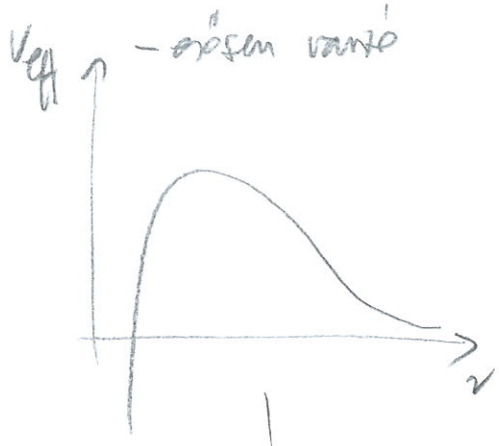
$$V_{eff}(r) = \frac{N^2}{2mr^2} + \frac{\gamma}{r^2} - \frac{\delta}{r^4} \qquad \gamma, \delta > 0$$

N: ismeretlen

E: ismert

$\dot{r} = 0$ körpálya miatt



$$E = \frac{1}{2} m\dot{r}^2 + \frac{N^2}{2mr^2} + \frac{\gamma}{r^2} - \frac{\delta}{r^4} =$$

$$= \frac{N^2}{2mr^2} + \frac{\gamma}{r^2} - \frac{\delta}{r^4} \qquad N^2 = ?$$

$$V'_{eff}(r^*) = 0 = -\frac{N^2}{m r^{*3}} - \frac{2\gamma}{r^{*3}} + \frac{4\delta}{r^{*5}}$$

$$\Rightarrow N^2(E) = 2m r^{*2}\left[E - \frac{\gamma}{r^{*2}} + \frac{\delta}{r^{*4}}\right]$$

$$0 = -2\frac{E - \frac{\gamma}{r^{*2}} + \frac{\delta}{r^{*4}}}{r^{*5}} - \frac{2\gamma}{r^{*3}} + \frac{4\delta}{r^{*5}} =$$

$$= -\frac{2E}{r^*} + \frac{2\delta}{r^{*5}}$$

$$\Downarrow$$

$$E = \frac{\delta}{r^{*4}} \rightarrow r^* = \sqrt[4]{\frac{\delta}{E}}$$

A VÁRAKOZÁSUNK MEGFELELŐEN

$$V''_{eff}(r) = \frac{3N^2}{mr^4} + \frac{6\gamma}{r^4} - \frac{20\delta}{r^6}$$

$$V''_{eff}(r^*) = \frac{6mr^{*2}}{mr^{*4}}\left[E - \frac{\gamma}{r^{*2}} + \frac{\delta}{r^{*4}}\right] + \frac{6\gamma}{r^{*4}} - \frac{20\delta}{r^{*6}} = \frac{6E}{r^{*2}} - \frac{14\delta}{r^{*6}} = \frac{6E}{(\delta/E)^{1/2}} - \frac{14\delta}{(\delta/E)^{3/2}}$$

$$= \frac{6E^{3/2}}{\sqrt{\delta}} - \frac{14E^{3/2}}{\sqrt{\delta}} = -\frac{8E^{3/2}}{\sqrt{\delta}} < 0 \rightarrow \text{lok. maximum} \Rightarrow \underline{\text{INSTABIL}}$$