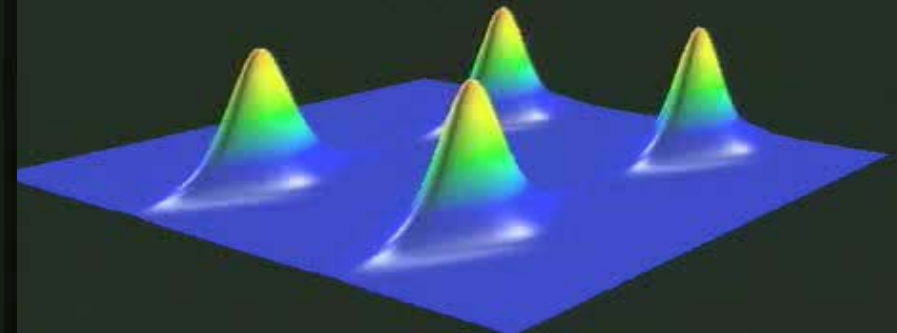
Param: 0.00  
Time: 0.00



(2,2)-dromion solutions Case 3

$$B = \begin{pmatrix} 1 & i9.24 \\ 0 & 1 \end{pmatrix}$$
$$H = \begin{pmatrix} -8 & -1 \\ -1 & -3/16 \end{pmatrix}$$
$$K = \begin{pmatrix} -1/8 & 0 \\ 0 & -16/3 \end{pmatrix}$$

Time: -2.00



# სინათლის “ტყვიების” ურთიერთქმედება

## Canonical Soliton Collision

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## Soliton Fission

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## Soliton Fusion

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## Soliton Tunnelling

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# ჩემი “ქართული წარმოების” ჯაჭვი



ბმადღოობთ!