

SFT

DÚ 7

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2) a) hustota energie ε $\varepsilon = \frac{E}{V} \rightarrow E = \varepsilon \cdot V$

pro tří-rozměrný vesmír $\mu = \frac{\varepsilon}{3}$

1. věta termodynamická: $dE = TdS - \mu dV$

$$\left(\frac{\partial E}{\partial V}\right)_T = T\left(\frac{\partial S}{\partial V}\right)_T - \mu = T\left(\frac{\partial \mu}{\partial T}\right)_V - \mu$$

$$\left(\frac{\partial E}{\partial V}\right)_T = \left(\frac{\partial \varepsilon \cdot V}{\partial V}\right)_T = \varepsilon \cdot \left(\frac{\partial V}{\partial V}\right)_T = \varepsilon$$

$$\left(\frac{\partial E}{\partial V}\right)_T = T\left(\frac{\partial \mu}{\partial T}\right)_V - \mu = \varepsilon \quad \text{dos.: } \mu = \frac{\varepsilon}{3}$$

$$\varepsilon = -\frac{\varepsilon}{3} + T\left(\frac{\partial \mu}{\partial T}\right)_V \rightarrow \frac{4}{3}\varepsilon = T\left(\frac{\partial \varepsilon}{\partial T}\right)_V \rightarrow \frac{d\varepsilon}{dT} \rightarrow 4\varepsilon = T \frac{d\varepsilon}{dT}$$

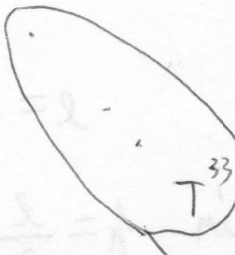
$$\frac{dT}{T} = \frac{d\varepsilon}{4\varepsilon} \rightarrow \int \frac{dT}{T} = \int \frac{d\varepsilon}{4\varepsilon}$$

$$\ln T = \frac{1}{4} \cdot \ln(\varepsilon \cdot K') / 4 \quad K' = \text{konst.}$$

$$K = K'^{1-1} = \text{konst.}$$

$$\ln T^4 = \ln(\varepsilon \cdot K') \rightarrow T^4 = \varepsilon \cdot K' \rightarrow \underline{\varepsilon = K \cdot T^4}$$

henson energie - napětí

$$\begin{pmatrix} T^{00} & T^{01} & \dots & T^{03} \\ T^{10} & & & \\ \vdots & & & \\ T^{30} & & & \end{pmatrix}$$


index 0 - čas

1, 2, 3 - souřadnice

$$n=3 \rightarrow 3p - \varepsilon = 0 \rightarrow p = \frac{\varepsilon}{3} = \boxed{\frac{\varepsilon}{n} = p}$$

zde je reprezentován tlak

1D případ

$$p = \frac{\varepsilon}{1}$$

$$\varepsilon = -\varepsilon + T \frac{d\varepsilon}{dT} \rightarrow 2\varepsilon = T \frac{d\varepsilon}{dT}$$

$$\varepsilon = K \cdot T^2$$

2D případ $p = \frac{\varepsilon}{2}$

$$\varepsilon = K \cdot T^3$$

n -rozměrný případ

$$\varepsilon = -\frac{\varepsilon}{n} + T \left(\frac{d\varepsilon}{dT} \right)_V = -\frac{\varepsilon}{n} + \frac{T}{n} \frac{d\varepsilon}{dT}$$

$$\underbrace{\varepsilon + \frac{\varepsilon}{n}}_{\frac{n\varepsilon + \varepsilon}{n}} = \frac{T}{n} \frac{d\varepsilon}{dT}$$

$$\frac{n\varepsilon + \varepsilon}{n} = \frac{\varepsilon(n+1)}{n}$$

$$\frac{\varepsilon(n+1)}{n} = \frac{T}{n} \frac{d\varepsilon}{dT}$$

$$\boxed{\varepsilon = K \cdot T^{n+1} = K \cdot T^\alpha}$$

$$\alpha = n+1$$