

## 5) Fehlerfortpflanzung

$$E_{\text{kin}} = \frac{1}{2} * m * v^2 = \frac{1}{2} * \rho * V * \frac{l^2}{t^2} = \frac{1}{2} * \rho * \frac{\pi * d^3}{6} * \frac{l^2}{t^2} = \frac{\rho * \pi * d^3 * l^2}{12 * t^2}$$

$$\delta E_{\text{kin}} = \pm \sqrt{\left(\frac{\partial E_{\text{kin}}}{\partial d} * \delta d\right)^2 + \left(\frac{\partial E_{\text{kin}}}{\partial \rho} * \delta \rho\right)^2 + \left(\frac{\partial E_{\text{kin}}}{\partial l} * \delta l\right)^2 + \left(\frac{\partial E_{\text{kin}}}{\partial t} * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \sqrt{\left(\frac{\partial \left(\frac{\rho * \pi * d^3 * l^2}{12 * t^2}\right)}{\partial d} * \delta d\right)^2 + \left(\frac{\partial \left(\frac{\rho * \pi * d^3 * l^2}{12 * t^2}\right)}{\partial \rho} * \delta \rho\right)^2 + \left(\frac{\partial \left(\frac{\rho * \pi * d^3 * l^2}{12 * t^2}\right)}{\partial l} * \delta l\right)^2 + \left(\frac{\partial \left(\frac{\rho * \pi * d^3 * l^2}{12 * t^2}\right)}{\partial t} * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \sqrt{\left(\left(\frac{\rho * \pi * 3 * d^2 * l^2}{12 * t^2}\right) * \delta d\right)^2 + \left(\left(\frac{\pi * d^3 * l^2}{12 * t^2}\right) * \delta \rho\right)^2 + \left(\left(\frac{\rho * \pi * d^3 * 2 * l}{12 * t^2}\right) * \delta l\right)^2 + \left(\left(\frac{-2 * \rho * \pi * d^3 * l^2}{12 * t^3}\right) * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \sqrt{\left(\frac{\pi}{12}\right)^2 \left(\left(\frac{\rho * 3 * d^2 * l^2}{t^2}\right) * \delta d\right)^2 + \left(\frac{\pi}{12}\right)^2 \left(\left(\frac{d^3 * l^2}{t^2}\right) * \delta \rho\right)^2 + \left(\frac{\pi}{12}\right)^2 \left(\left(\frac{\rho * d^3 * 2 * l}{t^2}\right) * \delta l\right)^2 + \left(\frac{\pi}{12}\right)^2 \left(\left(\frac{-2 * \rho * d^3 * l^2}{t^3}\right) * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \sqrt{\left(\frac{\pi}{12}\right)^2 \left(\left(\left(\frac{\rho * 3 * d^2 * l^2}{t^2}\right) * \delta d\right)^2 + \left(\left(\frac{d^3 * l^2}{t^2}\right) * \delta \rho\right)^2 + \left(\left(\frac{\rho * d^3 * 2 * l}{t^2}\right) * \delta l\right)^2 + \left(\left(\frac{-2 * \rho * d^3 * l^2}{t^3}\right) * \delta t\right)^2\right)}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi}{12} \sqrt{\left(\left(\frac{\rho * 3 * d^2 * l^2}{t^2}\right) * \delta d\right)^2 + \left(\left(\frac{d^3 * l^2}{t^2}\right) * \delta \rho\right)^2 + \left(\left(\frac{\rho * d^3 * 2 * l}{t^2}\right) * \delta l\right)^2 + \left(\left(\frac{-2 * \rho * d^3 * l^2}{t^3}\right) * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi}{12} \sqrt{\left(\left(\frac{\rho * 3 * d^2 * l * l}{t^2}\right) * \delta d\right)^2 + \left(\left(\frac{d^2 * d * l * l}{t^2}\right) * \delta \rho\right)^2 + \left(\left(\frac{\rho * d^2 * d * 2 * l}{t^2}\right) * \delta l\right)^2 + \left(\left(\frac{-2 * \rho * d^2 * d * l * l}{t^2 * t}\right) * \delta t\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi}{12} \sqrt{\left(\frac{d^2 * l}{t^2}\right)^2 (\rho * 3 * l * \delta d)^2 + \left(\frac{d^2 * l}{t^2}\right)^2 (d * l * \delta \rho)^2 + \left(\frac{d^2 * l}{t^2}\right)^2 (\rho * d * 2 * \delta l)^2 + \left(\frac{d^2 * l}{t^2}\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi}{12} \sqrt{\left(\frac{d^2 * l}{t^2}\right)^2 \left((\rho * 3 * l * \delta d)^2 + (d * l * \delta \rho)^2 + (\rho * d * 2 * \delta l)^2 + \left(\frac{-2 * \rho * d * l * \delta t}{t}\right)^2\right)}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^2 * l}{12 * t^2} \sqrt{(\rho * 3 * l * \delta d)^2 + (d * l * \delta \rho)^2 + (\rho * d * 2 * \delta l)^2 + \left(\frac{-2 * \rho * d * l * \delta t}{t}\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^2 * l}{12 * t^2} \sqrt{(d * l)^2 (\rho * 3 * d^{-1} * \delta d)^2 + (d * l)^2 \delta \rho^2 + (d * l)^2 (\rho * l^{-1} * 2 * \delta l)^2 + (d * l)^2 \left(\frac{-2 * \rho * \delta t}{t}\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^2 * l}{12 * t^2} \sqrt{(d * l)^2 \left((\rho * 3 * d^{-1} * \delta d)^2 + \delta \rho^2 + (\rho * l^{-1} * 2 * \delta l)^2 + \left(\frac{-2 * \rho * \delta t}{t}\right)^2\right)}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^3 * l^2}{12 * t^2} \sqrt{(\rho * 3 * d^{-1} * \delta d)^2 + \delta \rho^2 + (\rho * l^{-1} * 2 * \delta l)^2 + \left(\frac{-2 * \rho * \delta t}{t}\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^3 * l^2}{12 * t^2} \sqrt{\left(\frac{3 * \rho * \delta d}{d}\right)^2 + \delta \rho^2 + \left(\frac{2 * \rho * \delta l}{l}\right)^2 + \left(\frac{-2 * \rho * \delta t}{t}\right)^2}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^3 * l^2}{12 * t^2} \sqrt{\delta \rho^2 + \rho \left(\left(\frac{3 * \delta d}{d}\right)^2 + \left(\frac{2 * \delta l}{l}\right)^2 + \left(\frac{-2 * \delta t}{t}\right)^2\right)}$$

$$\delta E_{\text{kin}} = \pm \frac{\pi * d^3 * l^2}{12 * t^2} \sqrt{\delta \rho^2 + \rho \left(\left(\frac{3 * \delta d}{d}\right)^2 + 4 \left(\left(\frac{\delta l}{l}\right)^2 + \left(\frac{\delta t}{t}\right)^2\right)\right)}$$