$$\frac{dx}{dt} = \underline{N} \cdot \underline{v}(x)$$

$$\underline{N} = \underline{N}^{out} - \underline{N}^{in}$$

$$\mu_i := \mu_i^0 + \frac{1}{\beta} \log x_i$$

$$= \underline{N} \cdot ($$

$$= \underline{N} \cdot \left(\underline{v}_f(\underline{x}) - \underline{v}_b(\underline{x}) \right)$$

$$= \underline{N}$$

$$v_{f_i}(\underline{x}) = K_{f_i} \prod_j x_j^{N_{ji}^{in}} \quad / \quad v_{b_i}(\underline{x}) = K_{b_i} \prod_j x_j^{N_{ji}^{out}}$$

$$\left\| \quad \dot{x}_i = \sum_k N_{ik} \cdot \left(K_{f_k} \prod_j x_j^{N_{jk}^{in}} - K_{bk} \prod_j x_j^{N_{jk}^{out}} \right) \quad \right\|$$

$$K_{f_i} = e^{-\beta(E_{A_i} - \sum_j N_{ji}^{in} \cdot \mu_j^0)} \quad / \quad K_{b_i} = e^{-\beta(E_{A_i} - \sum_j N_{ji}^{out} \cdot \mu_j^0)}$$

$$K_{f_i} \prod_j x_j^{N_{ji}^{in}} = e^{-\beta(E_{A_i} - \sum_j N_{ji}^{in} \cdot \mu_j^0)} \cdot e^{\log(\prod_j x_j^{N_{ji}^{in}})}$$

$$= \exp\left(-\beta(E_{A_i} - \sum_j N_{ji}^{in} \cdot \mu_j^0) + \sum_j N_{ji}^{in} \log(x_j) \right)$$

$$= \exp\left(-\beta \left(E_{A_i} - \sum_j N_{ji}^{in} \left(\mu_i^0 + \frac{1}{\beta} \log(x_j) \right) \right) \right)$$

$$= e^{-\beta E_{A_i}} \cdot \exp\left(\sum_j N_{ji}^{in} (\beta \mu_j^0 + \log x_j) \right)$$

$$= e^{-\beta E_{A_i}} \cdot e^{(\beta \sum_j N_{ji}^{in} \mu_j)} \qquad (*)$$

$$(*) \quad K_{bi} \prod_j x_j^{\nu_{ji}^{out}} = \ldots = e^{+\beta E_{A_i}} e^{(\beta \sum_j \nu_{ji}^{out} \mu_j)}$$

$$\dot{x}_i = \sum_K \nu_{iK} \cdot e^{-\beta E_{AK}} \cdot \left(e^{\beta \sum_j \nu_{jK}^{in} \mu_j} - e^{\beta \sum_j \nu_{jK}^{out} \mu_j} \right)$$

$$\beta(\mu_i - \mu_i^0) = \log x_i$$

$$x_i = e^{\beta(\mu_i - \mu_i^0)}$$

$$\frac{dx_i}{dt} = e^{\beta(\mu_i - \mu_i^0)} \cdot \beta$$

$$\beta e^{\beta(\mu_i - \mu_i^0)} \dot{\mu}_i = \sum_K \nu_{iK} \cdot e^{-\beta E_{AK}} \left(e^{\beta \sum_j \nu_{jK}^{in} \mu_j} - e^{\beta \sum_j \nu_{jK}^{out} \mu_j} \right)$$

$$\dot{\mu}_i = \frac{1}{\beta} \sum_K \nu_{iK} e^{-\beta(E_{AK} + \mu_i - \mu_i^0)} \left(e^{\beta \sum_j \nu_{jK}^{in} \mu_j} - e^{\beta \sum_j \nu_{jK}^{out} \mu_j} \right)$$

$$\dot{x}_i = \sum_K \nu_{iK} \left(\prod_j x_j^{\nu_{jK}^{in}} \cdot e^{-\beta(E_{AK} - \sum_j \nu_{jK}^{in} \mu_j^0)} - \prod_j x_j^{\nu_{jK}^{out}} \cdot e^{-\beta(E_{AK} - \sum_j \nu_{jK}^{out} \mu_j^0)} \right)$$

$$\dot{x}_i = \sum_K \nu_{iK} e^{-\beta E_{AK}} \left(\prod_j x_j^{\nu_{jK}^{in}} \cdot e^{+\beta \sum_j \nu_{jK}^{in} \mu_j^0} - \prod_j x_j^{\nu_{jK}^{out}} \cdot e^{\beta \sum_j \nu_{jK}^{out} \mu_j^0} \right)$$

(3) $\Rightarrow$

$$M_{il} = \frac{\partial \dot{x}_i}{\partial x_l} = \sum_K N_{iK}\, e^{-\beta E_{A_K}} \left(e^{\beta \sum_j N_{jK}^{in} \mu_j^0} \cdot \frac{\partial}{\partial x_l} \prod_j x_j^{N_{jK}^{in}} - e^{\beta \sum_j N_{jK}^{out} \mu_j^0} \frac{\partial}{\partial x_l} \prod_j x_j^{N_{jK}^{in}} \right)$$

$$= \sum_K N_{iK}\, e^{-\beta E_{A_K}} \left(e^{\beta \sum_j N_{jK}^{in} \mu_j^0} \cdot N_{lK}^{in} \cdot x_l^{N_{lK}^{in}-1} \cdot \prod_{j \neq l} x_j^{N_{jK}^{in}} - e^{\beta \sum_j N_{jK}^{out} \mu_j^0} \cdot N_{lK}^{out}\, x_l^{N_{lK}^{out}} \prod_{j \neq l} x_j^{N_{jK}^{out}} \right)$$